

SCIENTIFIC COMMITTEE ON ANTARCTIC RESEARCH

**STANDING SCIENTIFIC GROUP ON
PHYSICAL SCIENCES**

REPORT TO THE SCAR DELEGATES

OCTOBER 2004

1. INTRODUCTION

This document presents a summary of activities carried out by the SCAR Standing Scientific Group on Physical Sciences (SSG/PS) 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,
- and an action timetable for the next two years.

Expanded reports on the work of the various sub-groups are in the minutes of the SSG/PS meeting held in Bremen, available from the SSG/PS web site (http://www.antarctica.ac.uk/met/SCAR_ssg_ps/). The web site also contains national and other reports on science that comes under SSG/PS.

2. REPORT OF THE SSG AS A WHOLE

The SSG/PS was formed in July 2002 during the re-organisation of the SCAR subsidiary groups that took place following the major review of the organisation. The SSG evolved from the three former working groups on Physics and Chemistry of the Atmosphere (PACA), Glaciology and Solar-Terrestrial and Astrophysics Research (STAR), and also took responsibility for a number of ongoing activities that came under the GLOCHANT Group of Specialists. It therefore covers a broad range of science that embraces:

- the climatology and meteorology of the Antarctic as investigated via the *in-situ* meteorological reports, ice cores and numerical models
- atmospheric and ice chemistry, along with aerosols
- glaciological investigations of the Antarctic ice sheet and surrounding sea ice
- studies of solar-terrestrial phenomena and geospace
- astronomical investigations carried out from the Antarctic Plateau
- and increasingly, as discussed below, the physical oceanography of the Southern Ocean and more northern waters as they relate to the climate of the Antarctic

The first two years of SSG/PS have been very much a period of transition between the activities of the old Working Groups and the period when the new SCAR Programmes will be the primary focus for SCAR sciences. We have therefore put a considerable amount of effort into developing our two programme proposals on Antarctica and the Global Climate System (AGCS) and Interhemispheric Conjugacy Effects in Solar-Terrestrial and Aeronomy Research (ICESTAR). Much of the planning for these initiatives has been carried out by email, but planning/drafting meetings were held in Cambridge, UK for AGCS and Villefranche-sur-Mer, France for ICESTAR. The outline proposals for the programmes were approved by the SCAR Executive in Brest, France, July 2003 (ICESTAR) and Bremerhaven, Germany, January 2004 (AGCS). The full, 15 page proposals were revised in the light of discussions at SCAR XXVIII and presented to SCAR in August 2004.

Over the last two years most of the scientific work of SSG/PS has been carried out by its seven Action Groups and six Expert Groups. Their work has consisted of ongoing activities from the old Working Groups/Groups of Specialists and some new initiatives begun at SCAR

XXVII. Details of their work are presented below, but we would flag the following as some of the science highlights:

- The MOSAK Action Group has produced an improved near-surface wind field for the Antarctic, which is in press in the International Journal of Climatology (van Lipzig, N P M, Turner, J, Colwell, S R and Van den Broeke, M R. 2004. The near-surface wind field over the Antarctic continent. International Journal of Climatology).
- A successful SCAR Symposium on Antarctic Glaciology was held in Milan, Italy over 25-29 August 2003 at which 211 papers were presented.
- The International Antarctic Weather Forecasting Handbook has been published in conjunction with COMNAP. The volume was originally published on CD but a hardcopy version has just been published using funds provided by the World Meteorological Organisation.
- The READER Action Group has produced a new, improved data base of mean, Antarctic tropospheric/stratospheric temperatures, winds and heights from radiosonde observations (<http://www.antarctica.ac.uk/met/READER/>). The data base and mean conditions are described in Turner, J, Colwell, S R, Marshall, G J, Lachlan-Cope, T A, Carleton, A M, Jones, P D, Lagun, V, Reid, P A and Iagovkina, S. 2004. The SCAR READER project: Towards a high-quality database of mean Antarctic meteorological observations. Journal of Climate 17: 2890-2898. A paper on Antarctic climate change over the last 50 years is under revision with the International Journal of Climatology.
- 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 between ISMASS and the Antarctic Neotectonics (ANTEC) Scientific Programme Planning Group of the Geosciences SSG. The lead paper in the Special Issue is the report from the ISMASS Committee meeting in Annapolis, Maryland, USA, Recommendations for the collection and synthesis of Antarctic ice sheet mass balance data.
- Significant new astronomical results have been obtained in the last decade from the Amundsen-Scott South Pole Station, including measurements of the cosmic microwave background radiation (CMBR) and galactic/interstellar emission in a sub-millimeter diapason, as well as infrared observations of the Milky Way. More than 50 refereed papers have come from these data, and the CMBR polarization has been first ever measured from the Antarctic.
- The ASPECT data base of sea ice observations continues to grow with data from 81 voyages being added over the last two years. The data archive has been used for a number of recent studies, including comparisons with satellite ice edge location to determine seasonal variability in the reliability in the satellite estimates, comparisons with sea ice-ocean model and the development of a circumpolar climatology of area-averaged albedo.
- ITASE collected more than 240 firn cores (for a total of 7,000 m) and about 20,000 km of snow radar resulting in numerous publications most recently highlighted in Milan Annals of Glaciology and Bremen Annals of Glaciology dedicated volumes. In addition ITASE developed multi-centennial scale proxies for sea ice, regional temperature, and major atmospheric circulation features plus new continental scale maps depicting the distribution of major chemical species over the ice sheet.

