

**SCIENTIFIC COMMITTEE ON ANTARCTIC RESEARCH**

**STANDING SCIENTIFIC GROUP ON  
GEOSCIENCES**

**REPORT TO DELEGATES**

**OCTOBER 2004**

## 1. INTRODUCTION

This document presents a summary of activities carried out by the SCAR Standing Scientific Group on Geoscience (GSSG) since SCAR XXVII in Shanghai, July 2002. It included:

- brief reports on the work of our Action, Expert and Programme Planning Groups,
- outcomes of the recommendations agreed at SCAR XXVII,
- new recommendations to SCAR and external organisations,
- budget proposals for 2005 and 2006,
- workplans for action and expert groups for the next two years.

Expanded reports on the work of the various sub-groups will be available from the GSSG web site (<http://www.geoscience.scar.org>). The web site also contains national and other reports on science that comes under GSSG.

## 2. REPORT OF THE SSG AS A WHOLE

The Geoscience Standing Scientific Group of SCAR was formed by the amalgamation of the Working Groups on Geoscience and Geodesy and Geographic Information at SCAR XXVII in Shanghai in 2002 and as such, covers activities that range from scientific research to spatial data standards and data base management.

The transition period necessitated by the amalgamation has meant that considerable effort has gone into a reorganisation of web-based communications, inauguration of newsletters and listservers. A detailed report on the Communications and Outreach Action Group is included in this report to illustrate the advances in GSSG communications. The new web site can be viewed at [www.geoscience.scar.org](http://www.geoscience.scar.org). The web site also contains copies of the *GeoReach*, the GSSG newsletter. The Geoscience listserver now has 134 subscribers and listservers for GIANT (Geodesy in Antarctica), ANTEC (Antarctic Neotectonics Expert Group) and ADMAP (Antarctic Digital Magnetic Anomaly Project) have been established.

A focus of the GSSG has been the development of two Program Proposals for endorsement by SCAR. They are Subglacial Antarctic Lake Exploration (SALE) and Antarctic Climate Evolution (ACE). Both Programs represent groups of researchers already actively engaged in Antarctic research and ACE in particular represents a large group of researchers who have not been involved in SCAR in the past. **The GSSG and members of the ACE steering committee strongly recommend the retention of ACE as its acronym rather than CASE. Addition of Cenozoic to the title would tend to exclude the very important work on Pleistocene and Holocene identified by the Physical Sciences and Life Sciences SSGs as well as the Geosciences SSG.**

The members of this SG and its affiliated activities were involved in many conferences and meetings over the last 2 years. There were 10 major meetings supported by the GSSG between SCAR XXVII and SCAR XXVIII. Meeting

summaries are posted on the GSSG web site. Subsidiary groups such as ANTEC and ACE also organized sessions at major scientific meetings such as American Geophysical Union meetings.

### **SCAR XXVIII GSSG meeting**

The SCAR Geoscience SSG and associated groups met from the 23<sup>rd</sup> to 30<sup>th</sup> July at SCAR XXVIII, starting with meetings of the Geospatial Expert Group in Bremerhaven on the 23<sup>rd</sup> and 24<sup>th</sup> July. In addition to the general group meetings, there were also meetings of the GIANT (Geodesy in Antarctica) ANTEC (Antarctic Neotectonics), ADMAP (Antarctic Digital Magnetic Anomaly Project), Permafrost, IBCSO (International Bathymetric Chart of the Southern Ocean) groups and a workshop on automation technologies for remote observatories.

The SCAR science symposium succeeded in attracting a much larger group of interested scientist to parts of the meeting and facilitated some cross-discipline communication.

While the meetings were successful, there were problems juggling the schedule of all the subgroups with the general SSG business meeting, partly caused by the Chief Officer's unexpected absence from work in the week leading up to the meeting, partly caused by the highly diverse range of specialised areas being coordinated. Another concern with the compressed meeting format is that group members less familiar with English require a slower pace to be fully engaged in business meetings. The Geoscience SSG executive is hoping that improved electronic communications between meetings will assist the engagement of all SSG members.

The meeting made a number of changes to activities. Two new Action Groups were created, while two were discontinued. Three new Expert Groups were created and ANTEC was endorsed as an Expert Group for the next two years. Expert Group descriptions and work plans are listed below. The SSG is recommending the creation of two Programs, Antarctic Climate Evolution (ACE) and Subglacial Antarctic Lake Exploration (SALE).

The combined SSG discussed the International Polar Year (IPY) extensively and broke into small groups to develop a series of consolidated geoscience project outlines.

The GSSG drafted one new recommendation for consideration by the SCAR Delegates meeting and one new internal recommendation. The external recommendation addresses the fact that some national programs have not identified an officer who can be contacted to coordinate geospatial information activities. The internal recommendation is that national GSSG representatives identify "National Correspondents" for each SCAR Program to ensure the widest possible participation in these initiatives and to aid in capacity building.

### **Intersessional Activities of the GSSG Office Bearers**

**Communications with SCAR Executive.** The Chief Officer was unable to attend intersessional executive meetings in Europe because of the time and cost involved in

travelling from Australia. The Deputy Chief Officer, Prof Alessandro Capra was able to attend but SCAR needs to consider the possible disincentives for potential office bearers of meeting locations and schedules.

**Prince of Asturias Fellowships:** The Chief Officer read and ranked the very good applications for these fellowships for the Executive to make the final decision.

**Advice to the Treaty:**

**Complete Environmental Evaluations (CEE):** Phil O'Brien reviewed the CEE for the ANDRILL project on behalf of the Group.

**Acoustics Action Group** – The Acoustics report was posted on the GSSG web site. We have received positive feedback on Report 1.2 which has been downloaded by 1000 different users. The second workshop was held in May 2004 and the resulting Information paper was well received at the Committee for Environmental Protection (CEP). The CEP Chairman said he had good comments in private as well as in the meeting.

**Antarctic Specially Protected Area (ASP) proposals:** Phil O'Brien reviewed the management plans for proposed Antarctic Specially Protected Areas with which he was familiar with. Others ASPA proposals were notified to those on the listserver.

## **Reports of Program Planning Groups**

Three Program Planning Groups were established at SCAR XXVII. Of these, SALE and ACE have developed full proposals for recognition as Programs by SCAR. The Antarctic Neotectonics (ANTEC) Group recommended that they form an Expert Group for the next 2 years.

The Geoscience Standing Science Group fully endorsed ACE and SALE as Programs. Both Programs represent important fields of Antarctic science and are supported by groups of scientists who are already active. The range of activities already underway under these headings can be viewed by following the links from the Geoscience web page. ACE has already coordinated a special issue of "*Palaeogeography, Palaeoclimatology, Palaeoecology*", Volume 198, issues 1-2, was published in 2003. The volume is titled "Antarctic Cenozoic Palaeoenvironments: Geologic Record and Models, edited by Fabio Florindo, Alan Cooper and Philip O'Brien.

There has been a suggestion that ACE have "Cenozoic" added to the title because of a number of other groups using ACE as an acronym. **The ACE steering committee and the GSSG oppose this suggestion because it places restrictions on the scope of the program that would seriously undermine its value.** All SCAR Standing Science Groups have recognised the importance of the Pleistocene and Holocene in understanding the evolution of the Antarctic Ice Sheet, the continent's biota and the processes that control the natural variability of the Antarctic environment. ACE is placing a high priority on following up the work of the ANTIME project that formerly focussed on the Last Glacial Maximum environment of Antarctic as part of GLOCHANT. Restricting ACE to the Cenozoic (i.e. pre-Pleistocene) would exclude some of its most important fields of research.

ANTEC (Antarctic Neotectonics) has already been active for some years as a Group of Specialists. Its main output comprised the July 2004 issue of *Global and Planetary*

*Change* is a Special Issue on Ice Sheet Mass Balance and Neotectonics that was a joint effort with the ISMASS committee of the SCAR Physical Sciences SSG. Because of its significant pre-existing history, the ANTEC Program Planning Group thought it more appropriate to be designated an Expert Group for the next two years rather than to continue as a Program.

## Reports of Action Groups

### **ACOUSTICS ACTION GROUP REPORT**

The issue of the environmental impacts of anthropogenic noise has not gone away. The first SCAR report has received wide attention. Glenn Johnston reports that it has been accessed 13,042 times on the web. It has been used by the Australian Department of Environment and Heritage to prepare Ministerial Briefings and the US Marine Mammal Commission is recommending it to people as a good introduction to the field.

The Action Group organised a new workshop in May 2004, having started trying to find a date in October 2003. The meeting at the British Antarctic Survey was smaller than the first workshop but this was not a problem as the aim was to update the first report rather than revisit everything covered in the first meeting. The Action Group had the benefit of participants who are prominent researchers in the field and are heavily involved in meetings organised by the US Marine Mammal Commission and so had very up to date information.

The meeting reviewed new research on marine mammal hearing that provides a firmer basis for estimating effects on mammal hearing and then applied a structured risk evaluation methodology to the problem. This method used a qualitative assessment of impacts and their likelihood to rank scientific surveys, antisubmarine sonars implicated in recent whale stranding events and normal Antarctic shipping activities. The group concluded that most scientific activities posed a risk to the marine environment less than or equal to shipping.

The results plus comments on other information papers on the topic presented to the CEP were presented as an Information Paper to the CEP in Cape Town. Feedback from the meeting was very positive. Parties wishing to comment have until the end of August when the workshop results will be incorporated into the Acoustics Report Version 2.

Because the issue is one of a number of things that could be raised at CEP or Treaty level, the SCAR Geoscience Standing Science Group recommends that the Impacts of Acoustics Technology on the Marine Environment technology be incorporated in the new Treaty and CEP Action Group. This Action Group will be coordinated by Philip O'Brien and deal with matters raised by Treaty bodies for attention by the GSSG or with issues identified by the GSSG as needing attention from the Treaty (see Work plan below).

## Permafrost

The Permafrost Action Group was constituted at SCAR XXVII with the following aims:

1. To assess (review) the state of permafrost science in Antarctica.
2. To identify gaps and priorities in Antarctic permafrost science.
3. To establish links with the broader permafrost community (particularly the International Permafrost Association) and put Antarctic permafrost into a global context.

The Action Group met at the 8<sup>th</sup> International Permafrost Conference, at the International Symposium on Antarctic Earth Sciences and at SCAR XXVIII and prepared a strategy for advancing Antarctic Permafrost science in the form of a work plan presented below.

## Communication and Outreach Action Group

The Communications and Outreach Action Group has been highly successful at improving and broadening communications of GSSG activities. SCAR Geoscience Standing Science Group recommends the continuation of the Communications and Outreach Action Group with Convener Glenn Johnstone and Phil O'Brien as assistant.

Action Group Chairman: Mr Glenn Johnstone, Australia (based in UK)

### ***Program Objective:***

*To provide information on Antarctic geoscientific research to the scientific and general community.*

### **1. Electronic Communication**

**Project Leader:** Chairman

**Collaborators:** All members

**Goal:** To assist the Standing Scientific Group in achieving its objectives.

### **Activities:**

1. Expand and maintain website for GSSG and host at Geoscience Australia Done. New URL registered – in accordance with the *de facto* SCAR standard – [www.geoscience.scar.org](http://www.geoscience.scar.org) -and the site has continued to be hosted by Geoscience Australia. Content of the site was expanded to include other geoscience activities including: geology; geophysics; Antarctic Digital Magnetic Anomaly Project (ADMAPP); Age, Growth & Evolution of Antarctica (AGEANT); Permafrost and GSSG products, as well as direct links to ANTEC, ACE and SALE. The site now contains more than 300 pages. The increase in content and GSSG membership (ie. the amalgamation of WG-GGI and WG-Geoscience at SCAR XXVII) has meant there has also been a large increase in the traffic for the new GSSG site. On average the site now receives more than 25 000 unique visitors per year – more than 3 times what it was before XXVII SCAR. See Appendix 1 for a more comprehensive listing of statistics.

2. Amalgamate existing web resources (such as the ANTEC site) into the new site Done. The ANTEC was relocated to Ohio State University, where it is now hosted with a new URL – [www.antec.scar.org](http://www.antec.scar.org)

3. Maintain listservers

Five listservers ('geosci-l', 'gig-l', 'giant-l', 'antec-l' and 'admap-l') were established and maintained throughout the reporting period. Currently there are 134 subscribers to the 'geosci-l' list, 49 subscribers to the 'giant-l' list, 101 subscribers to the 'antec-l' list, 39 subscribers to the 'gig-l' list and 31 subscribers to the 'admap-l' list. All GSSG members have a registered email address and there would be approximately 2 messages per week that are distributed through the 'geosci-l' list. It seems as though it has not been utilised to its full potential during this report period – and perhaps that is a reflection of the COG Chairman not working full-time on SCAR and COG matters.

4. Maintain the list of contacts for the exchange of map, chart and geographic publications Maintained to the best of the Chairman's ability. Notification from members of updated details is appreciated.

5. Maintain the list of distributors of Antarctic maps  
Maintained to the best of the Chairman's ability. Notification from members of updated details is appreciated.

## **2. Publications**

**Project Leader:** Chairman

**Collaborators:** GSSG Executive Group, Programme Group Chair, Programme Planning Group Chairs, Expert Group Chair, Action Group Chairs and Project Coordinators.

**Goal:** To publicise GSSG activities.

### **Activities:**

#### 1. Publications

– Develop a bibliography of key GSSG papers  
– Encourage Action Groups and Projects to publish their work in a timely manner  
Publications by GSSG members or those of interest to GSSG members (and details of which have been received by the COG Chairman) have been put onto the web site. In addition to these publications there have been 6 GSSG newsletters – 'GeoReach' - over the reporting period – [www.geoscience.scar.org/actiongroups/cog/](http://www.geoscience.scar.org/actiongroups/cog/) - available in both HTML and PDF versions.

The Marine Acoustics Report, first published in 2002 and then updated in 2003 has been accessed a total of 13 402 times from the period 1 July 2002 to 30 June 2004. Each unique user, on average, has downloaded the file 12 times. Feedback received by the Chief Officer has indicated the document is well regarded and considered by many as an authoritative source on the impact of marine acoustic technology on the Antarctic environment.

