

Scientific Committee on Antarctic Research

Standing Scientific Group on Physical Sciences (SSG/PS)

Report to the Delegates, SCAR XXX July 11th, 2008

Estimated SCAR funding required for the next 2 years (in USD)

\$ 29.500 in 2009 and \$ 26.500 in 2010.
(Pending approval of the SCAR finance committee)

Summary of five main achievements within SSG/PS:

1. The cross-SSG workshop in Rome, November 2006, resulted in the initiative of proposing a joint Action Group, GPS Space Weather, sponsored by the SSG/GS and SSG/PS; this will draw together the instrumental array and expertise of the POLENET program array, the expertise in ionospheric research of the ICESTAR GPS scientists (UAMPY), and the skills of the meteorology experts, into a combined effort for data analysis and archival. This research program takes off from the ICESTAR/IHY IPY core project labelled as Cluster#63.
2. Astronomy SRP proposal: the connection between SCAR and IAU comes at the right time and stresses the potentiality for results of excellence in the field of Antarctic astronomy; the establishment of an astronomy SRP will foster the advancement of Antarctic astronomy as a key contributor to worldwide astronomical research in several areas. The specific properties of the Antarctic site will favour top quality science. This SRP, if approved by the delegates will replace and assume the activities carried out in the past by the AAA Expert Group, in 2010; accordingly the request for a budget devoted to Astronomical initiatives for 2010 will be dropped.

The two Scientific Research Programmes approved by SCAR in the context of the SSG/PS are AGCS (Antarctica in the Global Climate System), and ICESTAR (Interhemispheric Conjugacy Effects in Solar Terrestrial and Aeronomy Research); main achievements in these programs are as follows.

3. Some AGCS results are especially relevant and consist of improved projections of climate change in the Antarctic and Southern Ocean, for the XXI century. This work is based on the output of models used in the 4th Assessment report of IPCC. Changes will affect temperature (0.34 °C increase per decade), sea ice area decrease (33% over decade). The Antarctic Climate Change and Ecosystems (ACCE) report is a solid result of the involvement with AGCS of the three SSG's (as result of the cross-SSG meeting). A complete report of the AGCS program activities is given in the AGCS report.

4. ICESTAR has investigated links among various regions of near Earth space: atmosphere, mesosphere, ionosphere and magnetosphere; The Global Auroral Imaging Access (GAIA) portal has been released for use by the scientific community. GAIA is a virtual observatory providing quick access to summary data from satellite and ground-based instruments that remote sense auroral precipitation. GAIA is presently operational and managed by research groups at the University of Calgary, Lancaster University, and the Finnish Meteorological Institute: see <http://gaia-vxo.org>. ICESTAR will continue to encourage and enable the development of data portals and virtual observatories related to the core mission of the program. After such developments it is proposed that ICESTAR terminates its operation and becomes an SSG/PS expert group, in 2010, to further pursue the objective of quantitative description of solar terrestrial physics; funding is therefore requested only for 2009.
5. The ISMASS Expert Group, recognising the importance of ice sheets in controlling global sea level, and the inadequacies in current efforts to model observed rapid changes in ice sheets, held a Workshop, July 5-7, 2008, prior to the SCAR-IASC Open Science, to develop a community strategy on how best to (i) improve the physical understanding of ice sheet processes responsible for rapid change; (ii) incorporate improved physical understanding into numerical models; (iii) assimilate appropriate data into the models for calibration and validation; and (iv) develop prognostic whole ice-sheet models that better incorporate non-linear ice-sheet response to environmental forcing (such as change in surface mass balance, loss of buttressing from floating ice shelves and ice tongues, and rising sea level). The ISMASS Expert Group, under the advice of SCAR, has been awarded an ICSU grant to hold the next workshop.

Report of the SSG as a whole

The Standing Scientific Group on Physical Sciences (SSG/PS) was formed in July 2002 at SCAR XXVII during the major re-organisation of SCAR. It brought together SCAR's involvement in solar-terrestrial research, astronomy from the Antarctic, meteorology, recent climate change research, ocean science and glaciology. It therefore covers a very broad range of scientific interests. In 2004 the AGCS and ICESTAR SRP's were established. During the past four years of activity of the two Scientific Research Programmes (SRPs) that come under the SSG/PS, the main focus of SSG/PS has been on its Action and Expert groups. In the following sections we provide detailed reports on the progress and plans of these groups, and the recommendation that some other be established; here we highlight some points relevant to the SSG as a whole and concerns that need addressing.

There have been no significant problems in the running of the SSG over the last 2 years, but we would repeat from the report to SCARXXIX, the following points:

- Communication with the SSG/PS members in some countries is sporadic, and it only surfaces in connection with the SCAR meetings. The role of the SRP's should be encouraged in the maintenance of regular connections with the science communities in those countries that seem to contribute only in the occasion of such general assemblies. We would encourage the national SCAR programmes and the individual scientists to keep us informed of their current email address. On the other hand there are still a number of SCAR nations who we have not been able to draw into our SRPs, despite them working in the relevant areas of science. We would encourage all the national programmes to participate in these world class programmes of science.
- Prior to SCAR XXX it would have been very useful for the officers of the SSG to have been informed of the names of the national delegates to the SSG.