Over the last two years we have attempted to improve communications both within SSG/PS and with the broader Antarctic and global Earth system science community. The SSG/PS web site (http://www.antarctica.ac.uk/met/SCAR_ssg_ps/) provided details of all our

subsidiary groups, and also publicises our meetings and provides report. An SSG/PS mailing list is available based on those who have attended recent SSG/PS meetings at SCAR, plus those who have been nominated as representatives to the SSG by several National SCAR Committees. However, we would urge other National SCAR Committees to inform us of their representatives to the SSG so that we can maintain liaison with scientists working in relevant areas of Antarctic science.

At SCAR XXVII it became clear that oceanography was becoming of increasing importance to many aspects of the science carried out by SSG/PS. An Action Group on SCAR and Oceanography was therefore established to determine how oceanography should be incorporated into SCAR science and advise on linkages that could be established with other bodies. A meeting was therefore held on SCAR and Oceanography in Rome in October 2003. Several recommendations were made and since that time SCAR has signed MOUs to co-sponsorship of the CLIVAR-CliC Southern Ocean Panel and establish a new SCAR/SCOR Coordinating Group on Interdisciplinary Southern Ocean Science (ISOS). SCAR is also now co-sponsoring the International Programme for Antarctic Buoys. Because of the need for long-term coordination of oceanography within SCAR it is recommended below that the SCAR Action Group on Oceanography be converted into an Expert Group.

3. BRIEF REPORTS OF THE SUB-GROUPS

PROGRAMME PLANNING GROUPS

Antarctica and the Global Climate System (AGCS)

The AGCS Programme Planning Group was established at SCAR XXVII with the following terms of reference:

- Determine the future directions and interdisciplinary links of SCAR climate system and climate impact science. This would possibly (but not necessarily) include the development of a major new Scientific Programme.
- Provide a climate system research network to advise the SCAR Executive and community and to provide a pool of expertise for the representation of SCAR in external fora.
- Forge and maintain increased interaction and cooperation between SCAR and the other major international programmes concerned with climate (WCRP, IGBP, IHDP, etc)
- Ensure that the direction of SCAR-promoted research was guided by the requirements of global programmes and that the outcomes of SCAR programmes were fully integrated into global system science.

The PPG met once at the headquarters of the British Antarctic Survey over 3-5 February 2003 and prepared an outline programme proposal. This was submitted to the Executive and accepted at their meeting in Bremerhaven in January 2004. A full 15-page proposal was then prepared over the following months and discussed extensively at SCAR XXVIII. The revised proposal was submitted to SCAR in August 2004.

Interhemispheric Conjugacy Effects in Solar-Terrestrial and Aeronomy Research (ICESTAR)

Vladimir Papitashvili, the leader of this PPG, took the lead in preparing the outline programme proposal. An informal meeting of some members of the PPG was held during the

workshop on “The scientific outlook for Astronomy and Astrophysics Research at the CONCORDIA station” held in Capri during April 2003. However, the draft proposal was discussed extensively over 22-23 April 2004 at the ICESTAR planning meeting held in Villefranche-sur-Mer (near Nice), France. Following further discussions at SCAR XXVII the full ICESTAR proposal was submitted to SCAR in August 2004. The new leader of the PPG is Dr. Allan Weatherwax (USA).

For more details on ICESTAR see <http://maggy.engin.umich.edu/mist/icestar/icestar.html>.

