

## **Intersessional Report to the SCAR Executive Committee**

### **Standing Scientific Group on Geosciences**

#### **June 2007**

### **1. Introduction and Highlights**

The AG and EG activities after XXIX SCAR meeting were focused on IPY preparation and on next ISAES symposium , September 07, Santa Barbara , USA.

Since last year GI (Geographic Information) EG within SSG-G became a SCAR Standing Committee (Standing Committee on Antarctic Geographic Information - SCAGI).

ANTEC EG ceased to exist as a SCAR EG and the activities of this group have been absorbed within the IPY POLENET Programme, which can be accessed via the POLENET web site: <http://www.polenet.org/>.

A 2<sup>nd</sup> SCAR cross linkages workshop has been made in Rome, November 2006. From that meeting has been proposed the creation of a working group between ICESTAR/IHY and POLENET through UAMPY. The Proposed title is GPS for weather and space weather forecast ( see more informations in attached document)

### **2. SSG-G 06-08 structure**

The Standing Scientific Group on Geosciences (SSG-G) comprises the following group approved at XXIX SCAR in 2006:

- *Action Groups (AGs):*
  - Marine Acoustics (the impacts of acoustic technology on the marine environment).
  - SIGE (Sub-Ice Geological Exploration)
- *Scientific Programme Groups (SPGs):*
  - Antarctic Climate Evolution (ACE)
  - Subglacial Antarctic Lake Enviroments (SALE, jointly sponsored with the Geosciences Standing Scientific Group)
- *Expert Groups (EGs):*
  - Geodetic Infrastructure of Antarctica (GIANT )
  - Expert Group on Antarctic Permafrost and Periglacial Environments ( EGGPE)
  - International Bathymetric Chart of the Southern Ocean (IBCSO)
  - Antarctic Digital Magnetic Anomaly Project (ADMAM)
  - ANTEC: Antarctic Neotectonics has drapped in POLENET , IPY project.

### **3. ISAES Xth International Symposium on Antarctic Earth Science, August 26-31, Santa Barbara, California, USA, 2007.**

The Xth ISAES will be held in Santa Barbara at University of California.

#### 4. Expert Groups reports

##### *GIANT (Chair: Reinhard Dietrich)*

Most of EG activities have been made within POLENET IPY project.

A meeting has been organized in Dresden, October 2006, IPY-POLENET workshop ( see on web site [www.tu-dresden.de/ipg/polente](http://www.tu-dresden.de/ipg/polente)).

##### *Antarctic Permafrost and Periglacial Environments ( Chaired by J.G. Bockheim (USA)*

The Expert Group on Antarctic Permafrost and Periglacial Environments reports the following scientific highlights for 2007:

- Completion of a special issue of the journal GEODERMA entitled “Antarctic Soils and Soil-Forming Processes in a Changing Environment” (Addendum 1). The special issue contains 12 refereed papers and is intended for distribution at the SCAR OSC and the Ninth International Conference on Permafrost (NICOP) to be held in July 2008 in Fairbanks, Alaska.
- Hosting a pre-conference workshop on “Status of Antarctic Permafrost and Soils Database Compilation and Mapping” for the International Symposium on Antarctic Earth Sciences (ISAES) August 26, 2007 at the University of California-Santa Barbara (Addendum 2). The workshop will feature presentations by 10 persons representing 7 countries and a group discussion of EGGPE objectives, website, current projects, and publication of map products. In addition, several of our members will be presenting papers.
- Preparation of preliminary maps of permafrost and soils for key ice-free areas of Antarctica. Preliminary maps showing the distribution of permafrost by form and soil subgroups have been prepared for the Transantarctic Mountains, which comprise 24,200 km<sup>2</sup> or 49% of the ice-free area of Antarctica (McLeod et al., 2007). In addition, permafrost and soils maps have been prepared for the McMurdo Dry Valleys (Bockheim et al., 2007; Bockheim and McLeod, accepted). Detailed permafrost and soil maps are available Taylor Valley (Bockheim et al., 2007) and are in preparation for Wright Valley (McLeod, in preparation). M. Balks is coordinating soil and permafrost maps for the Antarctic Peninsula and its offshore islands.
- Preparation of sections for the SCAR publication “Antarctic Climate Change and the Environment (ACCE).” Our group is preparing sections dealing with the current status, history, and predictions of climate change on Antarctic permafrost. Permafrost is a key “geo-indicator” for monitoring and assessing environmental change.

Plans for SCAR OSC meeting in July 2008, St. Petersburg, Russia: hosting a workshop on Antarctic Permafrost and Soils to be attended by approximately \_\_\_ persons during the SCAR OSC meetings. The workshop will be coordinated by Dr. Mauro Guglielmin (Italy).

Representative Publications:

Bockheim, J.G., I.B. Campbell, and M. McLeod. 2007. Permafrost Distribution and Active-Layer Depths in the McMurdo Dry Valleys, Antarctica. *Permafrost & Periglacial Processes*:in press.