2. Produce support materials for Antarctic geoscience related conferences, workshop, symposia etc on GSSG activities.

Some support material has been provided to a few GSSG activities. Full support has not been possible due to the relocation of the Chairman from Australia to the UK during much of the reporting period. The Chairman has helped, where possible, with arrangements for about 5 meetings during the reporting period. For a detailed list of meetings see section later in this report.

3. 'Best practice' guidelines on observatory related activities and data management  
Not yet produced - Prof Alessandro Capra to write these up and provide to members.

4. Maintain metadata for GSSG products in the Antarctic Master Directory  
Metadata entries for the 'flagship' GSSG products are checked approximately every 6 months on the AMD <[gcmd.gsfc.nasa.gov/Data/portals/amd/](http://gcmd.gsfc.nasa.gov/Data/portals/amd/)> and updated if required.

### **3. Liaison**

**Project Leader:** Chairman

**Collaborators:** GSSG Executive Group, Programme Group Chair, Programme Planning Group Chairs, Expert Group Chair, Action Group Chairs and Project Coordinators

**Goal:** To establish and maintain communication between GSSG members, SCAR and related external bodies.

#### **Activities:**

1. Continued liaison at a working level with key SCAR and non-SCAR bodies

- Life Sciences, Physical Sciences, Data and ATS Standing Committees
- COMNAP (STADM / JCADM)
- Committee for Environmental Protection (CEP)
- Relevant IUGG groups
- International Steering Committee for Global Mapping (ISCGM)
- Digital Earth
- Global Spatial Data Infrastructure (GSDI)
- ISO TC211

Liaison with the above organisations has been limited over the last 2 year period. Full support has not been possible due to the relocation of the Chairman from Australia to the UK during much of the reporting period. The Chairman has helped, where possible, with liaison between GSSG and the above organisations. He was invited to attend and participated in the 7<sup>th</sup> JCADM meeting in Brussels, Belgium. This provided a good opportunity to refresh the links between GSSG and JCADM. Discussion of activities between the 2 groups revealed there were a number of areas of commonality and possible opportunities for collaboration. This will be further examined at XXVIII SCAR. In the lead up to XXVIII SCAR there has been increased contact with the new COMNAP Executive Secretary– principally about how closer ties between core GSSG activities (particularly those in the geographic information area) could be utilised by COMNAP and what other services or data GSSG could provide to logistics managers. There has been good contact between GSSG and the International Hydrographic Commission (IHO) – particularly in the lead up to the International Bathymetric Chart of the Southern Ocean (IBCSO) meeting being held in Bremen.

Likewise between SCAR and the ISO TC211 group there has been good liaison. Paul Cooper, SCAR representative to ISO TC211 has participated in a number of meetings (assisted by presentations by Steffen Vogt, Germany) and provided regular updates on SCAR standards activities to TC211.

At a higher level, the Chairman understands there have been many discussions between the newly appointed SCAR Executive Director and the International Oceanographic Committee in relation to establishing a SCAR/SCOR/IOC Coordinating Group on Inter-disciplinary Southern Ocean Science (ISOS). This group will facilitate coordination between the different discipline research groups currently



active in the Southern Ocean. There has been good contact between the COG Chair and the SCAR Executive Director and Executive Secretary during this reporting period – with 2 visits to the SCAR office in Cambridge. There has been less interaction with the other SCAR SSG's, ISCGM, IAG, IUGG, Digital Earth, the CEP/ATCM and the GSDI group. It is hoped that with the new appointments being made of the ATCM Executive Secretary and Chair of CEP there can be some closer ties made between GSSG and CEP/ATCM –particularly in relation to the provision of geographic information that the CEP/ATCM may require for it's activities.

## **Meetings**

### **Activities:**

1. The following inter-sessional meetings have taken place:

- SALE meeting, California, USA, 2-3 October 02
- Antarctic Geodesy Symposium 2002 (AGS'02), Wellington, New Zealand, 25-27 November 02
- SALE meeting, California, USA, 4-5 April 03
- ANTEC sponsored symposium at EGS-AGU-EUG Joint Assembly, Nice, France 6-11 April 03
- 2 nd International Antarctic GIS Workshop, Freiburg, Germany 7-10, April 03
- Composite Gazetteer of Antarctica Meeting, Freiburg, Germany, 9 April 03
- GSSG, ANTEC and 9 th ISAES meeting, Potsdam, Germany, 6-13 September 03
- Antarctic Geodesy Symposium 2003 (AGS'03), Lviv, Ukraine, 17-19 September 03
- Cybercartographic Atlas of Antarctica, 14-17 October 03
- SALE meeting, Bristol, UK, 14-15 October 03
- ANTEC meeting, EGU meeting, Nice, France 25-30 April 04
- 3 rd International Antarctic GIS Workshop, Wuhan, China, 27-29, May 04

There has been an active inter-sessional period for GSSG members with 12 SCAR-endorsed or SCAR-sponsored meetings taking place around the globe. There have been many other specialist Antarctic sessions at international geoscience conferences, for example at the American Geophysical Union biannual meetings and the European Geophysical Union annual meeting in Nice, France. Reports and documents from 10 of these meetings can be found at: [www.geoscience.scar.org/meetings/](http://www.geoscience.scar.org/meetings/). Details on the 2 ANTEC meetings can be found at: [www.antec.scar.org/active.htm](http://www.antec.scar.org/active.htm)

## **Other**

All information relating to the activities of the Communication and Outreach Action Group (including archived newsletters and website statistics) can be found at: [www.geoscience.scar.org/actiongroups/cog/](http://www.geoscience.scar.org/actiongroups/cog/)

## **Age Growth and Evolution of Antarctica Action Group (AGEANT)**

AGEANT was established as to progress studies of the Antarctic basement geology and identified the need for compilation of Antarctic geochronology data. Though the group identified suitable repositories and computer systems to house a single geochronology data base, there was a marked reluctance of researchers to contribute data to a single repository. The Convener, Prof Chris Wilson, reported that he was unable to continue the work and no other GSSG member was able to take over the role. SCAR Geoscience Standing Science Group recommends that the Action group on the Age Growth and Evolution of Antarctic (AGEANT) be discontinued.

# Report of Expert Groups

## Geospatial Information Expert Group

There are ten projects in the GI Program, these are:

1. [Place Names](#);

Coordinator [Prof Roberto Cervellati](#)

This project continues to maintain an authoritative database of all Antarctic place names approved by recognised bodies, for reference by national Antarctic naming authorities, scientists and operators. Full workplan details are available on the GSSG web site (<http://www.geoscience.scar.org/geog/geog.htm>) and the gazetteer is on [http://www3.pnra.it/SCAR\\_GAZE](http://www3.pnra.it/SCAR_GAZE).

2. [Topographic Database](#);

**Project Leader:** UK - [Mr Adrian Fox](#)

**Members:** Australia, USA, Germany

**Goal:** Provide a SCAR standard small scale topographic GIS database, for use by scientists and operators, and contribute topographic data to global mapping initiatives.

3. [Map Catalogue](#);

**Project Leader:** Australia - [Mr Henk Brolsma](#)

**Members:** UK, USA, Germany, Chile

**Goals:** To maintain a public-access catalogue of all Antarctic mapping products.

Work on this facility continues, it can be accessed at [http://aadcmaps.aad.gov.au/aadc/mapcat/search\\_mapcat.cfm](http://aadcmaps.aad.gov.au/aadc/mapcat/search_mapcat.cfm).

4. [King George Island GIS \(KGIS\)](#);

**Project Leader:** Germany - [Mr Steffen Vogt](#)

**Members:** Argentina, Chile, Brazil, Poland, China, Korea, UK, Uruguay

**Goal:** To produce an integrated geographic database for use by all countries, for use in multi-disciplinary applications.

This project held a workshop in 2003 and has produced a GIS and has identified some issues in spatial data integrity that are the subject of a Recommendation to SCAR.

5. [Spatial Data Standards](#);

**Project Leader:** Australia - [Mr Henk Brolsma](#)

**Members:** UK, USA, Germany, Chile

**Goal:** To provide a SCAR standard spatial data model for use in SCAR and national GIS databases.

This project has produced a spatial data model for Antarctica that can be viewed and used at:

[http://aadcmaps.aad.gov.au/aadc/ftc/search\\_ftc.cfm](http://aadcmaps.aad.gov.au/aadc/ftc/search_ftc.cfm)

6. [National On-line Atlases](#)

**Project Leader:** USA - [Mr Jerry Mullins](#)

**Members:** Australia, China, Canada

**Goal:** To develop a distributed network of national Antarctic online atlas nodes linked to the Cybercartographic Atlas hub.

This project has mostly been facilitating communications between national groups.

#### 7. [Cybercartographic Atlas](#)

**Project Leader:** Canada - [Prof D.R. Fraser Taylor](#)

**Members:** Australia, USA, China, Argentina, Chile, International Hydrographic Organisation (IHO), Poland

**Goal:** To provide an online Antarctic Cybercartographic Atlas.

This project is aimed at developing tools for communication of spatial data. Software is in development and the Cybercartographic atlas is being offered as a possible tool for disseminating data generated by IPY.

#### 8. [GIS Collaboration in East Antarctica](#)

**Project Leader:** Russia - [Dr Alexander Yuskevitch](#)

**Members:** Australia, China, Italy

**Goal:** To develop and finalise a proposal for GIS collaboration at a key site in East Antarctica.

#### 9. [IHO Bathymetry Proposal](#)

**Project Leader:** Australia - [Mr John Manning](#)

**Members:** Canada, New Zealand, IHO

**Goal:** Support the proposal for the production of a new International Bathymetric Chart of the Southern Ocean.

This project is now complete with the formation of the Action Group for the International Bathymetric Chart of the Southern Ocean (see below).

#### 10. [Grove Mtns ortho-rectified satellite image map](#)

**Project Leaders:** [Prof E Dongchen](#) and [Mr Henk Brolsma](#)

**Members:** Australia, China

**Goal:** To prepare a 1:25 000 scale ortho-rectified satellite image map of the Grove Mountains.

Collaborative work is continuing.

### **GIANT (Geodesy in Antarctica) Projects**

#### **1. Permanent Observatories**

**Project Leader:** Australia - [Mr John Manning](#)

**Goal:** To develop an infrastructure of permanent geoscientific (ie. seismologic, geomagnetic, geodetic and gravimetric) stations to bring all individual networks to a common datum, and to provide geoscientific information for the global monitoring and analysis of natural earth processes.

SCAR Geoscience Standing Science Group maintains a master index of information on permanent geophysical and geodetic observatories are also listed in web-accessible form from the GSSG web site

[http://www.geoscience.scar.org/geodesy/perm\\_ob/sites.htm](http://www.geoscience.scar.org/geodesy/perm_ob/sites.htm)).

#### **2. Epoch Crustal Movement Campaigns**

**Project Leader:** Germany - [Prof Reinhard Dietrich](#)

**Collaborators:** Italy, Chile, Japan, China, Australia, USA

**Goals:** 1. To densify the geodetic infrastructure established from the permanent observatories; and

2. To develop a deformation model for surface movement vectors within a common Antarctic reference frame.

### **3. Physical Geodesy**

**Project Leader:** Italy - [Prof Alessandro Capra](#)

**Collaborators:** Germany, Australia, Russia, USA, Japan, Canada,

**Goal:** Compilation and analysis of physical geodesy data, for the development of a new high resolution Geoid for the Antarctic.

### **4. Geodetic Control Database**

**Project Leader:** Australia – [Glenn Johnstone](#)

**Collaborator:** All

**Goal:** Maintain the master index for Antarctic positional control, including all levels of accuracy.

The SCAR Geoscience Standing Science Group master index for Antarctic positional control, including all levels of accuracy, can be accessed via the World Wide Web (<http://www.geoscience.scar.org/geodesy/giant.htm#controldb>).

### **5. Tide Gauge Data**

**Project Leader:** Japan - [Dr Kazuo Shibuya](#)

**Collaborators:** Australia, China, Germany, New Zealand, Italy, Russia, USA (Amos), UK (Woodworth), other specialists as required

**Goal:** To consolidate the collection of and access to Antarctic tide gauge information

### **6. Atmospheric Impact on GPS Observations in Antarctica**

**Project Leader:** Poland - [Dr Jan Cisak](#)

**Collaborators:** Germany, Italy, USA, Australia (IPS), Norway, China

**Goal:** To understand the ionospheric and tropospheric impact of the atmosphere on the quality of GPS observations in Antarctica

### **7. Remote Observatory Technologies**

**Project Leader:** USA - [Mr Larry Hothem](#)

**Collaborators:** Japan (GSI), Australia, Italy, Netherlands (Swartz)

**Goal:** Identify technology and monitor developments for the deployment of geophysical and geodetic measurement sensors, and ancillary support equipment, at unattended remote (no existing infrastructure for power, shelter and communications) Antarctic localities.

### **8. Ground Truthing for Satellite Missions**

**Project Leader:** Germany - [Prof Reinhard Dietrich](#)

**Collaborators:** Italy, Australia, USA (U of Texas)

**Goal:** To ensure new satellite missions are integrated with the Antarctic geodetic system

### **9. Geodetic Advice on positioning limits of special areas in Antarctica**

**Project Leader:** Chile

**Collaborators:** Germany, Australia, USA

**Goal:** To provide advice to SCAR, through the Geoscience Standing Scientific Group on the geodetic aspects of protected area definitions.

## Existing Recommendations

The GSSG reviewed existing recommendations and recommends no changes to them. One new recommendation to SCAR is proposed (see below).

### 1. Place Names

*Noting* that the SCAR Composite Gazetteer of Antarctica (CGA):

- has been published in March 1998 by the SCAR Working Group on Geodesy and Geographic Information (WG-GGI);
- contains names data from twenty-two SCAR member countries and the International Hydrographic Organisation (IHO) / International Oceanographic Commission (IOC);
- comprises around 34,165 entries for 17,097 features, with about 10% of features having two or more entirely different names.

*Also noting* the increasing importance being placed on names for operational and research purposes there is a requirement for a greater accuracy of the coordinates

*Considering* that, in the interests of both scientific clarity and operational safety, the general principle of ‘one name per feature’ should apply for all new feature names;

The Expert Group on Geospatial Information (GIG) *recommends* to SCAR that:

National Committees, directly or through their national Antarctic naming authority:

1. refer to the CGA in considering all proposals for new place names;
2. avoid adding new place names to features already named;
3. submit all new approved place names to GIG for inclusion in the CGA;
4. provide existing data to the GIG for inclusion in the CGA.