The near-Earth space (geospace) is an integral part of the Earth system, providing the material link between the Sun and Earth, primarily through the polar regions, and posing a potential hazard to space-borne and ground based technology on which human society is increasingly dependent. Understanding of the complex geospace environment has matured to the level of being able to describe many of its components and mechanisms. A major goal of the proposed Programme is to seek a unified framework that can specify and predict the geospace’s global state and, therefore, “space weather”. To enable this, this Programme will establish a forum and working groups to provide an Internet-based portal to all Antarctic geospace data and metadata, and tools for extracting and reducing these data into value-added products, similar to those available or being developed in other areas of SCAR science. The proposed activity aims at making SCAR one of the leading bodies for solar terrestrial physics research, in coordination with SCOSTEP (the ICSU Scientific Committee for Solar Terrestrial Physics), the space agencies involved in this field of investigation (NASA, ESA, and the national space research agencies), and in close liaison with the polar programs for research in the Arctic, and IASC.

EXPERT GROUPS

Solar-Terrestrial Processes and Space Weather (STEPS)

The main effort here has been in preparing the ICESTAR proposal.

Antarctic Astronomy and Astrophysics (AAA)

Three meetings have been held since SCAR XXVII, in Capri (Italy) in April 2003, in Sydney (Australia) in July 2003 and in Toulouse (France) in June 2004.

The Capri meeting was sponsored by the European Polar Board, IPEV and PNRA. Many members of AAA & PASTA attended, and informal discussions were held on a number of topics. Entitled “The Scientific Outlook for Astronomy and Astrophysics Research at Concordia Station”, the meeting attracted over 70 attendees. This was the fourth meeting in a series discussing the prospects, plans and results from the development of Concordia Station at Dome C (following Casaccia (Italy) in April 2000, Hobart (Australia) in July 2001 and Nice (France) in November 2001).

The first formal meetings of PASTA and AAA were held during the period of the International Astronomical Union 25th General Assembly in Sydney in July 2003. As part of the IAU GA a session on Astronomy in Antarctica (Special Session 2 – SPS2) was held on the 18th of July in the Sydney Convention Centre, and featured a review of astronomical results about from a variety of experiments being undertaken in Antarctica. It also included a live link-up with scientists at the Amundsen-Scott South Pole station, who described the experiments they were working on there that winter. The following day a workshop on “Visions for Antarctic Astronomy” was held at Taronga Park Zoo in Sydney (the “Zoo” meeting), under the auspices of AAA and PASTA. This featured a free-wheeling discussion

on the prospects for Antarctic astronomy across a range of disciplines, and provided an inspirational forum for exchanging ideas on the remarkable possibilities that the unique climatic conditions of Antarctica offer for a wide range of astronomy. Proceedings for both the IAU GA and Zoo meetings were prepared, edited by Michael Burton, and will be published in Volume 13 of the IAU's 'Highlights in Astronomy' series in 2004, covering the highlights of the 25th GA. Approximately 100 people attended these meetings in Sydney.

The funds awarded to AAA and PASTA (1K) were used to help support attendance at the Zoo meeting, with the IAU providing a further 1K to help attendance at the SPS2 session.

Operational Meteorology in the Antarctic

A major initiative of this group has been to try and ensure that the latest developments in Antarctic meteorological research are being used to improve weather forecasting in the Antarctic. This has resulted in the preparation of the International Antarctic Weather Forecasting Handbook. This 700 page volume grew out of the proceedings of the First International Symposium on Operational Weather Forecasting in the Antarctic, held in Hobart, Australia over 31 August – 3 September 1998. The handbook is a joint venture between SCAR, COMNAP, the British Antarctic Survey, the World Meteorological Organisation, the Australian Bureau of Meteorology and the International Commission on Polar Meteorology. Dozens of forecasters and research scientists contributed to the volume and it was initially published on CD-ROM, and a version can now be downloaded from the web (<http://www.antarctica.ac.uk/met/jtu/ftpinst.html>). Recently the World Meteorological Organisation has provided funding for a hardcopy version to be published and copies are being sent to all Antarctic operators, polar libraries and SCAR National Committees.