- Bockheim, J.G. and M. McLeod. 2008. Soil distribution in the McMurdo Dry Valleys, Antarctica. *Geoderma*:accepted.
- Bockheim, J.G., M.L. Prentice, and M. McLeod. 2007. Distribution of glacial deposits, soils and permafrost in Taylor Valley, Antarctica. *Arctic, Antarctic and Alpine Res.*:accepted.
- Campbell, I.B. and G.G.C. Claridge. 2006. Permafrost properties, patterns, and processes in the Transantarctic Mountains region of Antarctica. *Permafrost & Periglacial Processes* 17:215-232.
- Guglielmin, M. 2006. Ground surface temperature (GST), active layer, and permafrost monitoring in continental Antarctica. *Permafrost & Periglacial Processes*:17:133-143.

**Addendum 1***Final Manuscripts for Special Issue of GEODERMA  
Antarctic Soils and Soil Forming Processes in a Changing Environment*

- Ugolini, F.C. and J.G. Bockheim. "Antarctic soils and soil-forming processes in a changing environment: overview."
- Aislabie, J.M., S. Jordan, G. Barker, and D.J. Sau. "Relation between soil classification and bacterial diversity in soils of Victoria Land Antarctica"
- Bate, D.B., J.E. Barrett, M.A. Poage, and R.A. Virginia. "Soil phosphorus cycling in an Antarctic polar desert"
- Bockheim, J., "Functional diversity of soils along environmental gradients in the Ross Sea region, Antarctica"
- Bockheim, J.G. and M. McLeod, "Soil distribution in the McMurdo Dry Valleys, Antarctica"
- Cannone, N., D. Wagner, H.W. Hubberten, and M. Guglielmin. "Relations among active layer soil properties and vegetation across a latitudinal gradient in Victoria Land, continental Antarctica"
- Claridge, G.G.C. and I.B. Campbell, "Zeolites in Antarctic soils; examples from the Coombs Hills and Marble Point
- Guglielmin, M., C.J. Ellis Evans, and N. Cannone. "Ground thermal regime under different vegetation conditions in permafrost areas and sensitivity to climate change: a case study at Signy Island (maritime Antarctica)"
- Hopkins, D.W., A.D. Sparrow, E.G. Gregorich, P. Novis, B. Elberling, and L.G. Greenfield. "Redistributed lacustrine detritus as a spatial subsidy of biological resources for soils in an Antarctic dry valley."
- McLeod, M., Bockheim, J.G., and Balks, M.R., "Glacial geomorphology, soil development and permafrost features in central-upper Wright Valley, Antarctica"
- Schaefer, C.E.G.R, F.N.B. Simas, R.J. Gilkes, C. Mathison, and L.M. de Costa, "Micromorphology and microchemistry of Cryosols from maritime Antarctica"
- Simas, F.N.B; Schaefer, C.E.G.R; Albuquerque-Filho, M.R., "Genesis, properties and classification of Cryosols from Admiralty Bay, Maritime Antarctica"

## Addendum 2

Workshop on Status of Antarctic Permafrost and Soils Database Compilation and Mapping for ISAES X - Proposed Date for Workshop: Sunday, August 26, 2007

- I. Introductions
- II. Informal presentations – 20 minutes each; a laptop, projector and projection screen will be provided
- III. Group discussion – 2 hours
  1. Review of ANTPAS objectives – are we still on-track? Do our objectives need to be updated/amended?
  2. Review of timeline and people responsible – is it achievable? Do we need to re-assign roles – are there any new people we need to include?
  3. Review of Website – is there anything else that we need to add/do? Anyone else want to look after it or is present arrangement OK?
  4. Funding arrangements – is there any thing we can do here?
  5. Publication of map products – can we make any progress/decisions on this?
  6. Plans for next ANTPAS meeting (with NICOP conference in Alaska in 2008 and SCAR in St. Petersburg, Russia).
  7. Other items

***Antarctic Digital Magnetic Anomaly Project (ADMAP) (Chair: Marta E. Ghidella)***

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. After the XXVIII SCAR meeting, it became an Expert Group.

*Achievements*

- 1) Development of a DVD of the compilation of data up to year 1999 for release to the World Data Centers.
- 2) Update of the near-surface anomaly predictions from Magsat in the ADMAP database with the significantly more accurate observations from the Ørsted and CHAMP satellite missions.
- 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 promotion of regional and continental scale interpretation efforts of the ADMAP data. This provides new insight into global tectonic and geologic processes in the Antarctic context.
- 6) Support to the World Magnetic Anomaly Map initiative of the International Association of Geomagnetism and Aeronomy (IAGA).
- 7) The ADMAP Expert Group has produced 5 Ph.D. dissertations and over 40 in-review, in-press, or published scientific papers. The OSU ADMAP website gives the citations of these scientific works.