SSG/PS and the IPY:

AGCS contributions to IPY :

- The first expedition of the Chinese IPY programme, PANDA, a successful traverse to Dome-A, investigated ice layers, bedrock, snow accumulation rates and ice flow.
- Ice cores were collected near Maïtri station as part of the Indian ITASE (2006-2007) collaborative programme between the National Centre for Antarctic & Ocean Research (NCAOR), Goa and the Geological Survey of India (GSI).
- There was joint Brazilian-Chilean-US ice core drilling on the Detroit Plateau, Antarctic Peninsula as part of the Climate of the Antarctic and South America (CASA) programme. CASA collected 155m of ice core, conducted GPS and GPR based measurements of ice flow and accumulation rates, and installed an automatic telemetric weather station.
- The US ITASE team arrived at South Pole on 24 December 2007, their second traverse to the Pole. Since 1999 US ITASE has traversed more than 8000 km throughout West and East Antarctica and collected a total of 3945m of ice core.
- The Norwegian - US Scientific Traverse of East Antarctica involved scientific investigation along an overland traverse in East Antarctica, from the Norwegian Troll Station to the vicinity of the USA South Pole Station in 2007-2008.
- Two major IPY sea ice programmes were conducted in Spring 2007. The Australian Sea Ice Physics and Ecosystem eXperiment (SIPEX) and the US Sea Ice Mass Balance of Antarctica (SIMBA) campaign. These focussed on the physical sea ice environment and links to the associated biology and biogeochemistry of the sea ice. The Geoscience Laser Altimeter System (GLAS) aboard NASA's ICESat satellite was turned on for 33 days to coincide with the field campaigns to improve the calibration and validation of the satellite data.

Heliosphere Impact on Geospace, ICESTAR contributions to IPY.

- The IPY project #63, with the title "Heliosphere impact on geospace", is coordinated by the programs ICESTAR and IHY (International Heliophysical Year, a worldwide initiative that addresses the investigation from near Earth space to the whole heliosphere, the region of the Universe in which the effects of the Sun dominate the interstellar space). The consortium includes altogether 29 multinational research initiatives conducted by scientists from 22 different countries. The scientific work of IPY Cluster 63 addresses the Sun-Earth connection under three main themes: (i) coupling processes between different atmospheric layers (ii) magnetosphere-ionosphere energy exchange and (iii) interhemispheric relationships.
- The positive impact of IPY campaign in the publication records of IPY Cluster 63 scientists is already now visible and this trend can be assumed to continue also after the official campaign years. Examples of Cluster 63 science highlights are:
 1. pioneering findings about the linkage between solar proton events and stratospheric ozone content variations, and
 2. the investigation on the causal relationship between mid-latitude lightning activity and energetic electron precipitation.
 3. Cluster 63 has also revealed that the concept of magnetic conjugacy in auroral physics is more complicated than previously anticipated. The statistical magnetic field models which are currently used in interhemispheric comparison studies need some improvement as their conjugacy estimates show systematic errors in certain conditions.
 4. New information has been achieved also about the appearance of pulsating auroras: pulsation can appear only in one hemisphere or in some cases the northern and southern pulsation periods can differ significantly from each other. This finding challenges some previously presented theories which explain pulsations as a consequence of magnetospheric wave-particle interactions with the implication of coherent behaviour in both hemispheres.
- The Greenland Space Science Symposium (May 2007) and the Polar Gateways Arctic Circle Sunrise meeting (Barrow, Alaska, Jan 2008) are highlights in the IPY Cluster 63 PR and outreach activities. Researchers from 14 countries participated the Greenland meeting which celebrated the rich history of Greenland as a forum for near-Earth space observations. Local people and political decision makers were invited to the sessions presenting historical reviews and the state-of-art of today's geospace instrumentation. The Barrow meeting discussed the motivations and legacies of the first three International Polar Years and the main challenges for the on-going Polar Year. The presentations by NASA scientists discussed also the advantages of polar icy regions for testing instrumentation of different planetary missions and of outer solar system exploration. In addition to the sessions in Barrow the meeting included several video conferences with other

- institutes around the Arctic Circle. The meeting had in total 109 participants (47 in Barrow, 62 remote).
- As an implementation of one of its objectives, ICESTAR has had important role in the development of efficient dissemination and archiving systems for IPY Cluster 63 data sets. The GAIA Virtual Observatory for auroral precipitation data and the data of the EISCAT radar IPY runs in the Madrigal data base are the flagships in the Cluster 63 legacy for future generations. GAIA serves as one-point browsing tool for auroral data from several distributed data sources. Besides its original home institute in Calgary GAIA has mirror nodes also in Sweden and Finland. The Madrigal service has been upgraded to facilitate versatile usage of EISCAT IPY data e.g. in statistical studies or as reference material in atmospheric model evaluation work.

SSG/PS and other ICSU bodies:

SSG/PS has established links with other organisations working in relevant fields such as the Climate Change programme (CliC), of the World Climate Research Programme (WCRP), the International programme of Antarctic Buoys (IPAB), the CLIVAR/CliC Southern Ocean Implementation Panel, the Cryosphere Theme of the Integrated Global Observing Strategy (IGOS), the International Antarctic Zone Programme, the Integrated Analyses of Circumpolar Climate Interactions and Ecosystem Dynamics in the Southern Ocean (ICED), the SCAR/SCOR Oceanography Group and the International Partnerships in Ice Core Sciences (IPICS). Some of these have developed into the formation of SCAR groups, like in the case of IPICS. Further links may be envisaged with the connection of IAU, in several areas of astronomical research.