### Amending existing recommendation (XXVI-3)

### 2. Bathymetric Data

*Noting* that the lack of bathymetric information in large areas of the Southern Ocean is a limiting factor in bathymetric mapping and nautical charting;

*Noting* the initiative from the IHO for an improved International Bathymetric Chart for the Southern Ocean (IBCSO)

*Further noting* the key role of the IHO Data Center on Digital Bathymetry (DCDB) located at the US National Geophysical Data Center (NGDC) in Boulder, CO, and the efforts of the IOC/IHO organizations for updating and maintaining the General Bathymetric Chart of the Ocean (GEBCO);

*Considering* the need for bathymetric maps for the morphological interpretation of the sea-floor structure and general oceanographic studies, the geo-location of scientific data, and the general requirements for precise nautical charts to ensure the safety of navigation in Antarctic waters;

The GIG *recommends* that:

1. SCAR supports the acquisition of echo-sounding data on all vessels operating in Antarctic waters and the delivery of the gathered measurements to the IHO DCDB for further use in bathymetric mapping;
2. wherever possible, vessel transits should be planned through oceanic regions where few bathymetric data exist in order to gather additional bathymetric information.

### Amending existing recommendation (XXVI-11)

### **3. Geodetic and Geographic Information**

*Noting* the Antarctic Treaty Article III (1c) requirements regarding data exchange, *Recognising* that the information products produced by the SCAR Geoscience Standing Scientific Group are all derived from the work of National Committees and Programmes:

SCAR *recommends* that National Committees request National Programmes to provide continuing access for all SCAR members to fundamental geodetic and geographic information, including:

- geodetic observations and databases;
- geodetic control point and tide gauge records;
- remotely sensed data (including satellite imagery and aerial photography)
- topographic and bathymetric data;
- and place names data.

#### **Amending existing recommendation (XXVI-12)**

### **4. Airborne Gravity Data for Geoid Computation**

*Noting* that determination of a high resolution geoid in Antarctica benefits research of the ice density of the Antarctic ice sheet, determination of surface elevation relative to mean sea level, and the calibration and validation of satellite missions;

*Recognising* that there is a major gap in gravity data required for the computation of a high resolution geoid in Antarctica;

*Considering* the current lack of gravity data, the need to acquire gravity data at close intervals (optimally spaced between 10 and 50 km), that new satellite gravity missions will leave a gap from 82 to 90 degrees south, and that airborne gravity observation is considered the most cost effective and reliable method for collecting data;

SCAR *recommends* that National Committees request National Programmes:

- support a scientific programme of airborne gravity to cover gaps in Antarctica gravity data; and
- encourage all researchers to coordinate their efforts in Antarctic gravity data acquisition, in particular airborne gravity data, and to provide such data to the SCAR Geoscience Standing Scientific Group for incorporation into a physical geodetic database of Antarctica.

### **5. Geodetic observations at remote locations**

*Recognising* the technological advances being made in low power operation, data storage capacity and data communication at remote Antarctic sites

The Expert Group on Geospatial Information:

*Recommends* that National Committees, where possible, place long-term GPS observatories on remote bedrock features (as identified by the SCAR ANTEC group – [www.antec.scar.org/proposed\\_gps.htm](http://www.antec.scar.org/proposed_gps.htm)) to provide information on the current tectonic motion of the Antarctic plate.

### **6. King George Island Geographic Information System**

*Noting* the SCAR recommendation XXVI-6 concerning rationalization of scientific activities on King George Island the Geospatial Information Group of Experts

*Recognising* that a Geographic Information System for the whole island has been produced and is now available on the internet

*Recommends* that countries with program activities on King George Island should make use of this integrated system for science activity, environmental planning and logistic operations.

And *further recommends* that National Committees, through their National Programmes, continue providing spatially referenced data to the GIS for the mutual benefit of all National Programmes with activities on the island.

## **New Recommendation**

### **Concerning Geographic Information contact officers**

#### **Background**

Recent studies of spatial information stored in SCAR data bases, in particular the SCAR Composite Gazetteer of Antarctica have highlighted problems with the integrity of that data. In particular, coordinates for some named places vary between national gazetteers. This has happened for a variety of reasons that do not reflect on the competence of those responsible for the data but rather reflect such factors as:

1. Changes in surveying techniques which go from historical times to present
2. Loss of metadata such as, which geodetic reference system was used during the original mapping of a feature.
3. Changes in the features themselves. For example, a named nunatak may now be part of a ridge because of ice recession, or streams have migrated across their floodplain.
4. Lack of clarity in the original feature description.

This problem has important practical implications. Some Antarctic Specially Protected Areas are defined about a topographic feature. If there are several sets of coordinates for the feature, management of the area becomes impossible. Computer access and processing of scientific data attached to a named feature can be compromised, and search and rescue can be hindered if search parties have several different coordinate options for the same feature to choose from.

This problem should be rectified during re-mapping activities and requires international liaison between responsible geographic information specialists. Not every SCAR nation has a designated Geographic Information contact person, therefore hindering the resolution of this problem and other spatial data issues.

Thus the Geoscience Standing Scientific Group puts forward the following recommendation:

*Concerning Geographic Information contact officers*

*Noting* the SCAR XXVII-I Recommendation concerning Antarctic place names;

*Recognising* the importance of high quality spatial data to Antarctic science and operations;

*Mindful* that data integrity discrepancies can occur between data sets collected by different programs;

SCAR *recommends* to National Committees and Programs that they identify a Geographic Information contact person who is able to provide the information required to ensure the greatest possible coordination of geographic information across the Antarctic.

## **Internal Recommendations**

1. The SCAR Geoscience Standing Science Group recommends that the SCAR Delegates Meeting endorse the Antarctic Climate Evolution proposal as a SCAR Program.
2. The SCAR Geoscience Standing Science Group recommends that the SCAR Delegates Meeting endorse the Subantarctic Lake Exploration proposal as a SCAR Program.
3. The Geoscience Standing Science Group recommends that National Geoscience Representatives identify National Correspondents for each new SCAR Program.

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# **GEOSCIENCE STANDING GROUP ACTION GROUPS, GROUPS OF EXPERTS WORK PLANS JULY 2004**

## **Action Groups**

### **Communication and Outreach Action Group (COG)**

#### **Background**

The Communication and Outreach Action Group – formed at SCAR XXVII successfully completed its 2 year programme from 2002-04. Feedback solicited at XXVIII SCAR has indicated this Action Group has been working well and should continue for another 2 years. Glenn Johnstone (UK) has been re-appointed as Chairman of COG, assisted by Phil O'Brien (Australia) and asked to identify the terms of reference, a proposal on what funding the Group would require and develop a forward work plan.

#### **COG Terms of Reference**

1. To gather, collate and disseminate geospatial and geoscientific information relevant to GSSG members and activities through electronic communication methods (website and listservers).
2. To maintain an up-to-date website for the GSSG containing information on member contact details, observatory details, reports from meetings / symposia etc., links to GSSG projects, SSG publications,



3. To form and maintain strong links with SCAR and non-SCAR bodies to promote geospatial and geoscientific information for use in research and planning.
4. To research, publish and distribute regular newsletters on GSSG activities
5. To cooperate closely with the SCAR Secretariat in relation to their activities on communication and outreach for 2004-06

*Work Plan 2004-2006*

**1. Electronic Communication**

**Project Leader:** Glenn Johnstone

**Goal:** To assist the Standing Scientific Group in achieving its objectives in relation to communication and outreach of its activities.

**Activities:**

- Maintain website for GSSG and continue to host at Geoscience Australia
- Maintain listservers
- Maintain the list of contacts for the exchange of map, chart and geographic publications

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**2. Publications**

**Project Leaders:** Glenn Johnstone and Phil O'Brien

**Goal:** To publicise GSSG activities.

**Activities:**

- Publications
  - Maintain and expand a bibliography of key GSSG papers
  - Encourage Action and Expert Groups and Projects to publish their work in a timely manner
- Produce 4 editions per year of the GeoReach newsletter
- Maintain metadata for GSSG products in the Antarctic Metadata Directory (AMD).

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**3. Liaison**

**Project Leader:** Glenn Johnstone

**Collaborators:** GSSG Executive Group

**Goal:** To establish and maintain communication between GSSG members, SCAR and related external bodies.

**Activities:**

- Continued liaison at a working level with key SCAR and non-SCAR
  - Life Sciences, Physical Sciences, Data and ATS Standing Committees
  - COMNAP (STADM/JCADM)
  - CEP
  - Relevant IUGG groups
  - Global Map, Digital Earth, GSDI

- ISO TC211
  - ISPRS Polar Research Group
  - To take advantage of opportunities for liaison with other bodies, if and when they arise
- 

#### **4. Meetings**

**Project Leader:** Glenn Johnstone

**Goal:** To assist, where possible, with the organisation of inter-sessional meetings.

**Activities:**

1. Produce support materials for Antarctic geoscience related conferences, workshop, symposia etc on GSSG activities
  2. Provide input into Local Organising Committees for the following meetings:
    - Antarctic Geodesy Symposium 2005 (AGS'05), Cairns, Australia, August 2005
    - 4<sup>th</sup> International Antarctic GIS Workshop, Chile, October 2005
- 

## **New Action Groups**

The SCAR Geoscience Standing Science Group endorses the following New Action Groups.

### **Treaty and CEP Action Group**

*Convenors:* Philip O'Brien (Australia), Luiz Gamboa (Brazil)

*Background:* Experience of the last 2 years shows that an extra link is needed between SCAR representative to the CEP and the Standing Science Groups. The Geoscience Standing Science Group proposes to establish an Action Group to handle issues of two-way communication between working scientist SCAR representatives to the CEP.

*Terms of Reference:* To communicate with SCAR representative at the CEP and ATS to bring matters of concern to the CEP and Treaty to the Geoscience SSG for advice and to identify areas of concern in geosciences and geospatial information, raise them in ATS fora and provide scientific advice.

*Activities for 2004-2005*

1. Integrity of Place names.  
Develop guidelines for national programs to review spatial data and associated metadata attached to named places to improve the integrity of the Gazetteer of place names.

*Milestones :* Produce information paper and suggested guidelines for the 2005 ATS meeting.

Participants: Stefen Vogt, Brian Storey, Roberto Cervellati

2. Sampling Management Guidelines

Review existing rules and guidelines for the management geological samples to see if improvements can be made to ensure the best use of samples, the minimum disturbance to sample sites and the preservation of material for future study.

*Milestones:* Produce information paper and any revised guidelines for the 2005 ATS meeting.

*Participants:* Phil O'Brien (Australia), Jane Francis (UK), Lothar Viereck-Goette (Germany)

### 3. Environmental Impact of Marine Acoustic technology

Provide reviews of the best scientific advice on the impacts of acoustic technology on the Antarctic marine environment to aid Treaty nations and scientists in management to minimise any impacts.

*Milestones:* 1. Produce Report Version 2.0 by October 2004.  
2. Produce revised CEP information paper and report by the ATCM of 2006.

*Participants:* Phil O'Brien

## **Marine Survey Coordination Action Group**

*Conveners:* Phil O'Brien (Australia), Miquel Canales (Spain), Ron Macnab (Canada), Rainer Gersonde (Germany)

*Background:* Members engaged in marine geoscience research have identified a need for additional mechanisms for communication between those working in this field, especially communication of planned surveys before they take place. This is important in enhancing collaboration and reducing duplication of effort. The Acoustics Action Group has identified coordination of surveys to avoid unnecessary resurveying as an important measure to minimise the environmental footprint of marine research.

*Terms of Reference:* To develop mechanisms for improved communication about planned marine surveys within the Antarctic community.

*Milestones:* 1. Develop web forms for documentation of essential details of planned surveys for posting on the GSSG web site (May 2005).  
2. Develop list of contacts among national operators and the marine geoscience community (via CONMAP) to obtain the information needed (June 2005).

## **Existing Expert Groups**

The Geoscience Standing Science Group endorsed the continuation of the Expert Group on Geospatial Information and its work program for 2004-2006.