*News*

- 1) Organization of a meeting of ADMAP Expert Group at ISAES 10 (<http://isaes2007.geol.ucsb.edu/ProgramWorkshops.html>), that includes:
  - The Release of the ADMAP DVD.
  - Update and planning for the next generation of ADMAP.
  - Election of a new chair.
- 2) Moving the website to <http://earthsciences.osu.edu/admap/>
- 3) Two ADMAP presentations were prepared for the 2007 IAGA/IUGG and ISAES 10 meetings.

- 4) ADMAP is part of the World magnetic anomaly map compilation that will be released at IAGA/IUGG meeting in Perugia, 2-13 July 2007 (See EOS NEWS: Magnetic Anomaly Map of the World, by M. E. Purucker, <http://www.agu.org/pubs/eos/>).

#### *Highlights*

The *New magnetic anomaly map of East Antarctica and surrounding regions* (Golynsky et al., 2007, see complete reference below) is the result of the integration of significant new data to the entire Antarctic compilation and really improves it.

- Golynsky, A., D. Blankenship, M. Chiappini, D. Damaske, F. Ferraccioli, C. Finn, D. Golynsky, A. Goncharov, T. Ishihara, S. Ivanov, W. Jokat, H. R. Kim, M. König, V. Masolov, Y. Nogi, M. Sand, M. Studinger, R. von Frese and the ADMAP Working Group, New magnetic anomaly map of East Antarctica and surrounding regions, in Proceedings of the 10th ISAES, edited by A. K. Cooper and C. R. Raymond et al., USGS Open-File Report 2007.
- von Frese, R.R.B., A.V. Golynsky, H.R. Kim, L. Gaya-Piqué, E. Thébault, M. Chiappini, M. Ghidella, A. Grunow, and the ADMAP Working Group, The next generation Antarctic Digital Magnetic Anomaly Map, in Proceedings of the 10th ISAES, edited by A. K. Cooper and C. R. Raymond et al., USGS Open-File Report 2007.

#### *Relevance*

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

#### *Plans for next semester*

- Incorporate new magnetic surveys into the ADMAP digital database as the data become available according to the ADMAP protocols. By these protocols, working group members are prepared to contribute magnetic data to ADMAP's database within 6 years of the completion of the field survey. Numerous surveys have been completed by the international community since the production of the first map which was based on magnetic surveys through 1999.
- Continue working to compile all available terrestrial, marine, and satellite magnetic survey data collected by the international community since the IGY 1957-58 for the region south of 60°S.
- Continue the development and promotion of regional and continental scale interpretation efforts of the ADMAP data. New data and interpretations will also enhance studies addressing interplays between geological boundary conditions, Antarctic ice sheets and climate change. These efforts will also greatly assist in identifying high-priority areas for new collaborative magnetic surveys.

#### ***International Bathymetric Chart of the Southern Ocean (IBCSO) ( Chairs: Hans Werner Schenke & Norbert Ott)***

The IBCSO project was presented and discussed at several workshops and conferences. At the GEBCO conference 2006 in Bremerhaven a status report was given. On 17 June 2006, in the frame of the 10<sup>th</sup> Meeting of the CGOM, the responsible IOC body for regional ocean mapping programs, IBCSO was endorsed and will receive adequate support by the IOC. GEBCO especially welcomes and appreciates IBCSO, since this project will concentrate working in those regions which are recognized as areas of sparse or no data coverage e.g. South Pacific, Weddell Sea, and Ross Sea.

IBCSO has now liaisons per personal membership with the GEBCO Subcommittee on Digital Bathymetry (SCDB), the SCAR Standing Committee on Antarctic Geographic Information (SC-AGI), and with the SCAR/SCOR Expert Group on Oceanography. The SCAR/SCOR Expert Group adopted two recommendations about bathymetric data

acquisition and data availability in support of oceanography during the 2<sup>nd</sup> SCOR Meeting held in London, December 2006. The buildup of bathymetric databases is strongly recommended in consideration of the International Polar Year (IPY). Letters regarding Southern Ocean bathymetry data have been sent to national funding agencies in June 2007.

Exceeding interest on the IBCSO project is expressed by the IHO Hydrographic Committee on Antarctica (HCA), which is interested in using the IBCSO product for the preparation of Nautical Charts in Antarctic waters. The IHO/HCA formulated an explicit request to Member States for bathymetric data needed for the completion of the Nautical Charts in Antarctica. A written status report about IBCSO was delivered to the 6<sup>th</sup> HCA Meeting, 6-8 November 2006, in Punta Arenas.