At it's meeting in Hobart, the SSG considered our links with ICSU's Scientific Unions. SCAR is developing links with IUGG through its associations such as IAMAS and IAPSO, and with the IACS (International Association for Cryospheric Sciences). Links with the Scientific Committee on Solar Terrestrial Physics (SCOSTEP) are in place. SSG/PS also agreed to examine the connection to the International Union of Pure and Applied Chemistry (IUPAC) to see if their interests overlapped with those of SCAR; this will be one of the objectives of the SSG/PS Expert Group on Environmental Contamination in Antarctica (ECA).

Brief reports on the Scientific Research Programs

Antarctica in the Global Climate System (AGCS). Five scientific highlights:

1. Improved projections of how the climate of the Antarctic and Southern Ocean will evolve over the Twenty First Century have been produced, based on the output of the models used in the Fourth Assessment Report of the IPCC. The models have a wide range of skills in simulating the Antarctic climate, and their output was weighted according to their ability to reproduce the mean climate of the late 20th

century. The models suggest an increase in the circumpolar westerlies, which is largest (27%) in the autumn. The surface warming averaged over the continent is projected to be 0.34 deg C per decade. More rapid warming of 0.5 deg C per decade is expected during the winter in areas where there will be sea ice loss around the coast of East Antarctica. Approximately 33% of the sea ice area is expected to be lost by the end of the century, while there will be an increase of precipitation onto the continent.

2. An oceanographic section across the eastern Scotia Sea occupied in 1995, 1999 and 2005 revealed significant variability in the deep and bottom waters of Southern Ocean origin. Warming ($\sim 0.1^{\circ}\text{C}$) of the warm mid-layer waters in the Scotia Sea between 1995 and 1999 reversed through to 2005, reflecting changes seen earlier upstream in the Weddell Sea. The volume of deep waters with potential temperature less than 0°C decreased during 1995-2005, though such a reduction was only clear between 1995 and 1999 at the southern end of the section. The abyssal waters of the eastern Scotia Sea apparently changed circulation between 1995 and 1999, with the dominant point of their entry to the basin shifting from the south to the northeast; by 2005, the former route had regained dominance. These changes are best explained by interannual variations in the deep waters exiting the Weddell Sea, superimposed on a longer-term (decadal) warming trend. The interannual variations are related to changes in the strength of the Weddell Gyre, reflecting large-scale atmospheric variability that may include the El Niño / Southern Oscillation phenomenon. The Scotia Sea is the most direct pathway for dense waters of the overturning circulation emanating from the Weddell Sea to fill much of the world ocean abyss. The regional changes reported have the potential to affect the climatically significant ventilation of the global ocean abyss.
3. A first assessment has been made of the circumpolar distribution of sea ice and snow thickness distribution around the Antarctic continent. Results are presented on seasonal and regional variability of the sea ice (and snow cover) thickness distribution based the SCAR Antarctic Sea Ice Processes and Climate (ASPeCt) climatology of ship observations from 1980 to 2005.
4. A new medium depth (136 m) ice core has been drilled in a high accumulation site on the south-western Antarctic Peninsula during 2007. The Gomez record reveals a doubling of accumulation since the 1850s, from a decadal average of 0.49 m (water equivalent) per year in 1855-1864 to 1.10 m per year in 1997-2006, with acceleration in recent decades. Comparison with published accumulation records indicates that this rapid increase is the largest observed across the region. Evaluation of the relationships between Gomez accumulation and the primary modes of atmospheric circulation variability reveals a strong, temporally stable and positive relationship with the Southern Annular Mode (SAM).
5. SASOCS, the “State of the Antarctic and Southern Ocean Climate System”, is a first assessment that has been made covering the last 10,000 years and the next century.

Interhemispheric Conjugacy Effects in Solar Terrestrial and Aeronomy Research (ICESTAR). Selected Science Results.

-Geospace-atmosphere coupling: Lightning activity during strong thunderstorms is known to launch electromagnetic waves which propagate both in the wave guide between the earth surface and ionosphere (spherics) and along geomagnetic field lines (whistlers). The waves propagating along the field-aligned ducts can interact with radiation belt electrons and under certain conditions cause their precipitation into the atmosphere. The coupling between lightning, spherics, whistlers and energetic electron precipitation at middle latitudes has been known for a while but clear observational evidence has been missing so far. Recent studies with combined observations from VLF-antennas, lightning detection system, and the DEMETER satellite, show that there really exists a causal relationship between lightnings and electron precipitation events. DEMETER carries instrumentation both for detecting electromagnetic waves and electron fluxes which together with the ground-based observations enables testing theoretical models connecting the intensity of electromagnetic waves with precipitation fluxes.

-Solar-Terrestrial physics: The correspondence between energetic particle injections at the geostationary orbit and energetic electron precipitation into the ionosphere during storm time substorms has been studied. During strong solar wind forcing, substorms tend to appear as quasi-periodic activations called sawtooth events. The analysis reveals that first activations during sawtooth sequences can resemble very much isolated substorms from ionospheric viewpoint, but later on the picture becomes more complicated. Comparison of ionospheric precipitation observations from midnight and morning sectors suggests the magnetospheric electrons to experience significant energization due to dawnward drift at geostationary distances. Virtual observatories, for this case GAIA, and other web-based data servers can nowadays be used fluently as a combined asset to address the coupling processes of different scale sizes in geospace phenomena.