## **GEOGRAPHIC INFORMATION GROUP WORK PLAN 2004-2006**

### **Terms of reference**

Understanding that geographic location is a fundamental element for integrating and communicating Antarctic science knowledge, the GI group aims to create an Antarctic spatial data infrastructure (ANTSDI) by:

- Providing Antarctic fundamental geographic information products and policies in support of all SCAR science programs and operations management
- Integrating and coordinating Antarctic mapping and GIS programs
- Promoting an open standards approach to support free and unrestricted data access
- Promoting capacity building within all SCAR nations

### **1. Place Names (SCAR Composite Gazetteer)**

**Project Leader:** Italy – [Prof Roberto Cervellati](#)

#### **Activities:**

1. Continue to collect descriptions and dates of approval
  2. Development of a policy for the future of the CGA
  3. Address non-responding countries via letter through former GGI representatives / SCAR delegates / COMNAP delegates / Place Names Committees
  4. For new or modified entries include source of co-ordinates
  5. If countries supply names for submarine features advise GEBCO
  6. Investigate links to existing gazetteers for place names above 60° South
- 

### **2. Antarctic Digital Database (ADD)**

**Project Leader:** UK – Mr Adrian Fox

#### **Activities:**

1. Identify data sources for incorporation of sub-Antarctic islands into ADD
  2. Migrate the ADD to object oriented data model and create the Antarctic Map Server (including resolving the issue of interpretation of features)
  3. Add coastal change data to the Antarctic Peninsula region (and other parts of the continent if available)
  4. Add BEDMAP dataset
- 

### **3. Map Catalogue**

**Project Leader:** Australia – [Mr Henk Broksma](#)

#### **Activities:**

1. Relevant countries to check existing entries and to add new or missing ones
  2. Define additional fields if necessary
  3. Evaluate inclusion of SCAR geological map catalogue (at BAS)
  4. Link US and BAS thumbnails into the map catalogue
  5. Request countries to provide thumbnail scans of their maps
- 

### **4. King George Island GIS (KGIS)**

**Project Leader:** Germany – [Mr Steffen Vogt](#)

#### **Activities:**

1. continue obtaining and integrating data
2. maintain database and website
3. promote KGIS amongst user / data producers

4. establish / maintain close links to GIS projects on King George Island
5. continue contributing to the development of the SCAR Spatial Data Standards
6. make report on pilot study on place names available (October 2004)
7. contribute content to the Cybercartographic Atlas (June 2005, provided funding is available)

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## **5. Spatial Data Standards**

**Project Leader:** Australia – [Mr Henk Broksma](#)

**Collaborators:** China – Prof E Dongchen, UK – Mr Paul Cooper, Canada – Mr Peter Pulsifer

**Activities:**

1. Continue developing the SCAR Feature Catalogue and the SCAR Spatial Data Model
2. Develop policies on changes and updates for the SCAR Feature Catalogue
3. Ensure compliance to and investigate implementation of ISO TC211 and OGC standards
4. SCAR ISO TC211 liaison officer (Paul Cooper) to attend TC 211 meetings and report back to the project
5. Develop software to allow users to directly access registered Antarctic WMS/WFS/WCS services

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## **6. Geospatial Information – Enabling Technologies**

**Project Leader:** USA – [Mr Jerry Mullins](#)

**Activities:**

1. Integration of on-line geospatial information from distributed web services
2. Development and testing of airborne GPS digital cameras and navigation based photogrammetry for near real-time mapping

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## **7. SCAR Cybercartographic Atlas of Antarctica**

**Project Leader:** Canada – [Prof D.R.Fraser Taylor](#)

**Activities:**

1. Complete conversion of Antarctic Digital Database to a Web accessible Feature Serve through collaboration with BAS (12-2004)
2. Develop preliminary Atlas content modules. Present 'Alpha' release to relevant stakeholders for review (04-2005)
3. Hold a stakeholders workshop to review Alpha release. Possibly in conjunction with GIG workshop. (October 2005)
3. Incorporate stakeholder feedback -> present next iteration Alpha (09-2005)
4. Develop International content for inclusion in beta version (01-2005 - 01-2006)
6. Beta Atlas release (07-2006)
7. Release Atlas Version 1 (11-2006)

(estimated month of completion)

Activity plan pending confirmation with CAAP development team. Confirmation 08-04

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## **8. East Antarctica GIS**

**Project Leader:** Russia – [Mr Alexander Yuskevitch](#)

**Activities:**

1. Prepare a geodetic control information table of all ground control
2. Compare digital topography between Davis and Molodezhnaya for Russian, Chinese, Japanese and Australian data
3. Integrate 2004/05 ground control from Davis to Amery Ice Shelf
4. Compare and correlate digital data in selected areas progressing westwards from Davis
5. present progress to SCAR XXIX

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## **9. Antarctic data linkages**

**Project Leader:** Canada – Mr Peter Pulsifer

**Collaborators:** Canada, Australia, Germany

**Activities:**

1. Liaise with JCADM and STADM regarding geospatial information activities and projects relevant to each group
2. Meet inter-sessionally to discuss areas of mutual interest
3. Develop linkages to GI activities with Artic SDI group

## **GEODETIC INFRASTRUCTURE OF ANTARCTICA (GIANT) WORK PLAN 2004-06**

### **1. Permanent Observatories**

**Project Leader:** Australia - [Mr John Manning](#)

**Project Co-Leader:** Gary Johnston

**Activities:**

1. Undertake and facilitate new or repeated measurements (setup new GPS observatories)
2. Compile a register of existing survey results between collocated geodetic techniques to include VLBI, GPS, DORIS, PRARE, GLONASS, absolute gravity and tide gauge bench marks
3. Encourage access to data through international services (eg. IGS, IRIS)
4. Establish standards for on-site precise measurements between techniques (Local Ties) by cooperation with IERS WG3 on Collocation
5. Post details of all permanent sites on web site
6. Extend the network of permanent observatories to include seismic and geomagnetic techniques which provide data for crustal deformation studies
7. Collaborate with other SCAR scientists to identify requirements for space geodetic sites

### **2. Epoch Crustal Movement Campaigns**

**Project Leader:** Germany - [Prof Reinhard Dietrich](#)

**Project Co-Leader** [Prof Alessandro Capra](#)

**Activities:**

1. Co-ordinate annual continental or regional epoch campaigns

2. Maintain orderly data archive and data access from these campaigns
3. Identify and coordinate integration of regional campaigns (eg. TAMDEF and VLNDEF)
4. Facilitate GPS connections to tide gauge bench marks
5. Deliver results to ITRF in conjunction with results from permanent observatories
6. Collaboration with IAG Sub-Commission on Antarctica (IAG WG1.3f)
7. Integration of solutions using ITRF guidelines
8. Provide project results to ANTEC

### **3. Physical Geodesy**

**Project Leader:** Italy - [Prof Alessandro Capra](#)

**Project Co-Leader:** Mirko Scheinert

#### **Activities:**

1. Compilation of metadata list for high accuracy geoid computation (geodetic data, gravimetric database, etc)
2. Collaboration with IAG Antarctic Gravity project (chaired by Mirko Scheinert)
3. Promotion of Antarctic airborne gravity project
4. Coordinate with Project 8() on new satellite gravity data missions eg. GRACE, GOCE
5. Gravity ties between stations, airfields and Absolute gravity sites

### **4. Geodetic Control Database**

**Project Leader:** Australia – [Glenn Johnstone](#)

**Project Co-Leader:** Gary Johnston

#### **Activities:**

1. Maintain database and add in newly acquired data (eg. Australian recomputed coordinates and VLNDEF station information)
2. Develop draft guidelines for photo identification
3. Publish draft guidelines for geodetic control identification on web site
4. Add astronomic and geodetic control from Russia and USA
5. Define appropriate meta data for geodetic control

### **5. Tide Gauge Data**

**Project Leader:** Japan - [Dr Kazuo Shibuya](#)

**Project Co-Leader:** Australia (Henk Brolsma, Gary Johnston)

#### **Activities**

1. Revise information on the web to benchmark values and connections to IGS GPS observations sites GPS stations
2. [Research](#) and list all permanent and significant tide gauges established for hydrographic information and scientific studies. [Also available is [tide gauge instrumentation information](#) and [tide gauge reference information](#)]
3. Facilitate index data into the Geodetic data base and post meta data on web
4. Produce 'best-practice' guidelines on establishment and calibrating on bottom mounted and acoustic type gauges in Antarctic conditions (ie. GLOSS etc)
5. Deploy offshore bottom pressure tide gauges in support of satellite missions
6. Arrange supply of tide gauge data to the TIGA project

## **6. Atmospheric Impact on GNSS Observations in Antarctica in relation to Geophysical research**

**Project Leader:** Ukraine – Gennadi Milinevsky

**Project Co-Leader:** Poland - [Jan Cisak](#), Italy – Pierguido Sarti

**Collaborators:** USA (D.Brzezinska), Germany (M.Mayer, S. Vey), China (E. Dongchen), Malaysia (Z.Abdul Rashid)

### **Activities:**

1. Monitor the impact of atmosphere variability (troposphere and ionosphere) on Antarctic GPS observations
2. Collect and enhance accessibility to all available GPS-relevant atmosphere parameters and observations (P, T, e, radio soundings.....) performed near GPS sites
3. Evaluate affects of severe ionospheric disturbances and relationship to quality and quantity of data obtained with variety of dual frequency receivers
4. Obtain data for analysis from observations with receivers capable of using the new L2C civil code signal (launch of first satellite scheduled in March 2005).
5. Facilitate access to GPS observations from permanent GPS sites and SCAR GPS epoch campaign for computation of atmospheric delay to GPS signals.
6. Evaluate tropospheric models, accuracy of models and relationship to height of station.
7. Prepare for a routinely GPS estimated IPWV content for climatological applications
8. Enhance cooperation between geodesists and atmospheric physicists
9. Organize special standard data sets (website) for exchange and evaluation accuracy by researchers.
10. Review existing research and relevance to operation of GNSS receivers in Polar Regions.
11. Develop recommendations for future GNSS observations to minimize impact on high accuracy geodetic surveys.

## **7. Ground Truthing for Satellite Missions**

**Project Leader:** Germany - [Prof Reinhard Dietrich](#)

**Project Co-Leader:** USA - Bea Szatho

### **Activities:**

1. To identify and report on new satellite missions that will provide geodetic data or require geodetic support (eg. ICESAT, CryoSat, Envisat)
2. Coordinate ground truthing campaigns in Antarctica with other known researchers
3. Liaison with satellite mission principal investigators and ANTEC
4. Facilitate the transfer of satellite mission data to the Antarctic community

## **8. Geodetic Advice on positioning limits of special areas in Antarctica**

**Project Leader:** Chile – Tchl. Jorge Perez

### **Activities:**

1. Research how limits are described for protected areas and the accuracy of the coordinates
2. Identify difficulties / problems related to coordinates
3. Validate methodology established for the project (including field testing of RTK techniques)



4. Continue linkages with SCAR Antarctic Treaty group, CEP and other relevant groups
5. Develop guidelines for surveying and describing limits (SCAR XXIX)

[In Chile a Project Group consisting of [Mr Juan Carlos Montero](#), [Miss Wendy Rubio](#) and [Mr Edwin Hunt](#), being lead by Tchl. Rodrigo Maturana has been set up.]

### **9. In situ GNSS Antenna Tests and Validation of Phase Centre Calibration Data**

**Project Leader:** USA - Larry Hothem

**Project Co-Leader:** Poland - [Jan Cisak](#)

**Collaborators:** Australia (G. Johnston), USA (D. Brzezinska), Germany, Italy (L. Vittuari)

#### **Activities:**

1. Conduct testing and validation studies that support millimetre-level measurements in application of GNSS positioning technologies in Antarctica
2. Validate elevation-dependent antenna phase centre corrections; data includes, but is not limited to IGS phase eccentric data (antenna calibration measurements performed by Geosciences Laboratory/NGS/NOAA <http://www.ngs.noaa.gov/ANTCAL/> ), GEO++ absolute phase corrections for GNSS antennas <http://gnpcvdb.geopp.de/>
3. Establish in situ test sites in Antarctica; test data obtained at non-Antarctica test network sites may be used in analysis.
4. GNSS antennas should include all existing and new models deployed in Antarctica, such as the Dorne Margolin choke ring models, Trimble Zephyr, NovAtel GPS 702 (pinwheel design), etc.
5. Investigators process data with at least two independently developed software optimised for study objectives;
6. Facilitate exchange of standard test data sets between collaborators; coordinate adoption of standard parameters and software processing procedures (e.g. processing mask angle, data sampling rate, ephemeris, etc.)
7. Consider factors that could affect the solution results: with and without radomes, satellite geometry, multipath effects, effect of snow and/or moisture accumulation on antennas, etc.
8. Publish details on antennas tested, test results, and comparisons; post at SCAR/GSSG website
9. Prepare recommended procedures for antenna testing and phase centre calibration studies for Antarctic application
10. Develop list of related web links and include in the GIANT page

### **10. High Accuracy Surface Change and DEM's from Satellite and Airborne Imagery**

**Project Leader:** China – Prof E Dongchen

**Project Co-Leaders:** Australia – Dr Lin Lin Ge, John Manning

#### **Activities:**

1. Undertake research for the generation of high accuracy DEM's over limited areas
2. Test techniques on ice and snow for repeatability and for surface displacement
3. Evaluate application to sensitive rock and snow areas such as Larsemann Hills and special protected areas

4. Conduct research into using high accuracy DEM's in the monitoring of aircraft landing sites
5. Use DEM for other altimeter satellite mission (eg. ICESAT, GLAS)

## **11. High Accuracy Kinematic GPS Positioning**

**Project Leader:** UK – Matt King

**Collaborators:** Australia (G. Johnston), Germany, Italy, China, USA (L. Hothem)

### **Activities:**

1. Support airborne geophysical and photogrammetric surveys with precise positioning
2. Study iceshelf dynamics for tidal investigation
3. Develop technique for surface profile surveys
4. Evaluate accuracy estimates and perform comparison of different software and methods

## **New Expert Groups**

### **Expert Group on Permafrost and Periglacial Environments (EGPPE)**

#### *Expert group organisation*

**Chief Officer:** Jan Boelhouwers, Uppsala University, Sweden

**Deputy\*:** Jim Bockheim, University of Wisconsin, United States

Mauro Guguelmin, University Insubria, Varese, Italy

**Secretary:** Megan Balks, Department of Earth Sciences (chairperson), University Waikato, Hamilton, New Zealand

\* Two Deputy Chief Officers are identified because of the expected heavy workload associated with this expert group.

#### *Summary*

Neither the Science Committee for Antarctic Research (SCAR) nor the International Permafrost Association (IPA) effectively reach the entire Antarctic permafrost community. Given the important role played by permafrost and periglacial activity in Antarctic landscape dynamics, weathering, soil biogeochemical processes and biodiversity, and human activities (e.g. construction, disturbance, contaminant behaviour) there is a need to bring both groups together under the auspices of a single and expanded working group. Thus the main recommendation of the Permafrost Action Group (PAG) is the creation of a SCAR Expert Group on Permafrost and Periglacial Environments (EGPPE). This expert group will report to the Standing Science Group on Geoscience but has the added value of involving experts from both the Life and Physical Science SSGs. It will also have direct links with the IUGS International Permafrost Association, the WCRP CliC Programme, WMOs GTOS Programme and IPY.

#### *Background and Rational*

Permafrost and periglacial environments are key elements of the Earth's cryosphere and are highly sensitive systems subject to disturbance by human activity and climate change. These systems are an expression of the interaction between Antarctica's cold climate and geology, and operate on time scales ranging from minutes and seconds to millions of years. The role of permafrost areas in Earth system dynamics and the bi-

polar linkages between permafrost environments are still very poorly understood. In contrast with the Arctic, information about the permafrost and periglacial conditions of Antarctica and the sub-Antarctic islands is limited and generally sporadic in coverage. However, from the limited information it is clear that permafrost and periglacial processes have played, and continue to play, an important role in the evolution of Antarctic and Sub-Antarctic ice-free landscapes and areas beneath cold-based glacier ice. Several aspects of Antarctic permafrost are unique and different from the northern hemisphere. For example, in some places Antarctic permafrost is much older than anywhere else on Earth, there are also extensive areas of dry permafrost, active layers are often thin, soils have high salinities, and the intensity of mechanical weathering is high. The cold, dry nature of Antarctic landscapes provides valuable analogues for planetary exploration and astrobiological studies. The proposed expert group will approach the Antarctic permafrost and periglacial environment as a multidimensional and multidisciplinary system and will therefore be comprised of a multi-disciplinary team. It is noteworthy that the permafrost session at the 2004 SCAR Open Science Conference was attended by 40+ persons.