In 2007 international planning and organizing of IBCSO was continued, focusing mainly of the establishment of an international network for data collection and data exchange. Up to now some important topics have been completed or updated:

- collection of new bathymetric data by various cruises with RV Polarstern <sup>(1)</sup>
- design and implementation of the IBCSO website for web presentation ([www.ibcso.org](http://www.ibcso.org))
- initiating the IBCSO mailing list hosted at the NGDC
- presentation of IBCSO reports to IOC, IHO, SCAR, and GEBCO
- submission of abstracts and extended abstracts to periodicals and journals
- organizing a first IBCSO business meeting during the 10<sup>th</sup> ISAES in Santa Barbara
- development and conceptual design of work plan and data flow
- development of GIS architecture with desktop GIS and server GIS capabilities

<sup>(1)</sup> A previously unknown seamount was discovered in the Southwest Indian Ridge by RV Polarstern. It is located in a water depth of about 2900 metres and is more than 1350 m high. This seamount has a spatial extend of 9400 m and the diameter of the crater is about 700 m. The caldera suggests a volcanic origin. The first large undersea feature which RV Polarstern discovered at the beginning of the IPY was officially named 'IPY Seamount'.

### Work Plan

Since the restart of the IBCSO at the end of 2006, the work plan has been modified due to changes in data infrastructure and GIS environment. In the course of the IBCSO project the emphasis shifted from 'digital ocean mapping' to 'GIS based data compilation for thematic mapping'. This implies integration of geophysical and geological data sets with topographic and bathymetric data of Antarctica and the Southern Ocean.

Compiling Southern Ocean wide scattered echo sounding data:

- new bathymetric data by four cruises with RV Polarstern in 2006 and 2007
- existing bathymetric data from the AWI Bathymetric Chart of the Weddell Sea
- the Indian Ocean Bathymetry from the GEBCO GDA (2003)
- new bathymetric charts from the Ross Sea edited by Stagpoole and Davey (2004)
- single- and multibeam data provided by a great number of facilities and data centers
- data from other sources e.g. Fisher scans, contour maps, and ASCII data

Topographic data of Antarctica:

- Satellite data acquired by Radarsat (1997)
- RAMP Digital elevation model (2001)
- Coastline, bedrock topography, outcrops (2004)
- Land-Ice boundary showing grounding-line, sea ice, and ice edge
- Geographic names in accordance to SCUFN and the SCAR Composite Gazetteer of Antarctica

#### Additional data

- Seafloor topography by Sandwell and Smith (1996) and derived ETOPO2v2 data (2006)
- predicted bathymetry by Smith and Sandwell (1997)
- geophysical data from magnetic and gravity
- geological data e.g. sediment thickness and lineaments

Main objective of the IBCSO project is the production of a bathymetric map for the entire Southern Ocean. This comprises printed maps as well as digital web maps for use in GEBCO and other projects. Consequent use of digital data in a proprietary GIS environment leads to the buildup of a complex geodatabase with extensive meta-information. The proposed name is **SOGIS** – Southern Ocean Geographic Information System.

The most critical point in this early stage of IBCSO is the compilation of bathymetric data from a great number of facilities and data centers. We shall approach all organizations, universities, agencies, and research institutions that are in the possession of single and multibeam data in the waters south of 50°S and ask to supply the data for the preparation of IBCSO.

IBCSO needs close collaborations with relevant international governmental and non-governmental organizations and agencies in order to have access to existing data of the Southern Ocean to support the data compilation and the editorial work of IBCSO. In order to strengthen the IBCSO network and optimize input and outreach, the cooperation with SC-AGI, IHO and GEBCO continued by attending meetings and work shops.

Regarding this, the first IBCSO business meeting is announced during the 10<sup>th</sup> ISAES at the University of California, Santa Barbara (<http://isaes2007.geol.ucsb.edu/ProgramOverview.html>). Main topic of this meeting being held on 1 September 2007 will be the establishment of the IBCSO Editorial Board to be later endorsed by the IOC. Other agenda items are presentation of the IBCSO status report, discussion on echo sounding availability and data transfer modalities, updating the IBCSO work plan, and definition of upcoming tasks.

IBCSO is also presented to the GEBCO Sub-Committee on Digital Bathymetry Meeting being held at the LDEO of the Columbia University in Palisades, New York in September 2007. During the 7<sup>th</sup> HCA Meeting in Buenos Aires in October 2007, an IBCSO report is presented and prospective work on the Antarctic topographic database is discussed with the SC-AGI. The collaboration with the HCA is important for the exchange and transfer of bathymetric data between the national hydrographic offices into IBCSO.

#### Upcoming tasks and activities

In summary, ongoing and future work comprises:

- data compilation and evaluation of bathymetric data
- data integration of heterogeneous data sets
- organizing IBCSO meetings and work shops
- request for funding to get additional support for IBCSO

An IBCSO work shop is planned in July 2008 during the XXX SCAR Science Week in St. Petersburg, Russia. Work shop topics are (i) proceedings in echo sounding data acquisition (ii), problems and strategies in digital ocean mapping, (iii) progress in GIS based data modeling, and (iv) adjusting the implementation of SOGIS.