-Interhemispheric comparison studies: The initial tests about the appearance of interhemispheric conjugacy in small scale auroral structures, conducted with paired aircraft flight in late 1960's, showed that in some cases northern and southern auroras resemble each other surprisingly well and even pulsating structures can evolve in concert at both hemispheres. These observations suggest some wave-particle interaction occurring at the magnetospheric equator to cause the synchronous precipitation variations. More recent observations with ground-based all-sky TV-cameras suggest, however, that independent modulation sources for each hemisphere located far from the equatorial plane can also exist. Detailed analysis of all-sky images shows simultaneously non-pulsating structures which are similar in south and north and thus prove the ambient conjugacy and pulsation structures with obviously missing conjugacy. Two types of non-conjugacy emerge: (i) pulsating auroras can appear in both hemisphere but their spatial appearance and period are different and (ii) pulsating auroras appear only in one hemisphere.

-Planetary Waves, Ozone Distribution And Tropopause Height Asymmetries In connection To Antarctic Peninsula Warming: Decadal variations of the quasi-stationary wave amplitude and zonal structure have been analyzed using the TOMS data. Seasonal dependence of total ozone content (TOC) is considered. The amplitudes of quasi-stationary planetary waves in TOC zonal distribution at high latitudes of Southern Hemisphere have been calculated for 1979-2005. The highest values of the quasi-stationary wave amplitude are observed at latitude 65S in October. The asymmetry of total ozone distribution over the Antarctic region during Austral spring is discussed. The amplitude and longitudinal position of zonal anomalies are calculated for total ozone content distribution along seven individual latitude bands at 5-degree intervals between 50S and 80S. The mid-latitude ozone-rich collar has a mid-latitude maximum with mean position between 90E-180E longitudes and with up to 390 DU. The significant planetary wave TOC minimum eastward shift about 40 degrees in longitude is observed over Weddell Sea during 1979-2005, whereas the zonal maximum is relatively stable in position. This displacement is discussed in connections to latest findings of the strengthening circumpolar westerlies and regional climate warming in Antarctic Peninsula. Tropopause height anomalies over Antarctic region show seasonal change associated with total ozone losses during spring months. The tropopause height anomaly in West Antarctica coupled with its increasing decadal trend could be involved in climate change in this region.

SALE – Sub Antarctic Lake Exploration, inter disciplinary SRP.

Subglacial environments are now known to be continental-scale phenomena. The importance and role of subglacial water is recognized as central to many processes that have shaped the Antarctic continent and its ice sheets today and in the past. Subglacial environments include a range of features that differ in geologic setting, age, evolutionary history, limnological conditions, and size. These environments are "natural" earth-bound macrocosms that in some instances trace their origins to a time before Antarctica became encased in ice. Subglacial environments are isolated from the weather, the seasons, and celestially controlled climatic changes that establish fundamental constraints on the structure and functioning of most other earth-bound environments. In contrast to these other habitats, where solar energy is a primary influence, processes in subglacial environments are mediated by the flow of the overlying ice, a glaciological boundary condition, and the flux of heat and possibly fluids from the underlying basin, a tectonic control. The spectrum of types of sub-ice environments that occur across the Antarctic continent provides an unparalleled opportunity to explore and study one of earth's last frontiers and decipher fundamental earth and life processes. The exploration and study of subglacial environments will advance our understanding of how life, climate, and planetary history have combined to produce the Antarctic continent as we know it today. SCAR SALE encourages adherence to the agreed guiding principles for sub-glacial environmental stewardship, exploration, research, and data management. SCAR SALE continues to promote, facilitate, and champion international cooperation and collaboration to explore and study subglacial environments in Antarctica.

Reports on the Action and Expert Groups

Ice Sheet Mass Balance and Sea Level (ISMASS) Expert Group. Leader: C. van der Veen (USA)

There has been significant progress (by the national agencies and individual researchers) towards the scientific objectives of ISMASS during the past two years.

The latest assessment report issued by the IPCC challenges the glaciological community to develop better prognostic ice sheet models for predicting how the ice sheets of Greenland and Antarctica will respond to projected warming trends. Within the glaciological community, ISMASS has taken the lead in engaging the broader community to develop a strategy for developing the next generation of ice sheet models. This has resulted in the publication of SCAR Report 30, which outlines the shortcomings of existing models unable to explain recent observations.

With a view to responding to the request of IPCC, ISMASS has organised a workshop in the days prior to the SCARXXX meeting; a report follows:

Recognising the importance of ice sheets in controlling global sea level, and the inadequacies in current efforts to model observed rapid changes in ice sheets (outlined in detail in SCAR Report 30, “*A need for more realistic ice-sheet models*” by C.J. van der Veen and ISMASS), a Workshop was considered timely to develop a community strategy on how best to (i) improve the physical understanding of ice sheet processes responsible for rapid change; (ii) incorporate improved physical understanding into numerical models; (iii) assimilate appropriate data into the models for calibration and validation; and (iv) develop prognostic whole ice-sheet models that better incorporate non-linear ice-sheet response to environmental forcing (such as change in surface mass balance, loss of buttressing from floating ice shelves and ice tongues, and rising sea level). About 45 scientists from different disciplines (ice-sheet modelling, subglacial geophysics and hydrology, oceanography and atmospheric science) participated in formulating a Science Plan, outlining a community strategy for the next 5-10 years to address current inadequacies in prognostic ice-sheet models. Realizing what can realistically be accomplished over the decade, three key questions were formulated and research strategies outlined to answer these. A draft version of the Science Plan will be submitted to the broader polar community for comments and input during the Fall of 2008, with publication of the final version anticipated by the end of this year. The next step will be a Summer School to be held in 2009, and organized by ISMASS, with support from ICSU, SCAR, WCRP, IASC, IACS, CReSIS, and CIRES. We aim to bring together scientists from various disciplines for an intensive Summer School to improve ice-sheet models used to predict sea level change, and to train young researchers. Strengthening international efforts to better constrain sea-level predictions is of direct benefit to society. The Summer School will build on the improved understanding of rapid ice-sheet changes derived from projects undertaken during the International Polar Year 2007-2008 (IPY),