#### *Group aims*

The overarching aim of this expert group is to raise the profile of Antarctic permafrost science within the SCAR community and to provide SCAR with a stronger information base about the role of permafrost in the Antarctic Environment. Specific aims include:

- To provide coordination, communication and exchange of data amongst Antarctic permafrost researchers within SCAR and IPA and promote interaction and collaboration with SCAR and IPA working groups.
- To collect and collate spatial data on permafrost and cryosols and contribute to databases for Antarctic soils, permafrost and ground ice conditions including the active layer.
- To develop and promote monitoring/observation protocols and networks (CALM, GTN-P, periglacial processes).
- To promote international cooperation and facilitate collaborative field research.
- To address science questions pertaining to: (a) the age and history of Antarctic permafrost, landscape dynamics and evolution (including erosion, ground ice formation, patterned ground), (b) the impact of climate change on permafrost, (c) physical and chemical weathering, (d) active layer processes along environmental gradients, (e) the role of permafrost and frost action in Antarctic biodiversity and soil ecology, (f) research methods (e.g. geophysics and terrestrial drilling), (g) impact of human activity on permafrost (including the behaviour of contaminants), and (h) astrobiology and planetary analogues.

#### *Work plan and outputs*

This expert group will be active for a period of four to six years; with a review planned for the SCAR meeting in 2008. During this period the group will hold several meetings, the first dedicated meeting has already been organised (Antarctic Permafrost and Soils Workshop, November 15-18, 2004 at the University of Wisconsin convened by Jim Bockheim). In addition it will sponsor several sessions at professional meetings, including:

- CliC-IASC China – April 2005
- EUCOP II Potsdam June 2005
- IAG Zaragoza Spain 2005

- ICARP II, Copenhagen - November 2005
- IPA Regional Conference, China, Lanzhou - 2006
- INQUA Australia 2007
- ICOP (IPA) Fairbanks, USA - June 2008
- ISAES 2007 USA
- SCAR 2006 Hobart

The expert group will also:

- Prepare white paper on the State of Antarctic Permafrost Science
- Prepare a map showing permafrost and ground ice features in the southern circumpolar region
- Prepare maps showing soils of the southern circumpolar region
- Prepare a permafrost database with information permafrost distribution, depth , properties (active layer, temperatures, ground ice)
- Maintain an updateable online bibliography and researcher directory

Duration        Four-six years (2004-2010) and a review scheduled for 2008

## **Expert Group on the new International Bathymetric Chart of the Southern Ocean (IBCSO)**

Convener: Hans Werner-Schenke

*Background:* The topography of the Southern Ocean surrounding Antarctica is still largely unknown. Sea floor topographic maps are important for many areas of research and for safe navigation. The survey activities of modern icebreaking vessels during the last decade using multibeam systems have increased the data availability, making it possible for compilations of new bathymetric charts around Antarctica.

### *Terms of References*

The Expert Group on the new International Bathymetric Chart of the Southern Ocean (IBCSO) will develop new compilations of bathymetric data. The work plan for the proposed IBCSO may be summarized with the following steps:

1. Building and maintaining of a thorough data base, comprising
  - all available bathymetric and sidescan data and its meta information
  - existing digital bathymetric charts
  - existing marine gravity data, and free-air gravity models from satellite RA
2. Quality control and assessment, analysis and editing of available bathymetric data
3. Development of a new method for morphological interpolation of bathymetric contours using sonar data and satellite radar altimetry gravity anomalies
4. Determination of Digital Terrain Models around Antarctica. One with a resolution of 2.5 x 2.5 km on a Southern Polar Stereographic projection for minimal distortion due to the southerly latitude and one geographic grid with a resolution of 1'x1' that easily can be merged with other global ocean topography products
5. Creation of a set of 1:1 Million traditional bathymetry sheets in digital form
6. In areas of systematic areal multibeam surveys large scale bathymetric charts will be prepared.

The IBCSO shall be developed under the auspices and umbrella of the intergovernmental and international organisations IOC, IHO, and SCAR. The following organisations have been contacted in order to set up the IBCSO into an official frame:

1. IOC Consultative Group on Ocean Mapping (Chairman: Guenter Giermann)
2. IHO Hydrographic Commission on Antarctica (Chairman: Captain Hugo M Gorziglia)
3. SCAR –GSSG as Group of Specialists

Workplan:

2004: Formation of a WG, prior to the establishment of an Editorial Board  
Liaison with IHO Hydrographic Committee on Antarctica, 4. HCA Sept. 04, Greece

Active data search and acquisition at AWI

Establishment of a data archiving strategy

2005: Preparation of proposal to IOC GA 2005 in Paris, formal approval by IOC  
CGOM Meeting in Monaco April 2005, IBCSO as part of the IOC OM

Program

GEBCO Meeting in June 2005, Mexico, Collaboration with GEBCO

Participation at the IAG in Cairns, AGS 05, incl. 1<sup>st</sup> EB Meeting for IBCSO

2006: SCAR Conference in Hobart, Report to GSSG

2<sup>nd</sup> Editorial Board Meeting

GEBCO GC

HCA –Meeting.

More than 20 countries have expressed their interest in participating in IBCSO.

A first product in form of a DEM will be most probably available in 2006.

New Zealand	Vaughan, Fred Davey
Australia	Phil O'Brian, Hank Broolsma, Howard Stagg
China	Dongchen
Japan	Kazuo Shibuya, Shin Tani
Korea	
India	Panday,
South Africa	HO
Italy	Uni Trieste
Great Britain	Larter, Livermore, Morris
France	Moussat
Spain	Canals, Maldonado
Germany	Schenke
Norway	Sand
Russia	Udintsev, Leitschenko, HDNO
Ukraine	Greku
Chile	HO, Vicuna
Argentina	HO,
Uruguay	Roldos
Brazil	IPY
United States	Haxby, Cherkis, Divins, Newton, MacGillivray
Canada	Macnab, Taylor

## **Antarctic Digital Magnetic Anomaly Project (ADMAP)**

*Convenor:* Marta Ghidella

### *Background:*

The ADMAP multinational project was created in 1995 under the auspices of SCAR and IAGA (International Association of Geomagnetism and Aeronomy). It operated during several years working on the compilation of the Antarctic magnetic anomaly data.

The latest results of ADMAP have been the publication a map and the production a special issue of *Tectonophysics* with related papers (Magnetic Anomalies of the Antarctic, Vol. 347, 2002). The map, in digital form, as well as the corresponding grid, are available from the Internet at [www.geology.ohio-state.edu/geophys/admap](http://www.geology.ohio-state.edu/geophys/admap). The ADMAP group now intends to become an Expert Group with the major objective of maintaining the data base and making it a permanent tool available to the scientific community.

### *Terms of reference:*

Understanding the magnetic anomaly field of the Earth's crust is of fundamental importance for understanding geological processes. Considering that numerous magnetic surveys have been carried out by various institutions, the ADMAP group aims to produce a coordinated effort for:

- Compiling the existing magnetic data acquired by various institutions
- Coordinating protocols for data distribution
- Serve as a reference for future survey planning
- Archiving and maintaining the magnetic anomaly data base of Antarctica

### *Work plan:*

#### *a) Short term*

Production of a CD-ROM of the ADMAP grids and related surveys for release to the public through the World Data Centers. The CD will include the magnetic line data, metadata, and the already released grid, as well as documentation and graphical guidelines for survey location. This will be finished before the end of 2004 and released to the World Data Centers before June 2005.

Completing this objective requires roughly a month of dedicated effort by one or two Expert Group members and the meeting of the full Expert Group. The meeting is necessary to endorse the CD's release to the World Data Centers (WCDs) and renew ADMAP's protocols for maintaining and updating the database. The meeting is also necessary to plan ADMAP's contributions for the International Polar Year. In addition, new initiatives for the Group members will be considered, including the recent effort by the Italian, US, and other national Antarctic programs to launch

the next generation of ADMAP. Since 2002, the Working Group has expended considerable time and effort on this ongoing initiative that will allow ADMAP to serve Antarctic geomagnetic studies into the IPY and beyond.

*b) Longer term*

1. Implementation of ADMAP's protocols to maintain and update the database with new airborne and shipborne magnetic survey data and related metadata as they become available.
2. Updating the near-surface anomaly predictions from Magsat in the ADMAP database with the significantly more accurate observations from the Ørsted and CHAMP satellite missions. In the longer run, it is also considered to incorporate magnetic gradient measurements that will become available towards the end of the current decade from ESA's recently authorized multi-satellite SWARM mission. These observations will greatly improve crustal anomaly detail at satellite altitudes since one of the mission's main objectives is to model the polar external fields.
3. Development of improved modeling of the Antarctic core field and its secular variations, and external fields for better definition of the crustal anomalies in magnetic survey data.
4. Compilation of rock magnetic and other physical properties into a database to support geological applications of the ADMAP data.
5. Development and promoting regional and continental scale interpretation efforts of the ADMAP data. This will provide new insight into global tectonic and geologic processes in the Antarctic context. New data and interpretations will also enhance studies addressing interplays between geological boundary conditions, Antarctic ice sheets and climate change. Finally, these efforts will also greatly assist in identifying high-priority areas for new collaborative magnetic surveys.
6. Expanding collaborative efforts with Arctic working groups for more bi-polar magnetic exploration and research.
7. Providing a broad collaborative framework for new frontiers in the magnetic exploration of the polar regions, such as by long-range aircraft and UAVs.

The list of current ADMAP members is at the Geoscience SSG web site, [www.geoscience.scar.org/admap/](http://www.geoscience.scar.org/admap/)

## **ANTEC: Antarctic Neotectonics Expert Group**

*Convener:* Terry Wilson, Ohio State University, USA

*Background:* ANTEC was approved by SCAR in 1998 at the meeting in Chile. The group was appointed by the executive in 1999. ANTEC thematic symposia have been held each year at international meetings (European Geophysical Society; European Union Geology; American Geophysical Union); a major science planning workshop was held in 2001; and poster sessions and workshops have been convened at SCAR meetings in 2002 and 2004. Given the existence of ANTEC for some years, the GSSG

thought it appropriate that ANTEC continue as an Expert Group for another 2 years in its present form rather than be further developed as a Program.

*Terms of Reference:* The ANTEC group promotes and coordinates multidisciplinary, multinational research relevant to Antarctic neotectonics. The main roles of ANTEC include 1) coordinate an implementation plan for deployment of geodetic and seismological stations in Antarctica; 2) encourage coordinated geophysical and geological work to complement station deployments; 3) ensure that protocols for data collection, archiving and distribution are meeting the needs of the international research community; 4) Promote scientific research opportunities and promising directions in neotectonics and geodynamics of Antarctica by holding workshops and symposia; 4) liaise with international research programmes with complimentary scientific aims to ANTEC.

*Activities and Accomplishments, 2002-2004:*

## **1. Symposia**

2003:

- April, 2003: EUG-EGS-AGU, Nice, France: *Glacio-Isostasy and Neotectonics*
- September, 2003: ISAES, Potsdam, Germany: *Neotectonics - the SCAR ANTEC Programme*

2004:

- April, 2004: AGU-CGU, Montreal [Co-Convened]: *Observations of Glacial Isostatic Adjustment and Contemporary Ice-Ocean-Mantle Mass Redistribution*
- July, 2004: XXVIII SCAR, Bremen, Germany: *Antarctic Neotectonics and Geodesy*

## **2. Workshops**

2003:

- March, 2003: Boulder, USA: Major participation in Workshop “Structure and Evolution of the Antarctic Plate”, sponsored by U.S. National Science Foundation

2004:

- July, 2004: XXVIII SCAR - Bremen, Germany: Enabling technologies for remote geophysical observatories: status and requirements for continent-wide deployments
- September, 2004: Boulder, USA: Participation in US-NSF-sponsored workshop on Planning for Remote GPS Observatories

## **3. Meetings of ANTEC Group:**

- **2003: EGU-AGU, Nice**
- **2003: ISAES, Potsdam**
- 2004: SCAR Meeting, Bremen



#### **4. Web Resources Developed:**

- AnSWeR - Antarctic Seismology Web Resource:  
<http://www.rses.anu.edu.au/seismology/answer/>  
Coordinator: Dr. Anya Reading, Australian National University
- ANTEC site: <http://www.antecc.scar.org/>

#### **5. Publications**

##### ***Special Volume- Global and Planetary Change (Vol. 42, July, 2004): Ice Sheets and Neotectonics***

Editors: T. James, J. Jacka, R. Dietrich, A. Morelli

This full-volume issue contains 21 papers addressing aspects of ice mass change and ice dynamics, neotectonics and interplay with ice sheets. The papers represent contributions to symposia sponsored by ANTEC, and jointly by ANTEC and the ISMASS action group of the Physical Sciences SSG.

*Activities Planned: August, 2004 – July, 2006*

##### **1. Symposia**

2004:

- December, 2004: AGU, San Francisco, USA : *Lithospheric Structure and Neotectonics of the Antarctic Plate*

2005 [in planning]:

- *August 8-11, 2005, Calgary, Alberta, Canada, Earth System Processes II [GSA sponsored]* : Geodynamics, Ice Sheets & Climate

2006 [in planning]:

- Thematic symposium to be held either at EGU, April, 2006, Vienna; *or* at AGU, May, 2006, New Orleans.

##### **2. Workshops in Planning**

2005:

- Autonomous remote observatories for IPY  
Coordinators: R. Dietrich, A. Reading, T. Wilson

This will be the major workshop to finalize a science and implementation plan for deployment of a network of remote autonomous observatories for the International Polar Year. It is tentatively planned to be held in conjunction with a joint IRIS-UNAVCO meeting, including a planned Polar session, in Washington state.