The IBCSO Expert Group invites participants and official representatives who contribute to IBCSO by sharing data, information, and knowledge. Therefore, the IBCSO Expert Group applies for travel funds of \$5,000 (five thousand US Dollar) in 2008 in order to support the attendance of its members at international meetings, for example at the IHO/HCA, SC-AGI and GEBCO.

## 5. Scientific Programme Groups

The SSG-G is co-sponsoring the SALE SPG (SSG-LS) and ACE SPG.

### *Antarctic Climate Evolution (ACE)*

Progress:

ACE is coordinating the integration of enhanced geological data and improved Antarctic palaeoclimate models for a series of time periods from the onset of glaciation around the Eocene-Oligocene boundary 34 Ma ago, to the last glacial maximum (LGM) 20,000 years ago, in order to establish the origin of the present configuration of the ice sheet. ACE results will be of use to governments in developing national inputs to the Intergovernmental Panel on Climate Change and the UN Framework Convention on Climate Change, and national responses to climate change.

In 2006 ACE continued to engage its implementation plan to advance its programme. Two new members were appointed to the Steering Committee (Rob Bauer and Eric Wolff). Details of the ACE programme were updated on its website ([www.ace.scar.org](http://www.ace.scar.org)).

In 2006 ACE contributed to advances in pan-Antarctic science by publishing a special issue of an international journal:

Barrett, P., Florindo, F. and Cooper, A. (Editors) (2006). "Antarctic Climate Evolution - view from the margin". *Palaeogeography, Palaeoclimatology, Palaeoecology*, vol 231, 1-252.

This issue is the third in three years on the theme of Antarctic Climate Evolution. It covers a wide range of techniques and timeframes concerning the evolution of the Antarctic continental margin, ranging from detailed sedimentary analyses of the Cape Roberts Project core to numerical modelling investigations of ice sheet growth and decay.

A field campaign was undertaken in 2005/06, led by the British Antarctic Survey, to map, describe, sample and photograph glacial sedimentary sequences and associated fossils on James Ross Island. The rock and fossil samples will be analysed to create realistic environmental reconstructions and new data on environmental change, particularly Antarctic ice sheet history, over the past 7-10 million years, for input to climate models.

ACE members helped prepare the IODP Wilkes Land drilling proposal, which is now in the IODP drilling schedule for Austral summer 2008-2009. ACE has also helped to Develop the IODP Ancillary Program for obtaining a Holocene ultra-high resolution record of climate variability from the Adelie Drift (Wilkes Land).

ACE has continued to influence progress by organising two international meetings during the year:

(i) April 2006, EGU, Vienna: "Deep Time Perspectives on Climate Change:

Marrying the Signal from Computer Models & Biological Proxies". This session discussed scenarios for future climate change, which indicate that within the next 100-400 years, global annual average surface temperatures will increase by more than 6 degrees celcius (Intergovernmental Panel on Climate Change, 2001). This magnitude of warming has not been experienced for millions of years. There is a clear need to understand deep time (pre-

Quaternary) climates if we are to predict the effects of future global warming on the Earth System and on the Earth's biota. The outcome of the session is a new volume of *Palaeo 3* entitled "Antarctic cryosphere and Southern Ocean Climate Evolution".

(ii) December 2006, fall AGU, San Francisco: "Post IPY geophysical exploration of Antarctica". This special session brought together experts from the area of radio-echo sounding, who spoke about the development and use of this technique in the exploration of Antarctica over the last 50 years. The session also detailed new ways in which the technique can be developed, which is of central interest to ice sheet modellers (as RES provides the only feasible means by which sub-ice bed topography can be measured).

Sandra Passchier provided a keynote talk on ACE at II Simposio Latinoamericano Sobre Investigaciones Antárticas y VI Reunion Chilena de Investigacion Antartica, Concepcion, Chile, 16-18 August 2006.

ACE has been selected as a core programme of the International Polar Year, beginning in 2007.

ACE is committed to supporting the next generation of Antarctic researchers. It supplies funds to allow students and young

(post-doctoral) scientists to attend ACE-related workshops.

#### Plans

ACE has a comprehensive plan of activities for 2007. The plan can be seen in the Implementation Plan on the ACE web site. In addition, ACE plans the following activities:

(i) a special issue of *Palaeo3*, from an ACE session at the 2006 EGU entitled "Deep Time Perspectives on Climate Change: Marrying the Signal from Computer Models & Biological Proxies".

(ii) Supporting and encouraging involvement with the ANDRILL programme.

(iii) Developing an international plan for the collection of airborne and ground-based geophysical data relating to the Antarctic ice sheet (i.e. ice thickness and bed elevation data) in current 'data free' zones and in regions of glaciological change.

(iv) Planning an ACE modelling workshop for Easter 2008, in which the Antarctic ice volume through the Cenozoic is evaluated.

(v) ACE will contribute funds and numerous session activities at the Antarctic Earth Sciences meeting at Santa Barbara in August 2007.