and will provide a legacy of the IPY by consolidating these results, training young scientists, and community building. Advances in ice-sheet modelling require international collaborations of scientists from a broad range of related disciplines.

The scientific activities of various nations aimed at understanding the mass balance of the Antarctic Ice Sheet will continue, coordinated by the ISMASS group.

Oceanography Expert Group: Leader E. Hoffmann (USA)

An update was presented to SSG-PS on the Ocean Expert Group and the Southern Ocean Observing System (SOOS). Since the meeting in Hobart in 2006 the SCAR/SCOR Oceanography Expert Group has revised its Terms of Reference and updated its membership to have a strong focus on the development of SOOS that puts into practice the Group's inter-disciplinary approach.

(For full details see: <http://www.clivar.org/organization/southern/expertgroup/tor.htm>)

The reasons and possible users of a SOOS were summarized before detailing the structure and plan. The first goal of the Expert Group has been to work on a SOOS plan that demonstrates:

- why sustained observations are needed in the Southern Ocean and what science/policy questions they address,
- what mix of observations are required to address these questions,
- what is presently done and possible,
- a vision for the future

Some examples of the observing system already in place as well as key gaps were discussed. During the St Petersburg meeting the group worked on strawman plans for each component of the SOOS (physics, ecosystems, cryosphere etc.), justifications for the observations, key gaps and draft recommendations. The group agreed on the next steps and writing assignments as well as a fairly strict timeline that will hopefully result in a complete document by mid October.

Operational Meteorology Expert Group: Leader Jonathan Shanklin (UK)

The SCAR Expert Group on Operational Meteorology in the Antarctic is an informal grouping for those undertaking active meteorological operations in Antarctica. Business is conducted through email, and by maintaining a web presence, which is updated several times a month. The Group complements the (former) WMO Executive Council Working Group on Antarctic Meteorology and in particular allows informal communication of operational issues, resulting in much quicker resolution of problems. The past two years has seen a significant increase in the number of stations contributing observations via the

GTS, and in several cases this has come about because a SCAR resolution was in effect. Areas of concern are the absence of an operational radiosonde station in the northern part of the Antarctic Peninsula, and the fact that many ships do not submit meteorological observations. Noting the concerns over climate change and how it affects Antarctica, it is very important to maintain routine observations from the Antarctic stations, particularly from those stations with long records, and it is hoped that those stations which resumed or commenced observation for the IPY will continue.

Environmental Contamination in Antarctica Expert Group: Leader G. Capodaglio (Italy).

The Action Group for Environmental Contamination in Antarctica (ECA), held its meeting in St Petersburg on July 7th, 2008. The data collected by the groups formed during the workshop held in Venice was presented and discussed.

The workshop was organized to discuss the following themes related to Antarctic environment:

- Contamination in terrestrial water and soil environments.
- Heavy Metals Occurrence in snow and ice.
- Presence and distribution of POPs in environmental matrices.
- Trace elements in water and sediment of the southern ocean.

In order to integrate and to facilitate access to the collected data and information, the relation of the Data Management of the ECA Action Group data base with the Joint SCAR-COMNAP Committee on Antarctic Data Management (JCADM) was also discussed.

The following priorities were identified for future activities:

-to organize the third ECA workshop aimed at:

1. -completing datasets for environmental contaminants;
 2. -identifying gaps in the existing data;
 3. -defining topics for joint research projects on environmental contamination in Antarctica.
- to support the integration of the ECA data base in the JCADM by construction of one dedicated portal;
- to recognize and separate local sources (bases, aircrafts, ships, traverses) from global contaminant signatures by identifying proxies of the potential sources. In this activity, the national responsible for the application of the Madrid protocol relevant to the environmental impact monitoring of the logistic and scientific activities should be involved;

- to optimize the use of samples collected for environmental characterization purposes and warranty reliable data by:
 1. defining the role of specimen banks (international collaboration)
 2. organizing proficiency tests for trace contaminant determination in environmental matrices which should take into account the possibility of preparing specific Antarctic reference materials;

The Antarctic Astronomy and Astrophysics (AAA) Expert Group: Leader J. Storey (Australia)

The group was established in 2002 to coordinate efforts to:

- Explore the potential for astronomy, astrophysics and cosmology from Antarctica
- Enhance existing observatories and programs in Antarctica
- Support the development of new facilities

During the six years of its operation there has been vigorous activity both in site-testing and in the development of proposals for medium-scale astronomical facilities. In Europe, the FP6 Coordinating Action, ARENA (Antarctic Research: a European Network for Astronomy) has held a series of international meeting focusing particularly on Concordia Station, Dome C. At the South Pole, the 10-metre South Pole [sub-mm] Telescope has come into operation, and construction of the IceCube array is proceeding. These existing stations on the plateau, at the South Pole and Dome C, have now been joined by new stations at Dome A and Dome F. Circumpolar balloon flights continue to provide access to a unique observational space.