2006 :

- Advances in Crustal Deformation Modeling  
Coordinator: Tom James

To include methods to incorporate lateral heterogeneity for application to Antarctica

- Review of technologies for autonomous remote observatories, SCAR meeting in Hobart, mid-2006.

### *3. Additional Projects for 2004-2006*

- Airborne Mapping Task Group

Coordinators: Beata Csatho and Ralph von Frese

Goal of this activity is to encourage development of coordinated international airborne campaigns over Antarctic regions that are promising targets for neotectonic research.

- Compilation of Cenozoic Faults – Planning Group

Coordinators: Jesus Galindo-Zaldivar (Scotia Arc region); Christine Siddoway (Ross Sea Region)

Goal of this activity is to establish appropriate protocols for producing digital compilations of faults for the two Antarctic regions where sufficient information exists for such an effort. Input data will include field data, marine geophysical data, seismicity data, and other geophysical data.

- Outreach and Communications Task Group

Coordinators: Alessandro Capra, John Manning & Anya Reading

Goal of this activity is to compile information on upcoming meetings, a national correspondent list for ANTEC research, sources of information for ANTEC research, and compilation of metadata on existing observatories and research efforts underway providing data on neotectonic research. These materials will augment the existing ANTEC and ANSWER (Antarctic Seismology Web Resource) web sites.

- Technological Information Resources (Joint with GIANT group)

Coordinator: Larry Hothem

Goal of this activity is to compile a web-based resource of information on technological components required for autonomous remote observatories and also to compile success/failure experience of researchers with these components.

- Other projects under discussion for development are:

- Integration of data sets to study neotectonics of selected regions (compilation effort)
- Compilation of modern-day stress data
- Joint effort with a subset of the Physical Sciences SG (ISMASS and possibly others) to develop an updated ice sheet history for Antarctica

### *4. Proposed Meetings of ANTEC Group:*

2004: AGU, San Francisco, USA

2005: Autonomous Remote Observatories Workshop, Washington, USA

2005: August 8-11, **Earth System Processes II**, Calgary, Canada [tentative]

2006: XXIX SCAR, Hobart, Australia

### **10. Office Bearers 2004-2006:**

The Chief Officer, of the GSSG, Philip O'Brien, informed the meeting that he was standing down from the post for work and personal reasons. The full meeting of the SSG voted to install Prof Alessandro Capra of Italy as Chief Officer and for Prof Ross Powell to replace Prof Capra as Deputy Chief Officer.

**Chief Officer: Prof Alessandro Capra** - Department Distart University of Bologna Viale Risorgimento 2 40136 – BOLOGNA, ITALY.

**Deputy Chief Officer: Prof. Ross D Powell** - Department of Geology & Environmental Geosciences, Northern Illinois University, 312 Davis Hall, Normal Road, Dekalb Illinois 60115, UNITED STATES

**Secretary: Prof. Bryan Storey** - Director, Gateway Antarctica, University of Canterbury, Private Bag 4800, Christchurch, NEW ZEALAND

#### 11. Proposed Budget

<b>GSSG Funding Bids</b>		
<b>Project</b>	<b>Bid 2005</b>	<b>Bid 2006</b>
Cyberatlas meeting	3000	3000
Place names	2000	2000
Ant. Digital Database	3000	3000
Communication & outreach	1000	1000
ADMAP	8000	8000
IPY Initiatives	8000	
Atmospheric impacts on GNSS	2000	2000
ISO TC211 representation	2000	2000
ANTEC (Transfer from 2004)	10000	10000
Antarctic GIS workshop	8000	
GNSS Antenna calibration	500	500
IBSCO	4000	4000
High accuracy DEMs	2500	2500
	54000	38000

### **12. Office Bearers 2002-2004**

Chief Officer: Dr Philip E O'Brien, Division of Petroleum and Marine Geoscience, Geoscience Australia. Canberra Australia.

Deputy Chief Officer: Prof Alessandro Capra - Department Distart University of Bologna, ITALY.

Secretary: Prof. Bryan Storey - Director, Gateway Antarctica, University of Canterbury, Christchurch, **NEW ZEALAND**

### 13. Members 2002-2004

Country	Member	Address	Email
Argentina	Dr Rudy del Valle	Instituto Antártico Argentino Cerrito 1248 1010 Buenos Aires	delvalle@dna.gov.ar
	Dr Marta Ghidella	Instituto Antártico Argentino Cerrito 1248 1010 Buenos Aires	mghidella@dna.gov.ar
	Ing Federico Mayer	Servicio de Hidrografía Naval Avenida Montes de Oca 2124 1271 Buenos Aires	shn@hidro.gov.ar
Australia	Prof C J L Wilson	University of Melbourne School of Earth Sciences Parkville Victoria 3052	cjlw@unimelb.edu.au
	Dr Philip E O'Brien	Antarctic CRC Project Petroleum and Marine Division, Geoscience Australia, PO Box 378, Canberra, ACT 2600.	phil.o'brien@ga.gov.au
	Mr John Manning	Unit 8, 1 Queen Street Cooks Hill Newcastle NSW2300	j.manning@unsw.edu.au
	Mr Henk Brolsma	Australian Antarctic Division Channel Highway Kingston Tasmania 7051	henk.brolsma@aad.gov.au
Belgium	Dr Tony Van Autenboer	Limburgs Universitair Centrum Toegepaste Geologie Universitaire Campus B-3590 Diepenbeek	slimvzw@freegates.be
	Dr Jozef Hus	Institute Royal Météorologique Centre de Physique du Globe B-5670 Dourbes	jhus@oma.be

	Prof Hugo Declair	Vrije Universiteit Brussel Geografisch Instituut Pleinlaan 2 B-1050 Brussels	hdeclair@vub.ac.be
<b>Brazil</b>	Dr Rudolf A J Trouw	Universidade Federal do Rio de Janeiro Rua Sao Manuel 23 apt 801 Botafogo Rio de Janeiro 22290-010	trouw@igeo.ufrj.br
	Dr J M Souza	Petrobras Av. Rep. do Chile 65 S/1001 20035-900 Rio de Janeiro - RJ	
	Dr Tania Brito	Programa Nacional de Areas Protegidas Secretaria de Biodiversidade e Florestas Ministerio de Meio Ambiente - MMA Esplanada dos Ministerios Bloco B Sala 701-A 70068-90 BRASILIA-DF	tania.brito@mma.gov.br
<b>Canada</b>	Prof Wayne Pollard	McGill University Department of Geography 805 Sherbrooke Street Montreal QC H3A 2K6	pollard@geog.mcgill.ca
	Prof Fraser Taylor	Geomatics and Cartographic Research Centre Department of Geography Carleton University 1125 Colonel By Drive Ottawa, Ontario K1S 5B6	fraser_taylor@ccs.carleton.ca
<b>Chile</b>	Prof FA (Pancho) Hervé	Universidad de Chile Departamento de Geología Facultad de Ciencias Físicas y Matemáticas Casilla 13518, Correo 21 Santiago	Fherve@tamarugo.cec.uchile.cl
	Dr E Vera	Universidad de Chile Depto. de Geofísica Fac. Ciencias Físicas y Matemáticas Casilla 2777, Correo Central Santiago	evera@dgf.uchile.cl
	Tnt. Col. Rodrigo Barriga	Jefe Departamento de Investigación y Desarrollo Instituto Geográfico Militar (IGM) Nueva Santa Isabel 1640 Santiago	rbarriga@igm.cl

<b>China</b>	Prof L (Xiaohan) Liu	Chinese Academy of Sciences Institute of Geology and Geophysics PO Box 9825 Beijing 100029	xhliu@public3.bta.net.cn
	Dr Q Yan	Polar Research Inst. of China 451-481 Shang Chuan Road Pudong Shanghai 299129	pricsh@online.sh.cn
	Prof E Dongchen	Chinese Antarctic Centre of Surveying and Mapping Wuhan University 39 Loyu Road Wuhan 430079 Hu Bei	edc1939@public.wh.hb.cn
<b>Ecuador</b>	Capt Ulises Iñiguez Carrión	Armada del Ecuador Instituto Oceanográfico (INOCAR) Avenida 25 de Julio - Base Naval Sur Via Puerto Marítimo PO Box 5940 Guayaquil	inocar@inocar.mil.ec
<b>Finland</b>	Dr Tapio Ruotoistenmäki	Geological Survey of Finland Betonimiehenkuja 4 FIN-02150 Espoo	tapio.ruotoistenmäki@gsf.fi
	Dr Kari O Strand	University of Oulu Thule Institute PO Box 7300 FIN-90401 Oulu	kari.strand@oulu.fi
	Lic Jaakko Mäkinen	Finnish Geodetic Institute Geodeetinrinne 2 PO Box 15 FIN-02431 Masala	Jaakko.Makinen@fgi.fi
<b>France</b>	Dr Jean-Robert Petit	Université Joseph Fourier LGGE 54 rue Molière BP 96 38402 St Martin D-Heres Cedex	petit@glaciog.ujf-grenoble.fr
	Martine Amalvict	EOST 5 rue René Descartes 67084 Strasbourg Cedex	martine.amalvict@eost.u-strasbg.fr
	Jean-Jacques Leveque	EOST 5 rue René Descartes 67084 Strasbourg Cedex	jeanjacques.leveque@eost.u-strasbg.fr

	René-Pierre Menot	Université Jean Monet Département de Géologie- Pétrologie-Géochimie 23 rue du Dr Paul Michelon 42023 Saint-Etienne Cedex2	Rene.Pierre.menot@univ-st- etienne.fr
<b>Germany</b>	Prof Dr Hubert Miller	Institut für Allgemeine und Angewandte Geologie der Universität Luisenstrasse 37/1 D80333 Munchen	hubert.miller@iaag.geo.uni- muenchen.de
	Prof. Dr. Reinhard Dietrich	Technische Universität Dresden Institut für Planetare Geodäsie DE-01062 Dresden	Dietrich@ipg.geo.tu-dresden.de
	Dr Detlef Damaske	Bundesanstalt Für Geowissenschaften und Rohstoff Stilleweg 2 D-3000 Hanover 51	d.damaske@dgr.de
<b>India</b>	Dr H K Gupta	National Geophysical Research Institute Uppal Road Hyderabad 500007	info@ngri.res.in
	Shri D P Issar	Survey of India Research and Geodetic Branch Karanpur PO Box No. 77 Dehradun 248001 (UP)	gandrb@nde.vsnl.net.in
<b>Italy</b>	Prof Carlo Alberto Ricci	Universita di Siena Dipartimento di Scienze della Terra Via del Laterino 8 53100 Siena	riccica@unisi.it
	Dr Antonio Meloni	Istituto Nazionale di Geofisica Via di Vigna Murata, 605 I-00143 Roma	meloni@ingv.it
	Prof Roberto Cervellati	ENEA -Progetto Antartide Via Anguillarese 301 S. Maria di Galeria Roma 00600	roberto.cervellati@casaccia.enea.it
	Prof Alessandro Capra	University of Bologna Department Distart Viale Risorgimento 2 40136 Bologna	alessandro.capra@mail.ing.unibo.it

<b>Japan</b>	Dr Kazuyuki Shiraishi	National Institute of Polar Research Department of Crustal Studies 9-10 Kaga 1-chome Itabashi-ku Tokyo 173-8515	shiraishi@nipr.ac.jp
	Dr Kazuo Shibuya	National Institute of Polar Research (NIPR) Center for Antarctic Environment Monitoring 9-10, Kaga 1-chome Itabashi-ku Tokyo 173-8515	shibuya@nipr.ac.jp
	Mr Minoru Akiyama	Geographical Survey Institute (GSI) Planning Department Kitasato 1 Tsukuba-shi Ibaraki 305-0811	intex.gsi.go.jp
<b>Korea</b>	Dr Soon-Keun Chang	KORDI - Korean Ocean Research & Development Institute Polar Sciences Laboratory Ansan PO Box 29 Seoul 425-600	skchang@kordi.re.kr
	Dr Yea-Dong Kim	KORDI - Korean Ocean Research & Development Institute Polar Sciences Laboratory Ansan, PO Box 29 Seoul 425-600	ydkim@kordi.re.kr
	Dr Moon Young Choe	KORDI - Korean Ocean Research & Development Institute Polar Sciences Laboratory Ansan, PO Box 29 Seoul 425-600	mychoe@kordi.re.kr
<b>Netherlands</b>			
<b>New Zealand</b>	Prof Peter J Barrett	Victoria University of Wellington School of Earth Sciences PO Box 600 Wellington	peter.barrett@vuw.ac.nz
	Dr Fred J Davey	Institute of Geological and Nuclear Sciences PO Box 30368 Lower Hutt	f.davey@gns.cri.nz



	Mr Tony Bevin	Land Information New Zealand Private Box 5501 Wellington	tbevin@linz.govt.nz
	Prof Bryan Storey	University of Canterbury Gateway Antarctica Private Bag 4800 Christchurch	bryan.storey@canterbury.ac.nz
<b>Norway</b>	Prof Yngve Kristoffersen	University of Bergen Institute of Solid Earth Physics N-5007 Bergen	yngve.kristoffersen@ifjf.uib.no
	Dr Synnøve Elvevold	Norsk Polarinstitutt Polarmiljøsentret N-9296 Tromsø	elvevold@npolar.no
	Mr Yngve Melvar	Norsk Polarinstitutt (Geodesy and Geographical Information) Polarmiljøsentret N-9296 Tromsø	yngve.melvaer@npolar.no
<b>Peru</b>			
<b>Poland</b>	Prof Dr Aleksander Guterch	Polish Academy of Sciences Institute of Geophysics ul Ksiecia Janusza 64 P:-01-452 Warszawa	aguterch@igf.edu.pl
	Prof Dr Andrzej Gazdzicki	Polish Academy of Sciences Institute of Palaeobiology Twarda 51/55 00-818 Warszawa	gazdzick@twarda.pan.pl
	Dr Jan Cisak	Instytut Geodezji I Kartografii ul Jasna 2/4 00-950 Warszawa	astro@igik.edu.pl
<b>Russia</b>	Dr Eugene Mikhalsky	VNII Okeangeologia Angliyski Street 1 St Petersburg 90121	mikha@em5609.spb.edu
	Dr German Leitchenkov	VNII Okeangeologia (Antarctic Branch) 1 Angliysky Av. 190121 St Petersburg	ant@g-ocean.spb.ru
	Dr Alexander Yuskevitch	FSUE - Aerogeodeziya 6 Bukharestskaja Street 192102 St Petersburg	aerogeod@agsbp.ru
<b>South Africa</b>	Prof Steve McCourt	University of Durban-Westville Department of Geology Private Bag X54001 Durban 4000	smccourt@pixie.udw.ac.za