(vi) ACE is organising a session at the INQUA meeting in Cairns, July 2007 on "Climate and ice in Antarctica and the Southern Ocean since the LGM".

## **6. Action groups reports**

SIGE ( Chair Bryan Storey ) started few months ago and the plan is to organize a meeting with relevant people at the ISAES X conference in Santa Barbara end August, and have an ACTION group meeting in St Petersburg.

Alessandro Capra

Chief Officer

SCAR Standing Scientific Group on Geosciences

Modena, June 2007

**List of Acronyms and Abbreviations**

ACE	Antarctic Climate Evolution
ADMAP	Antarctic Digital Magnetic Anomaly Project
AG	Action Group
AGCS	Antarctica and the Global Climate System
ANTEC	Antarctic NeoTECtonics
ATCM	Antarctic Treaty Consultative Meeting
AWI	Alfred Wegener Institute for Polar and Marine Research
BAS	British Antarctic Survey
CGOM	Consultative Group on Ocean Mapping
COMNAP	Council of Managers of National Antarctic Programmes
EBA	Evolution and Biodiversity in the Antarctic
EG	Expert Group
EGGPE	EG on Antarctic Permafrost and Periglacial Environments
ETOPO2v2	2-Minute Gridded Global Relief Data
GDA	Digital Atlas Centenary Edition
GEBCO	General Bathymetric Chart of the Oceans
GI	EG Geographic Information
GIS	Geographic Information System
HCA	Hydrographic Committee on Antarctica
IBCSO	International Bathymetric Chart of the Southern Ocean
ICESTAR	Interhemispheric Conjugacy Effects in Solar-Terrestrial and Aeronomy Research
ICSU	International Council for Science
IHO	International Hydrographic Organization
IHY	International Heliophysical Year
IOC	Intergovernmental Oceanographic Commission
IPY	International Polar Year
ISAES	International Symposium on Antarctic Earth Sciences
LDEO	Lamont-Doherty Earth Observatory
NGDC	National Geophysical Data Center
NSF	National Science Foundation
POLENET	POLar Earth observing NETwork
Radarsat	Radar Satellite
RAMP	Radarsat Antarctic Mapping Project
RV	Research Vessel
SALE	Subglacial Antarctic Lake Environments
SCAGI	Standing Committee on Antarctic Geographic Information

SCAR	Scientific Committee on Antarctic Research
SC-ATS	Standing Committee for the Antarctic Treaty System
SCDB	Subcommittee on Digital Bathymetry
SCOR	Scientific Committee on Oceanic Research
SCUFN	Sub-Committee on Undersea Feature Names
SIGE	Sub-Ice Geological Exploration - AG of SSG-G
SOGIS	Southern Ocean Geographic Information System
SPG	Scientific Programme Group
SSG-G	Standing Scientific Group on Geosciences
SSG-LS	Standing Scientific Group on Life Sciences
UAMPY	Upper Atmosphere Monitoring for Polar Year

Attached Document

***Proposal from ICESTAR (SCAR SRP), SSG-LS,SSG-GS, POLENET (IPY project)***

Introduction

**ICESTAR/IHY** is a core project, defined as cluster 63, endorsed by IPY. It coordinates multinational research on solar-generated events which affect the composition and dynamics of the atmosphere in the terrestrial polar areas. The activity brings together two complementary programmes: the International Heliophysical Year (IHY) (EoI 172) and ICESTAR (EoI 554), endorsed by SCAR. The joint project includes the collective effort of 24 international consortia which submitted their Expressions of Intent (EoIs) to the IPY call in January 2005. Between them, **UAMPY** (Upper Atmosphere Monitoring for Polar Year 2007-2008) Consortium proposes to create the necessary international cooperation to develop a polar upper atmosphere observation network on both the hemispheres. It should allow unprecedented observation of the polar ionosphere, with extended auroral and polar coverage, making possible the mapping of features from mid- through polar latitudes and the studies of associated polar ionospheric processes. **The project includes a unique ability to monitor polar scintillation globally.** Scintillation is a significant concern for trans-polar navigation and communication. The potential exists for numerous new studies - both scientific and practical investigations.

The UAMPY consortium is composed by: INGV (Istituto Nazionale di Geofisica e Vulcanologia – Rome, ITALY), IFAC/ISC-CNR (Istituto di Fisica Applicata “Nello Carrara”/Istituto dei Sistemi Complessi, Florence, ITALY), UNIVERSITY OF BATH (UK), SRC-PAS (Space Research Center, Polish Academy of Sciences Warsaw, POLAND), UNIVERSITY OF CALGARY (CANADA), HMO (Hermanus Magnetic Observatory, Hermanus, SOUTH AFRICA) together with other collaborators of the South African Space Physics community including ISSA (Institute for Satellite and Software Applications), HartRAO (Hartebeesthoek Radio Astronomy Observatory), NWU(Northwest University), UND (University of KwaZulu-Natal in Durban), UP (Department of Electrical, Electronic and Computer Engineering, University of Pretoria). These groups manage several experimental observations in **Arctic and Antarctica**: GPS scintillations receivers at Ny Alesund (Svalbard, Norway) and along the EISCAT sites in Tromso, Kiruna and Sodankyla; ionosonde, scintillation receivers and magnetometer at the Polish Polar Station in Hornsund (Svalbard); the Canadian GPS Network for Ionosphere Monitoring (CANGIM); riometers and a digital ionosonde AIS-INGV (Advanced Ionospheric Sounder INGV) in Antarctica at the Italian Station “Mario Zucchelli”; magnetometer, riometer, GPS dual frequency receivers and HF Radar (part of the SuperDARN network) at the South Africa observatory at the SANAE IV in Antarctica.