As the level of activity in astronomy and astrophysics in Antarctica increased, it became clear by the XXIX in Hobart that a new Scientific Research Programme should be considered. The Antarctic Astronomy and Astrophysics (AAA) Scientific Programme Planning Group was approved at the meeting in 2006. A preliminary proposal for the SRP was presented to the SCAR Executive in July 2007. The full proposal was discussed by the SSG/PS at this XXX SCAR meeting in St Petersburg. Pending approval of the SRP by the Delegates, the AAA Expert Group will be dissolved.

IPICS - International Partnership on Ice Coring Science Expert Group: Leader E. Wolff (UK).

It has been determined that, according to the recommendation approved in Hobart, the IPICS initiative become an Expert Group of SSG/PS.

The IPICS Steering Committee met in Vienna, Austria on 19-20 April 2008. The aim was to endorse the science and outline implementation plans for the priority projects, and to

establish groups to oversee the implementation of the projects. Members of the IPICS Steering Committee, and other observers, attended the meeting. With the acceptance of Estonia, the IPICS SC now has representatives of 21 nations.

White Papers describing the IPICS projects, and the progress towards implementation were discussed over the two days. The 'Oldest Ice' project includes plans to drill at least one deep ice core in the Dome A region of Antarctica, and plans for airborne geophysical surveys in the forthcoming season were discussed, while other candidate sites in Antarctica are still being investigated.

The 'NEEM' (Greenland Eemian) drilling project is going ahead, with most of the funding in place, and drilling due to start in the summer of 2008. It was recognised that the 'last interglacial' was a critical period to the understanding of the current climate, and a group will investigate whether there should be a widening of the IPICS agenda to recognise this.

For the '40k Array' Project, several drilling campaigns have already been completed since the initiation of IPICS, with several further projects in various stages of planning and execution, and links to other PAGES communities spanning the same age scale should be sought.

The '2k array' Project has plans for a number of new cores which were discussed. There was vigorous discussion of the parameters measured on the high resolution shorter cores that form the '2K array' initiative.

The underpinning technology for ice core drilling and analysis formed the main bulk of the issues discussed in the 'Technology' group. The next IPICS meeting is planned for July 2009, associated with the PAGES OSM in Oregon. Details of the meeting, together with the five White Papers describing the main projects can be found on the IPICS website at www.pages-igbp.org/ipics.

PAntOS, Pan Antarctic Observing System Action Group. Leader: Scott Palo (USA).

Website: www.scar-pantos.org

The SCAR's multidisciplinary Action Group on the Pan-Antarctic Observations System (PAntOS) focuses on compiling details about currently existing or planned observational networks over the Antarctic in various scientific disciplines covered under the umbrella of the SSG/PS. The PAntOS Group main goal is to address the scope and implementation strategies for the potential development of a follow-on multidisciplinary Pan-Antarctic Observations Network encompassing the Antarctic Continent and the surrounding Southern Ocean. The optimum network scale for each element of the observing system will be investigated. This system of observing networks will focus on the measurement of conditions and detection of fundamental variations of physical parameters in the

Antarctic system. The network will serve both scientific and operational needs, and will help for high-resolution regional climate reanalysis poleward of 50°S.

PAntOS Objectives

PAntOS will be built on and enhance existing national and international observing efforts for the delivery of easily accessible and reliable pan-Antarctic observations. The PAntOS initiative includes three phases outlined below.

- Phase I: Identify and understand current and planned observation networks over the Antarctic. Develop a website to disseminate PAntOS related information.
- Phase II: Identify key variables that need to be observed in the Antarctic over long time for terrestrial climate change studies, as well as understanding climatology of near-Earth space (geospace) and corresponding solar activity regimes ultimately affecting Earth's climate.
- Phase III: Deliver a comprehensive analysis of the existing observational networks with an initial assessment of where deficiencies or over-provision exist, and recommend protocols for assembling networks' data via a family of Virtual Antarctic Observatories. Provide recommendations to SCAR for improving and enhance existing systems for the forming of the interconnected multidisciplinary Antarctic observing network.

Action Group on King George Island Science: Leader V. Lagun (Russia).

The group has worked to create a comprehensive interdisciplinary dataset of current and historic scientific observations of King George Island parameters, including meteorological, actinometric, upper-air, sea and terrestrial ice cover, geobotanic, biologic, permafrost dynamics and atmospheric chemistry data provided by 9 permanent scientific stations, automatic weather stations and satellite information (1968-2008) for the numerical detection of the local climate warming signal and to facilitate coordination of IPY studies.

Intercomparison studies, joint probabilistic data analysis, data quality control processing, and meteorological estimates in collaboration with Chile, Argentina, Poland, Germany, Uruguay, Brazil, UK, USA, China, Korea and Ukraine scientists have been carried out. A special Internet resource has been created to demonstrate the use of data for a regional electronic Climate Handbook.

Key results from the work of the Action Group were as follows:

The definitive archive of meteorological and upper air data for King George Island has been constructed using individual observation results;

The surface and free atmosphere temperature, wind speed, geopotential and water vapor trends have been determined;

The annual surface temperature trend over the northern part of Antarctic Peninsula is $+0.03 \pm 0.02^\circ$ /year, being significant at 1% level

Great tropospheric warming and increasing of water vapour have been observed from 850 hPa and higher, and an increase of total cloud thickness has been detected.