	Mr Richard Wonnacott	Department of Land Affairs Directorate of Surveys and Mapping Private Bag X10 Mowbray 7705	rwonnacott@sli.wcape.gov.za
<b>Spain</b>	Dr Miquel Canals Artigas	Dpt.Estratigrafía y Paleontología Facultad de Geología Universidad de Barcelona E-08071 Barcelona	miquel@natura.geo.ub.es
	Dr Jesús Galindo-Zaldivar	Dpto. Geodinámica Facultad de Ciencias Universidad de Granada E-18071 Granada	jgalindo@ugr.es
	Dr Carlos Sanz de Galdeano	Universidad de Granada Instituto Andaluz de Ciencias de la Tierra Facultad de Ciencias 18002 Granada	csanz@goliat.ugr.es
<b>Sweden</b>	Prof Kent Larsson	Lund Universitet Geologiska Institutionen Solvegatan 13 S-223 62 Lund	kent.larsson@geol.lu.se
	Prof Lars Sjöberg	Royal Institute of Technology Department of Geodesy and Photogrammetry SE-10044 Stockholm	sjoberg@geomatics.kth.se
<b>United Kingdom</b>			
<b>United States of America</b>	Dr Ross D Powell	Department of Geology & Environmental Geoscience Northern Illinois University 312 Davis Hall, Normal Road DeKalb Illinois 60115	ross@geol.niu.edu
	Dr Robin D Bell	Lamont-Doherty Earth Observatory Columbia University Route 9 West Palisades NY 10964	robinb@ldeo.columbia.edu
	Dr Beata Csatho	Byrd Polar Research Centre Ohio State University 275a Scott Hall 1090 Carmack Road Columbus, OH 43210	csatho.1@osu.edu
	Dr Amy Leventer	Colgate University 13 Oak Drive Hamilton, NY 13346	aleventer@mail.colgate.edu

**Uruguay**

Major J  
Melconian

Instituto Antártico  
Uruguayo  
Avenida 8 de Octubre 2958  
PO Box 6051  
Montevideo CP 11600

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antartic@iau.gub.uy

Major Héctor  
Rovera

Servicio Geográfico Militar  
Av. 8 de Octubre 3255  
CP 11600  
Montevideo

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sgm@iau.gub.uy

## **Appendix 1.**

### **GSSG Initiatives for the International Polar Year**

#### **Executive Summary**

The purpose of this document is to combine a variety of GSSG initiatives for the International Polar Year (IPY 2007-08) into one document. The initiatives have been developed over the past 12 months and during the recent SCAR GSSG Business Meetings in Bremen 2004 and will

- explore new scientific frontiers,
- deepen our understanding of polar processes and global linkages,
- increase our ability to detect change and
- attract and develop the next generation of polar researchers.

They relate specifically to the interactions of the cryosphere, lithosphere and hydrosphere with a focus on climate processes in polar regions. The individual proposals combine research already proposed by two GSSG led SCAR Scientific Programme Planning Groups, Antarctic Climate Evolution (ACE) and Subglacial Lake Exploration (SALE) together with the deployment of remote observatories throughout the Antarctic continent (part of Antarctic Neotectonics ANTEC Expert Group) and the exploration of new scientific frontiers (Gamburtsev Mountains and sub glacial lakes). The Geoscience community will also use the opportunity of IPY to draw together the results of fifty years of polar exploration by publishing a series of bench mark maps and by developing an outreach and education programme that will facilitate the widest possible distribution of polar research to global communities and that will attract the next generation of polar scientists, engineers and logistics experts..

The initiatives directly address all of the themes identified by the ICSU IPY 2007-2008 Planning Group and will leave a legacy of targeted remote observatories that will provide data for generations to come. This document includes the following five initiatives:

- 1. Climate Processes in the Polar Regions on time-scales from decades to millions of years**
- 2. The Gamburtsev Mountains: Exploration of a sub glacial highlands**
- 3. Autonomous Remote Observatories**
- 4. A bench mark map series**
- 5. Outreach and Education: An Antarctic spatial data infrastructure**

Contact Bryan Storey  
Secretary GSSG  
Bryan.storey@canterbury.ac.nz  
12 August 2004

## 1. Climate Processes in the Polar Regions: On Time-scales from Decades to Millions of Years

Polar Regions are more sensitive to climate change than lower latitudes, and understanding the polar response to global warming is becoming increasingly important because the present CO<sub>2</sub> level is already higher than at any time during the last 20 million years (IPCC 3<sup>rd</sup> TAR). The world is already under greater environmental stress than can be found in even the oldest ice core records. This initiative links three geoscience programmes that are designed to include targets that approach the time resolution of ice cores, but extend much further back into the past:

- 1) *Antarctic Climate Evolution*, which is investigating climate and ice sheet behaviour during both cold and warm periods in both the recent and distant past,
- 2) *Bipolar Climate Machinery*, a study of the interplay of northern and southern polar processes in driving and amplifying global climate variability
- 3) *Polar Ocean Gateways*, which investigates the role of changing ocean geometry on climate.

The IPCC is about to begin the development of its 4<sup>th</sup> assessment report on global climate change. The IPY provides a window of opportunity for this project to make a major contribution to the new IPCC report.

### Programme Summary

- **Antarctic Climate Evolution (ACE)**

ACE is an international research programme that aims to understand the interactions of climate and the polar cryosphere in order to resolve global linkages between sea level, oceanic circulation and atmospheric systems. This will involve integration of geological and geophysical databases with ice sheet and climate models in order to understand processes on different time scales, from millions of years to centuries and decades. Important foci include: the fundamental climate transition from a greenhouse to ice house world and the birth and evolution of the Antarctic ice sheet; the scale and rapidity of the response of large ice masses and associated sea ice to climatic forcing, particularly warming; external influences on the Antarctic cryosphere including tectonics, orbital cycles and solar forcing. Outcomes of this programme will provide geological constraints on modeling the future response of the Antarctic ice sheet to climatic change and global consequences.

- **Bipolar Climate Machinery (BIPOMAC)**

BIPOMAC will study the interplay of northern and southern polar processes in driving and amplifying global climate variability as recorded in paleoclimate archives. BIPOMAC will combine: (i) “ground truthing” based on well synchronized northern and southern polar high-resolution (10<sup>2</sup>-10<sup>3</sup> y) palaeoceanographic, palaeolimnological, palaeoatmospheric and continental ice volume/extent records (time window: mid-late Pleistocene climate cycles, Holocene), and (ii) numerical modelling of ice-atmosphere-ocean processes to decipher the complex pathway and timing of climate development, its internal amplification and propagation mechanisms (ice/ocean/atmosphere), and the effect of external forcing (insolation/solar activity). These initiatives will be the basis for the generation of models for realistic estimates

of future climate and sea level development under different anthropogenic impact scenarios. The latter is of major socio-economic relevance in a world of growing human population and increasing coastal area settlement.

- **Polar Ocean Gateways (POG)**

Polar Ocean Gateways is built on the observation that world oceans are primary drivers for the climatic state of the Earth and its global environmental changes as they carry. Exchanges of energy and matter in polar water between the Arctic Ocean, the world oceans, and around Antarctica (Antarctic Circumpolar Current), appear to be the most significant ones in the global circulation. These currents are steered and restricted by seafloor topography, which has been formed by tectonic and magmatic activities. Understanding the development of these polar ocean gateways is essential for understanding the consequences of water mass exchange on the global climate, from long geological time-scales to present. Establishing the detailed histories of the shallow and deep-water seaways will enable a close correlation with palaeo-climate observations collected across the globe. Focussed studies of tectonic, magmatic, sedimentary, biostratigraphic and biological evolutionary processes, as well as investigations of the past and present oceanographic conditions in the polar gateways, will provide the constraints for numerical simulations of palaeo-current systems and palaeo-climate.

### **Proposed Planning Strategy**

The proposed programmes are in various stages of development. Drilling projects are already planned (e.g. ANDRILL) and will yield significant data and results during the IPY period, but other large projects, such as examining the physical and biological processes in polar oceans, will require dedicated ship and air support provided by national operators. The overall goal within each program is to provide high quality data-sets that will provide the necessary constraints for numerical modelling of ice-land-ocean-atmosphere interactions. Individual programmes will generate their own conferences and workshops, but as they proceed joint meetings will become an effective way of disseminating and sharing information. Appropriate venues for such joint meetings will be future SCAR interdisciplinary symposia. In addition the huge data sets that will be generated will be made public available through the information system PANGAEA which is operated by ICSU World Data Center for Marine Environmental Sciences (WDC-MARE) data exchange/storage with PANGAEA data bank.

### **Linkages Among the Programmes and With IPY Themes**

The aims of these three programmes are fundamentally complementary. ACE is focused on long-term Antarctic history with emphasis on high-resolution records from particular time-slices, and to test and evaluate results with other global databases and modelling. POG and BIPOMAC are designed to collect data from both Polar Regions, but each programme focuses on critical time periods and processes with emphasis on global teleconnections and consequences.

The three programmes are further targeted directly at three of the themes identified in the Initial Outline Science Plan prepared by the ICSU Planning Group:

*Theme 2: the acquisition of key data sets necessary to understand factors controlling change in the polar environment.*

*Theme 3: the establishment of a legacy of multidisciplinary observational networks.*

*Theme 4: the launch of internationally coordinated, multidisciplinary expeditions into new scientific frontiers.*

### **Reasons for Running this Programme during IPY**

IPY presents a perfect home to amalgamate international multidisciplinary scientific, technological and logistic expertise for a quantum increase in the present decade for understanding processes in the Polar Regions that impact global climate, sea level and biosphere. Such effort is urgently needed, considering the dramatic environmental changes now being observed e.g. warming of the Antarctic Peninsula and thinning of the arctic sea ice pack. This initiative will contribute to the understanding required for underpinning international mitigation measures currently being negotiated for global climate change.

### **Visibility to Public and Value for Educational Programs**

This project strikes at the heart of public awareness that climate change is causing the melting of glaciers and disintegration of ice shelves. It will help the public understand the fundamental link between Antarctica and the global climate system and their own lives, such as the link with sea level variation and with changes in ocean circulation. The project will be a strong contributor to educational curricula that currently explore themes of climate change, especially by providing a wide range of visual images such as animated computer reconstructions of ice sheet growth and decay.

**Co ordinators:** Ross Powell, Peter Barrett, Karston Gohl

## **2. The Gamburtsev Mountains: Exploration of a sub glacial highlands**

The aim of this initiative is to investigate through satellite imagery, remote sensing and drilling, the subglacial highlands of the Gamburtsev Mountains that are hidden beneath the East Antarctic Ice Sheet using overland traverses, airborne geophysics and ice surface drilling. This is one of the last great challenge on the Antarctic continent and will not happen without the pooling of resources, international collaboration and impetus provided by IPY. It will challenge and capture the imagination of a new generation of Antarctic scientists, provide a legacy for future generations of climatic modelers, and provide ample opportunities for human capacity building and incorporation of scientific personnel from countries not usually involved in polar research. Remote sensing and sampling of the sub-ice landscape in this area is critical for accurate ice flow models and as such links with the climate processes initiative above.

### **Background and rationale**

There is no continent on Earth other than Antarctica that has a huge central mountain range for which an explanation in terms of plate tectonics does not exist. The centre of large continents are generally characterized by eroded remnant landscapes as plate tectonics result in mountain chains along continental margins or, as in the case of the Himalayan mountain chain, along the suture of two collided plates. Antarctica is an exception that contains the subglacial Gamburtsev highlands close to the central most isolated part of the continent. The highlands are closely linked geographically with many subglacial lakes including Lake Vostok and may provide some vital clues to the age and significance of these important features. Apart from providing possible evidence of past tectonic processes such as the amalgamation of Gondwana, the research will provide crucial information on the dynamics of ice build up and demise of the East Antarctic ice sheet at the pole, which in turn dictated past climatic fluctuations and will ultimately control future global change. The East Antarctic Ice Sheet has modulated global sea level since the transition from a greenhouse to an ice house world over 30 million years ago.

### **Key Questions**

- Why are these high mountains situated in the centre of a large plate? What tectonic processes were responsible for their formation? Are they related to the amalgamation of Gondwana at the start of the Phanerozoic Era and the rapid diversification of life forms? Do they represent a hot spot in the Earth's mantle and as such may influence the long term stability of the ice sheet?
- When did the mountains form? Were they present before the formation of the ice sheet and consequently controlled the formation and nucleation of the ice sheet, or did they form after the formation of the ice sheet and may ultimately control the disintegration of the East Antarctic ice sheet?
- What is their link to subglacial lakes?

### **Planning strategy**

1. Airborne and oversnow geophysical observations and surveys, including magnetics, gravity, radio echo soundings and laser altimetry



2. Deployment of geophysical (seismological) observation networks to image the lithospheric structure beneath the highlands
3. Development of drill technologies to sample ice and rock (already close to completion by the Chinese Antarctic programme)
4. Drilling and sampling of the subglacial highlands and new subglacial lakes in areas identified from initial geophysical data

### **Relevance to IPY Goals**

**Theme 4:** *To investigate the unknowns at the frontiers of science in the polar regions.* Understanding the Gamburtsev Mountains represents the last remaining great polar challenge

**Theme 1:** *To determine the present environmental status of the polar regions by quantifying their spatial and temporal variability.* The project will provide basic topographical and landscape information to climate modelers and the nature of the thermal flux arising from the bedrock surface of Antarctica.

**Theme 2:** *To quantify and understand past and present environmental and human change in the polar regions to improve predictions.* Knowledge of the time of formation of the subglacial highlands will determine whether temperate or polar glaciation occurred at the nucleation sites and provide an important input to climate models.