As this long experience the goal is to share data, know-how, expertise and models for studying ionospheric plasma evolution and dynamics with a multidisciplinary approach. To achieve the result the efforts are mainly addressed to:

- Coordinate the existing experimental observations to monitor the upper atmosphere phenomena;
- Enlarge the experimental equipment with the installation of other scintillations receivers necessary to cover the **current lack over the poles**;
- Collect the upper atmosphere data for constituting a robust database and archive for scientific as well as for Space Weather aims;

- Study and develop the ionospheric scintillation modelling and the simulation of physical processes causing structuring of the high-latitude ionosphere;
- Design a server for the remote control and management of the instrumentation, for hosting the database and for retrieving added value products (plots, maps, etc.).

The efforts that are undertaken by the scientific polar community to widen the perspective of operational scientific investigations towards the realization of multidisciplinary coordinated facilities and observations are central to **POLENET** project. The technical and scientific challenges that are going to be addressed by POLENET are numerous. On the scientific side, the primary co-location of GPS systems (Figure 1) and seismometers, possibly completed with meteorological sensors, geomagnetic observatories, tide gauges and bottom pressure gauges would realize a step towards the acquisition of **coordinated geophysical observations of the Earth system and its processes**.

Furthermore, the **GPS network** itself is going to benefit of a much denser and more homogeneous distribution of observing sites; this will certainly provide a more effective tool for performing polar observations in the field of geophysics and physical sciences. In particular, a continuous geodetic monitoring, exploited through GPS permanent stations, would accurately determine the 3-D motion of the crust. Besides all geodynamical applications, an accurate monitoring of vertical displacements will undoubtedly benefit the investigations related to cryosphere stability and ice mass balance, providing robust constraints on ongoing processes. Sea level change and post-glacial rebound are directly affected by modifications of the ice sheet; these investigations are particularly important as the modifications seem to occur at an unpredicted high rate of change. Finally, the possibility to co-locate the remote GPS stations with Automatic Weather Stations would allow to determine the distribution and evolution of **Precipitable Water Vapour in polar regions**; these latter areas play a key role in the characterization and evolution of global earth phenomena. Furthermore, water vapour is one of the most important greenhouse gases: its distribution and variability are crucial for inferring about climate change and possible related scenarios.

A close cooperation between scientists involved in GPS based atmospheric investigation is crucial for optimising any effort that is devoted to a densification of the polar GPS network and towards the enhancement of its performances.

On the operational side, coordinated actions devoted to optimisation and enhancement of highly accurate standardised performances of remote unmanned observing stations will be maximised by a coordinated effort in evaluating the different needs related to designing and planning the installations and the related technical solutions.

### **Cross-link Proposal between ICESTAR/IHY and POLENET through UAMPY**

**Proposed title: GPS for weather and space weather forecast**

Polar-ionosphere imaging over Antarctica using GPS data is of great challenge due to poor coverage of ground-based GPS receivers. It is difficult to track and image high-speed moving ionospheric structures without good coverage of observations. However, as the POLENET network has been proposed, the study of the ionosphere over the southern polar cap by radio tomography becomes promising. The new imaging technique, developed by the University of Bath and known as MIDAS (Multi-Instrument Data Analysis System), is unique in its approach to ionospheric imaging because it performs a four-dimensional inversion. The technique assimilates different kind of data: ionospheric characteristics from vertical soundings (virtual heights and critical frequencies of the layers), parameters from

backscattering radars (typically power and velocity of the echoes), GPS data (TEC and scintillation indices), ionospheric vertical profiles and ingests also models to reconstruct the spatial-temporal condition of the ionospheric plasma. To work properly MIDAS needs data and models and, naturally, the scientific expertise to evaluate and interpret the results. In this frame the UAMPY contribution to the proposed working group is crucial as it groups experts in different branches of the upper atmosphere physics. Most of them manage also instruments and models fundamental to provide the necessary information to the tomography technique.