Other participants noted that nice scientific results are emerging from coordinated glaciological research on the age of the KGI ice cover. Furthermore, Lucia Campos (Brazil) is coordinating CAML activities in that region.

A roadmap for the future work of the Action Group was recommended:

- 1. that support be provided (perhaps multi-operator) for a KGI radiosonde programme;*
- 2. that the Arctowski synoptic observations be renewed (this is in hand)*
- 3. that a wide range of climate parameters be collected at 3-hourly and 6-hourly intervals by all stations, and routinely exchanged.*
- 4. the SCAR KGI Action Group continue to compile information to complete the inventory of KGI science by XXXI SCAR.*
- 5. the Chief Officers of the SCAR SSGs or their representatives be enrolled as part of the KGI Action Group to provide a close connection to SCAR science programmes.*
- 6. that Jefferson Simões contact Tania Brito to find out what the Admiralty Bay ASMA encompasses, and to see to what extent its work could be a model for other scientific activities across KGI, and to determine how best to link it (if possible) to SCAR's interests across KGI.*
- 7. that SCAR and COMNAP to be asked to consider the proposal that a working paper on "Major scientific themes that could be addressed by a coordinated approach to KGI science" (or some such title) should be addressed to the COMNAP meeting in Punta Arenas (June 2009), as the basis for a discussion on how such coordination might be achieved, and by what means.*
- 8. that national SCAR representatives be urged to broadcast widely the message that to the extent possible we need local (i.e. KGI) science to be devised in such a way as to make a significant contribution to SCAR science programmes.*

Report on groups cosponsored by SCAR:

IPAB – International Partnership on Antarctic Buoys: Leader Christian Haas (Canada).

IPAB had some extensive buoy deployments during UK, Australian, and US cruises of the J.C. Ross, Aurora Australis, and Nathaniel B. Palmer. More than 15 buoys were deployed in February, March, September and October 2007 in the Bellingshausen Sea,

Ross Sea, and East Antarctic by various IPAB partners to study small scale ice deformation and large scale ice drift. IPAB will hold its biennial meeting in Bern in early July 2008 to discuss first results of this intensive buoy deployment campaign, within a workshop.

Budget

Group	2009	2010
ISMASS	7500	7500
IPICS	3000	3000
ECA	2000	2000
PAntOS	-	-
Op. Met.	3000	-
GPS Space Weather	5000	5000
Oceanography	5000	5000
Astronomy	3000	-
KGI	-	-
Cross-link (Space weather and weather)	1000	1000
ICESTAR	-	3000
Total	29500	26500

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New recommendations (internal to SCAR)

1. New action group: Polar Atmospheric Chemistry at the Tropopause (PACT)

SCARXXX- SSG/PS-1

A new action group is proposed to seek better understanding of the changes in the temperature structure of the Antarctic troposphere and regional climate variations by promoting investigation of radiative and dynamical processes at the tropopause. The group will do this by making new information derived from ozonesondes available to the international scientific community for study of the polar tropopause.

Specifically, the group will add key polar tropopause region parameters to the International Global Radiosonde Archive:

- High resolution profiles of ozone mixing ratio and partial pressure in the vicinity of the tropopause.
- Height of the chemical tropopause derived using ozone measurements.
- Forward and backward analysis of air parcel history for selected parcels sampled by ozonesondes and radiosondes.

This task will involve analysis and preparation of data, development of tools and development of a database.

The proposed activities will provide the international community with new information to assist in model validation and in simulation of this important part of the polar atmosphere.

The group propose at timeline with production of data, a scientific publication and a report to SCAR to be completed by July 2010. The full proposal is available from SSG/PS.

2. New Action Group: GPS for weather and space weather forecasting

SCARXXX- SSG/PS-2

This proposed new Action Group aims to bring together researchers from the former ICESTAR SRP with the POLENET network to provide ionospheric imaging, facilitate data and technology exchange with the broader community. Using new techniques, the group will deliver greater understanding of the polar ionosphere and ionospheric processes.

Specifically, the objectives of this group has the following aims:

- Ionospheric imaging over Antarctica.
- 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 group will deliver the following:

- One meeting per year among the WG members
- Joint publications on peer reviewed journals
- Joint presentation at national and international conferences
- Web site realization, maintenance and updating

SSG/PS also notes interest from the wider physical sciences and geosciences community in using POLENET for new applications, including a proposal from SSG/GS for a Scientific Program Planning Group on Solid Earth Response and Cryospheric Evolution (SERCE) that will use POLENET data. SSG/PS encourages development of new linkages with the proposed “GSP for Weather and Space Weather Forecasting” action group. The full proposal is available from SSG/PS.

3. Concerning a Code of Conduct for the Exploration and Research of Subglacial Aquatic Environments. SCARXXX- SSG/PS-3

Subglacial aquatic environments are becoming an increasingly important focus for Antarctic science. A primary focus of research will involve questions about microbial life in these unusual biomes that are now known to be quite prevalent across the Antarctic landscape beneath thick ice sheets. The scientific goals of this research will require entry, sampling, and emplacement of sensors in SAE at multiple sites. These environments are potentially sensitive to disturbance during efforts to enter and sample these environments in the conduct of important ground-breaking research. Recognizing the value of these environments and the need to exercise wise environmental stewardship, it is recommended that a “Code of Conduct for the Exploration and Research of Subglacial Aquatic Environments” be developed.