**Theme 3:** *To advance our understanding of polar –global teleconnections on all scales, and of the processes controlling these interactions.* **Nucleation and growth of the East Antarctic Ice Sheet has been the primary modulator of global sea level for approximately 30 million years and understanding its nucleation sites is critical.**

### **Contributing countries**

Australia, oversnow travel, air and field support as part of GigaGAP project

China, drilling equipment, oversnow travel

Germany, airborne geophysics

USA, oversnow travel, airborne geophysics

New Zealand drilling technology, oversnow travel

South America, airborne geophysics

South Africa, oversnow transport, air and field support

### **Visibility to the public**

This is the ultimate IPY project for capturing the imagination and interest of the public. The Gamburtsev Mts represent the last great unexplored feature on Earth's surface located in the centre of the most inhospitable place on Earth. We suggest holding a \$10 sweepstake on the age and type of rock that will ultimately be sampled by drilling. Proceeds in aid of a world charity. The winner will have the opportunity to visit Antarctica, perhaps even the drill site!

Co ordinators: Bryan Storey, Chris Wilson, Hartwig Frimmel

### 3. Autonomous Remote Observatories

The aim of this programme is to investigate systems-scale polar geodynamics and interactions with the cryosphere, hydrosphere and atmosphere by deploying autonomous remote observatories, on the continent and offshore. The principal components of these observatories will consist of GPS, seismometer and meteorology packages with the possible addition of geomagnetic observatories, tide gauges, and bottom pressure gauges (on offshore sites). GPS and seismometers may also be deployed on floating ice. The geoscience observatories could be linked with devices to monitor atmospheric chemistry and oceanographic parameters.

Anticipated outcomes include:

- First higher-resolution map of crustal structure across polar regions
- First higher-resolution tomographic maps of inner structure of Earth
- First comprehensive view of bedrock motions across polar regions
- Improved models of glacial isostatic adjustment
- Improved understanding of secular variation of Earth's magnetic field, and core structure and dynamics, including quantification of rapid field decrease that may signal a reversal of the Earth's field.
- Ground-based measurements will significantly leverage satellite observations by allowing discrimination of components of mass change signals (ice, ocean, atmosphere, solid earth).
- Understand and improve ocean tidal models, especially underneath ice shelves and in coastal regions of Antarctica. These areas are not covered by satellite altimetry.
- Establish a framework for ongoing international observatory network.

#### Interested countries

**Antarctic:** USA, Germany, Japan, France, Italy, UK, Australia, New Zealand, Finland, Sweden, India, South Africa, China, Poland, Spain, Russia, Ukraine,  
**Arctic:** Canada, Denmark, Finland, Norway, Sweden, China (new Svalbard station)

#### Proposed planning strategy

1. A major planning workshop, to be held in June, 2005, for preparation of Implementation Plan.
2. Submission of Bids for Funding and Logistics
3. Planning for Data Archiving and Analysis
4. Integrative science symposia

#### Linkages with IPY themes

##### *Polar Pulse*

- Complete a snapshot of glacial isostatic motions across the polar regions. Due to lack of adequate spatial coverage of continuous GPS stations, this is

currently constrained only from model predictions. New technologies for remote stations now make it possible to deploy autonomous remote stations. When coordinated with space borne measurements from current space missions, this is a key achievable goal.

- Complete a snapshot of seismicity across the polar regions. This is a key ‘unknown’, because inadequate station coverage is present to detect lower-magnitude earthquakes.
- Characterize Earth’s magnetic field across polar regions. Densification of observatories is required to quantify spatial and temporal variability of Earth’s field.

#### *Change*

- Understand feedbacks and drivers of climate change (links between tectonics, climate, surface processes)
- Contribute to assessment of sea level change (isolate solid earth motions from tide gauge measurements, etc.)
- Glaciological: contribute to ice dynamics snapshot from GPS observations
- Monitor mass changes in polar regions, to complement satellite observations. GPS observations, combined with satellite data, will allow discrimination of many sources of mass change signals.
- Interplay tectonic and biological systems
- Ice mass change and seismicity: drivers and controls

#### *Global teleconnections*

- Geomagnetic field characteristics
- Place polar regions within global geodynamic framework by filling data gaps in polar regions
- Technological frontiers overcome – autonomous systems in extreme environments. Provide new level of monitoring capability across polar regions.
- Validation and improvement of models and of satellite data.

#### *Unique vantage point*

- Polar regions are best platforms to investigate the deep interior of the Earth, particularly the core, using seismic waves.
- Measure major cryosphere mass changes only in polar regions

#### **Reasons for running this programme during IPY**

- Solid earth monitoring at an unprecedented spatial scale
- Interdisciplinary science that addresses all major IPY themes
- Dramatic progress possible in the time frame of 2-year IPY period
- Requires coordinated international effort
- Only major logistical effort, as provided by IPY, will allow this achievement
- Scientific advantages of simultaneous measurements
- Bipolar experiments – only realized through the framework of IPY
- Opportunities for all SCAR nations to participate in activity at some level

- Capacity-building: will transfer technological advances to all nations through SCAR
- Challenging but achievable
- Will produce a 'step function' in solid earth science observing in the polar regions.
- The legacy of observing systems will allow monitoring to continue at a new level.

### **Visibility to the public**

- Will allow a more comprehensive assessment of sea level change, which is of great concern to society.
- A better grasp of feedbacks and drivers of polar processes, will contribute to understanding of topics of significant relevance to society, including hazards, earthquakes, active volcanism), ice sheet stability and magnetic field
- Frontiers of technology in remote environments is an important avenue to engage the public imagination. Some examples of engagement include assigning schools to monitor instrumentation at remote sites, WebCams at sites and assigning schools to track floating instruments
- This effort is complementary to national/international programs studying the dynamic earth: e.g., Geonet (Japan); EarthScope (USA). The results of an observatory programme will bring polar regions into the global geodynamic framework.
- Requires activities at the frontier of technological development, hence requires partnerships with engineers, private enterprise, and a range of governmental agencies to achieve the science objectives.

**Co ordinator** Terry Wilson

#### 4. A benchmark map series

Antarctic geoscience maps and supporting databases (geographical, potential field, bedrock topography/bathymetry, geological, tectonics) are very important products to understanding Earth's evolution and environmental changes through geological time. Taking into account new broad initiatives in data acquisition during IPY, existing and forthcoming (which will be collected before IPY) geophysical data sets will be required for the Antarctic geoscience community in the form of grids (maps) or original information (in best case) or (at least) as metadata (position of geophysical lines, observational points, principal results of analytical studies, such as geological age determination etc.).

##### Status of Databases and Maps to be compiled

- ADMAP - CD with the data collected before 2002 (and possibly with later data) will be prepared by proposed ADMAP expert group;
- BEDMAP - most of data collected before 2000 are available as lines with ice thickness information. New initiatives are needed to succeed the BEDMAP Project completed in 2000 with the creation of advanced ice surface, ice thickness and bedrock elevation data bases using available and forthcoming radar and seismic materials. The purpose is to compile new more detailed small maps for the entire Antarctica, and medium/large scale maps for its individual regions with relatively dense observations.
- Antarctic Digital Gravity Anomaly Map - part of data is available (e.g. ADGRAV web site); No international project exists to create the relevant data base to compile the map; Free-Air Gravity anomaly map based on Russian data is proposed to be published in 2005-2006 and data in form of grid will be available.
- Tectonic Map of the Earth's Polar Regions - The latest overview tectonic map of Antarctica was published more than 20 years ago. The compilation of a new map will require a cooperative effort of scientists from many countries and can therefore be best performed under the auspices of CGMW, with endorsement by SCAR (and by IACS for the Arctic). The Russian specialists are prepared to undertake compilation of the entire original draft for Antarctica by 2007/2008. The project is open for participation by all SCAR countries willing to contribute relevant data, labor/expertise, etc.
- Revised Gondwana Reconstructions - this Project is important in terms of Earth's tectonic evolution and can accompany the tectonic map of Antarctica. There are many controversial ideas on how Gondwana broken-up (at least 5 models for the opening of the Weddell Sea) and so more data are needed to resolve problems
- International Bathymetry Chart of the Southern Ocean (IBCSO) - Project is starting and has great potential to compile a new bathymetric map of the Southern Ocean.
- Antarctic Digital Database (ADD) - the Project is in progress. New improved satellite images and maps are needed as an independent geographical product and as a base for other geoscience maps.

**Co ordinator** German Leitchenkov

## **5. Outreach and Education: An Antarctic Spatial Data Infrastructure**

A large amount of data will be collected during IPY and there is a great need to link this data in an interactive, online fashion. Understanding that geographic location is a fundamental element for integrating and communicating Antarctic science knowledge, the GI group aims to create an Antarctic spatial data infrastructure (ANTSDI). An SDI consists of fundamental reference data, policies and enabling technologies.

IGY developed an excellent network of WDCs, most of which serve their community very well. However, it is currently very difficult for a scientist in one discipline to use data from another. Under IPY there should be an additional layer of data dissemination. IPY projects should be required to provide high level products in standard based forms accessible cross disciplines. This will be important both for the proposal to expand the Cybercartographic Atlas and for the creation of an Antarctic SDI. For example, the geomagnetic community provides an excellent data sharing mechanism, but the data are not in forms accessible to non-specialists. A biologist interested in the navigation of seabirds could not readily compare track data with variations in magnetic data to see if there was an effect. This is just an example of the need for the approaches outlined above.

We build on existing projects such as the Cybercartographic Atlas of Antarctica which has as one of its goals, the communication of information on Antarctic science to the general public as well as a specific education element for high schooled aged children working with organizations such as Students on Ice (<http://www.studentsonice.com>) to create new educational materials.

### **Proposed planning Strategy**

- Build on already existing elements produced by the Expert Group on Geospatial Information we will create an Antarctic Spatial Data Infrastructure based on international and open standards and technologies (ISO TC211, OGC, etc.).
- Prior to IPY capacity building workshops on how to participate in the Antarctic Spatial Data Infrastructure will be organized.
- Continue development of Cybercartographic Atlas of Antarctica Project with new focus on IPY science initiatives.

### **Key elements of an integrated spatial data infrastructure**

- Fundamental reference data sets such as the Antarctic Digital Database and the SCAR Composite Gazetteer
- Standards, policies and procedures, such as the SCAR Feature Catalogue, implementations of ISO TC211 standards, etc.
- Implementation of enabling interoperable technologies
- Innovative means of communicating Antarctic scientific data through products

- such as the Cybercartographic Atlas of Antarctica
- Capacity building to ensure a consistent data infrastructure

### **Linkages with IPY themes**

The program outlined here is targeted directly at four of the themes identified in the Initial Outline Science Plan (20<sup>th</sup> April 2004) prepared by the ICSU IPY Planning Group as follows:

*Theme 1: To determine the present environmental status of the polar regions by quantifying their spatial and temporal variability.*

*Theme 2: To quantify, and understand, past and present environmental and human change in the polar regions in order to improve predictions.*

*Theme 3: To advance our understanding of polar – global teleconnections on all scales, and of the processes controlling these interactions.*

*Theme 4: To investigate the unknowns at the frontiers of science in the polar regions.*

### **Legacy of the IPY 2007-2008**

The data are collected, referenced and stored in standardized ways as part of a spatial data infrastructure. This will be a major legacy for Antarctic Science.

The integration and interoperability of scientific data sets will be a major legacy as well as well a methodology for presenting the results of the IPY in innovative ways to the public and educational institutions.

### **Next Steps**

- Consult with Canadian Committee on Antarctic Research and national IPY programs
- Approach funding agencies such as the National Science and Engineering Research Council of Canada for supplementary funds for a new phase of an currently funded project
- Investigate possibilities for EU funding
- Investigate possible support from COMNAP

**Co ordinator** Taylor Fraser

## **Appendix 2.**

### **General Website Statistics for Geoscience Standing Science Group Web site**

#### **1 July 2002 - 30 June 2003**

Total hits: 260,728	Repeat visitors 4,012
Total page views: 146,815	Sessions by repeat visitors 23,164
Total visitors: 25,669	One-time visitors 20,407
Total sessions 43,571	Two-time visitors 2,013
Average hits per day: 714	Three-time visitors 723
Average page views per day: 402	Four-time visitors 384
Average visitors per day: 111	Five-time visitors 206
Average sessions per day 119	Six+-time visitors 686
Average page views per session 2.19	Average session duration 0h 1m 37s

### **General Website Statistics for**

#### **1 July 2003 - 30 June 2004**

Total hits: 259,021	Repeat visitors 3,504
Total page views: 134,132	Sessions by repeat visitors 19,275
Total visitors: 25,146	One-time visitors 20,891
Total sessions 40,166	Two-time visitors 1,873
Average hits per day: 707	Three-time visitors 627
Average page views per day: 366	Four-time visitors 284
Average visitors per day: 101	Five-time visitors 188
Average sessions per day 109	Six+-time visitors 532
Average page views per session 2.04	Average session duration 0h 1m 55s

## **Appendix 3.**

### **Acronyms**

ACE	Antarctic Climate Evolution
ADD	Antarctic Digital Database
ADMAP	Antarctic Digital Magnetic Anomaly Project
AMD	Antarctic Master Directory
ANDRILL	Antarctic Drilling Program
ANTIME	The Late Quaternary Sedimentary Record of the Antarctic Ice Margin Evolution
ATCM	Antarctic Treaty Consultative Meeting
ATS	Antarctic Treaty System
CEE	Comprehensive Environmental Evaluation
CEP	Committee on Environment Protection
CGMW	Commission for the Geological Map of the World
CliC	Climate and Cryosphere
CONMAP	Conference of National Managers of Antarctic Programs
GIS	Geographic Information System
GLOCHANT	Global Change in Antarctica
GPS	Global Positioning System



GTOS	Global Terrestrial Observing System
IBCSO	International Bathymetric Chart of the Southern Ocean
IHO	International Hydrographic Organisation
IPA	International Permafrost Association
IPY	International Polar Year
IOC	Intergovernmental Oceanographic Commission
IPY	International Polar Year
ISMASS	Ice Sheet Mass Balance and Sea Level
ISPRS	International Society of Photogrammetry and Remote Sensing
IUGG	International Union of Geodesy and Geophysics
JCADM	Joint Committee on Antarctic Data Management
OGC	Open GIS Consortium
SDI	Spatial Data Infrastructure
SSG	Scientific Standing Group
STADM	Standing Committee on Antarctic Data Management
WDC	World Data Centre
WMO	World Meteorological Organization