**Figure 1 shows the locations of GPS receivers from IGS sites (green) and planned POLENET sites (red). Using simulated observations from IGS receivers and POLENET receivers, ray paths between ground GPS receivers and satellites, which are projected onto the surface of the Earth (see Figure 2), are generated from the current IGS sites (left panel of Figure 2 ), as well as from both current and planned sites (right panel of Figure 2). From figure 2 it is evident the potential of the proposed wg to improve the polar ionosphere knowledge.**

The **POLENET** and **ICESTAR - UAMPY** Communities could have **mutual benefits** in terms of:

- Ionospheric imaging over Antarctica (planned by both the projects).
- Exchange of data and expertise for the application of tomography to other fields of interest for both the communities (e.g. 3D water vapour reconstruction).
- Exchange of technologies to install and manage remote GPS stations.
- Possibility to host instruments in the polar stations represented by the two communities.

The suggested Working Group is composed as follows:

From **ICESTAR - UAMPY**: Kirsti Kauristie (Chair), Lucilla Alfonsi, Giorgiana De Franceschi, Ben Opperman, Massimo Materassi, Ping Yin.

From **POLENET**: Alessandro Capra (Co-Chair), Dorota Brzezinska, Jan Cisak, Larry Hothem, Gennady Milinevsky, Pierguido Sarti, Yevgen Zanimonskiy.

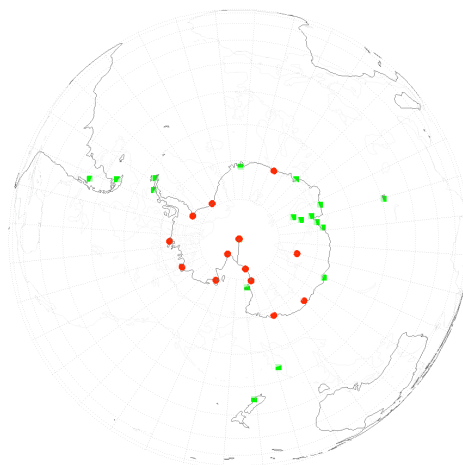


Figure 1 the distribution of ground GPS receiver from IGS sites (green squares) and proposed POLENET sites (red circles) over Antarctica.



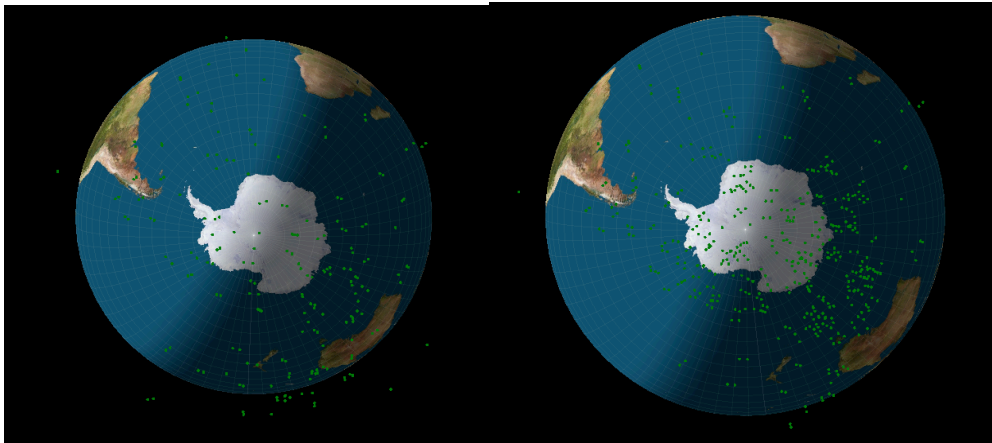


Figure 2 Ray paths between GPS satellites and ground receivers from existing sites only (left) and from current and planned POLENET sites (right).

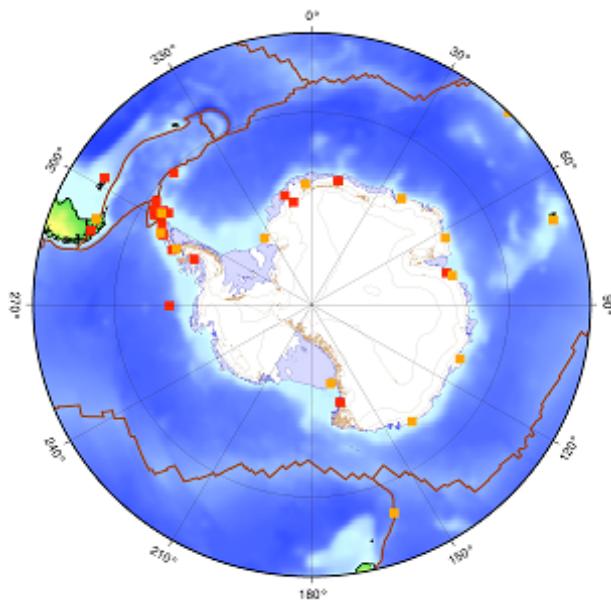


Figure 3 – GPS Observatories in POLENET, courtesy of SCAR website.