The Code would be developed by an Action Group comprised of suitable representatives from the three SSGs since a wide range of disciplines are involved in research in these environments and bring differing but important perspectives on protecting these environments. The AG should be made aware of the recent US National Research Council which provides helpful information and a starting point for developing the Code.

4. Concerning SCAR seeking observer status with the Intergovernmental Panel on Climate Change. SCARXXX- SSG/PS-4

Recognising the key role Antarctica plays in the global climate system, the changes that have become evident in recent decades and the likely consequences from future changes.

Acknowledging the important role played by the IPCC in assessing climate science since its inception in 1988

Noting that Antarctica is the only region of the earth that has no representation in its own right.

Cognizant of SCAR's role and responsibility in the Antarctic Treaty System for facilitating and disseminating the results of Antarctic research

Seeking to assist the IPCC to the greatest extent possible in future planning for the consideration of Antarctic research in its assessment of the state of the earth's climate system, past, present and future,

Recommend that SCAR seek observer status through the process outlined in INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE (14.III.2008)

TWENTY-EIGHTH SESSION IPCC-XXVIII/Doc.5, Corr.1

Old Recommendation internal to SCAR (from Hobart). SSG/PS wants this to stand.

Concerning the biogeochemical status of the Southern Ocean. SCARXXX- SSG/PS-5

The increasing concentration of CO₂ in the atmosphere and the consequences for the biogeochemical status of the Southern Ocean in particular the pH of the ocean are issues of concern. They may have consequences for the ecosystem of the Southern Ocean and require monitoring and research. SCAR should support research being undertaken by IMBER and SOLAS in this area. In particular, SCAR should encourage the SCAR Evolution and Biodiversity group to consider and discuss this issue. There should be particular attention given to this issue at the next Ocean Science conference, i.e. a special session

Recommendations external to SCAR

Concerning continued support of existing geospace observatories. SCARXXX- SSG/PS-6 (Originally SCAR XXVIII-6)

The Scientific Committee on Antarctic Research (SCAR) is concerned regarding planned closures of instruments and downgradings in their maintenance. The equipment under threat have provided irreplaceable data for several years, in some cases even for decades. Examples are: SuperDARN radars, VLF receivers, magnetometers, riometers, and ionosondes. SCAR recommends support by national funding agencies for continued operation of these infrastructures and for reliable archiving solutions for the data that they are providing.

Concerning Upper air and ionospheric observations along the Antarctic Peninsula SCARXXX- SSG/PS-7 (Originally SCAR XXVIII-9, plus SCAR XXIX -3 (replaced XXVIII-18) and XXIX-4)

SSG/PS

-Recognizing the importance of upper air observations for operational numerical weather prediction in the Antarctic Peninsula, a region of marked climatic change over recent decades,

-Noting that the Antarctic Peninsula is a unique topographic feature that may significantly interact with the tropospheric flow and thus may be a source of atmospheric gravity waves, which can propagate to ionospheric heights, and

-Taking into account an envisaged cooperation between the Solid Earth (POLENET) and Upper Atmosphere (UAMPY, SUPERDARN) communities that can greatly increase the value of current and future ground based and GPS observations over Antarctica, thus

clearly aiming at the synergy expected from SSG-GS and SGG-PS goals,

SCAR urges that

- i. countries doing upper air observations along the Antarctic Peninsula, particularly at the tip of the peninsula, coordinate operation and optimize resources to secure continuous daily sounding till at least the end of the IPY, and preferably beyond, and that
- ii. countries that have done ionospheric sounding over the Antarctic Peninsula, consider to restart observations, and those that are currently doing them to upgrade their installations.

Concerning sea ice observations. SCARXXX- SSG/PS-8 (Originally SCAR XXIX-6)

The Antarctic Sea Ice and Climate Program has developed a protocol for making standardised and quantified observations of sea ice properties from vessels operating in the Antarctic pack ice zone. The ASPECT data archive now comprises 83 voyages of data that provide an extremely valuable resource to the climate and modelling communities. The SSG/PS recommends that COMNAP urges national programmes to contribute sea ice observations made from their icebreaking research and supply vessels. This may include training of ship officers to conduct observations.

Concerning drifting buoys. SCARXXX- SSG/PS-9 (Originally SCAR XXIX-7)

As part of the plan for increased observations in the sea ice zone for IPY, SCAR encourages delegates to commit financing for one or more data buoys to be deployed by the logistic resources which is being coordinated by the International Programme for Antarctic Buoys.

Concerning meteorological observations for weather forecasting and the IPY
SCARXXX- SSG/PS-10(Originally SCAR XXIX-8)

Real-time surface meteorological observations from both land and sea remain critical in providing accurate weather forecasts. Such observations are also vital for many science programmes and are the key data for studies of climate change. SCAR recommends that:

- a) All research and supply ships operating in Antarctic waters and traverse parties (using the MOBIL code) should contribute real-time meteorological observations to the WMO GTS.
- b) Climatic data from land stations should be submitted to GCOS via the WMO GTS shortly after the end of each month.

c) In order to help planning of instrument deployment opportunities the group requested COMNAP to construct a web page listing intended ship movements.

d) Aircraft operating on long distance flights in Antarctica should be encouraged to report AIREPS