Ice Sheet Mass Balance and Sea Level (ISMASS)

ISMASS Workshop

On 24 August 2003, a one-day ISMASS workshop was held at University Bicoca, Milan. Presentations included:

- Wind-driven sublimation impact on surface mass balance in East Antarctica – Massimo Frezzotti
- Interannual Antarctic climate and surface mass balance variability - Christophe Genthon
- Observed variability in Antarctic accumulation rates and implications for mass balance calculations - Gordon Hamilton
- CECS/NASA airborne exploration of the Amundsen Sea Glaciers and the Antarctic Peninsula - Gino Casassa
- On the Sea Level Contribution due to Glacier Retreat on the Eastern Antarctic Peninsula – Helmut Rott
- Assessment of mass balance variability in Dronning Maud Land based on radio echo sounding, SAR interferometry, and field measurements – Uwe Nixdorf and Wolfgang Rack
- AMISOR - Amery Ice Shelf Ocean Research – Jo Jacka
- Ice flow properties and their effect on the ice-thickness change at Dome Summit South, Law Dome, East Antarctica - Weili Wang
- Results from ICESat - Jay Zwally

SCAR Symposium on Antarctic Glaciology

A total of 211 papers were presented at the Seventh SCAR International Symposium on Antarctic Glaciology (ISAG 7) held in Milan from 25 to 29 August 2003. Two hundred and seven participants attended. Many of the papers were relevant to and stemmed from the ITASE, ISMASS, ASPeCT and READER Expert Groups of the SCAR Physical Sciences SSG and the SALE Expert Group of the Geosciences SSG. *Annals of Glaciology* 39, due to be published before the end of 2004, will contain 87 papers from the ISAG 7 symposium.

ISMASS/ANTEC Special Issue of *Global and Planetary Change on Ice Sheet Mass Balance and Neotectonics*

The July 2004 issue (released during XXVIII SCAR) of *Global and Planetary Change* is a Special Issue on Ice Sheet Mass Balance and Neotectonics. This has been a joint effort between ISMASS and the Antarctic Neotectonics (ANTEC) Scientific Programme Planning Group of the Geosciences SSG. The lead paper in the Special Issue is the report from the ISMASS Committee meeting in Annapolis, Maryland, USA, **Recommendations for the collection and synthesis of Antarctic ice sheet mass balance data.**

The International Trans-Antarctic Scientific Expedition (ITASE)

1. Numerous National ITASE Meetings were held over the last two years
2. Milan Glaciological Society ITASE August, 2003 Meeting – Product: Papers in *Annals of Glaciology* Volume 39
3. Bremen SCAR Meeting, July 2004
 - a. *Annals of Glaciology* ITASE/ISMASS Dedicated Volume
 - b. Bremen SCAR ITASE Synthesis groups and coordinators summarized:
 - Mass-balance (precipitation) - Coord: Massimo Frezzotti (Italy)
Accomplishments: Large arrays, many linked by shallow GPR.
 - Isotopes (temperature proxy) - Coord: Hans Oerter (Germany)
Accomplishments: Add to existing array, co-registered to other parameters, calibrated to satellite imagery.
 - Chemistry (atmospheric circulation proxy) - Coord: Nancy Bertler (New Zealand)
Accomplishments: Large arrays, additional parameters, volcanic markers, linked aerosol studies
 - Climate variability - Coord: Tas van Ommen (Australia)
Accomplishments: Large arrays, climate proxies (Amundsen Sea Low, East Antarctic High, Westerlies, ENSO)
 - Change in the chemistry of the atmosphere – Coord: Margareta Hanson (Sweden)
Accomplishments: Large arrays, changes in atmospheric circulation deconvoluted
 - c. ITASE Data Planning - Coord: Rob Bauer (US)
 - d. ITASE Executive Summary to be included in Bremen *Annals of Glaciology* dedicated volume - Coord: Paul Mayewski (US)

Antarctic sea-ice processes and climate variability (ASPeCT)

Plans were completed for a drifting station on the summer pack ice of the Weddell Sea, under sponsorship of the Alfred Wegener Institute, Bremerhaven Germany. Ice Station Polarstern, or ISPOL, will drift during the November 2004 to Jan 2005 period in the western Weddell

Sea. As well as the German sea ice programme, other activities were encouraged by ASPeCt and have led to international participation by Australian, US, and Belgian investigators on several components of the sea ice programme. The measurements will also include a strong effort to measure sea ice biological components, using the physical measurements to determine the primary thermal and light regimes as some of the constraints on the biology.

The sea ice and snow thickness data base obtained from ship-based visual observations continues to have contributing cruises from other programmes such as AnSlope. Three cruises in the Ross Sea were made with ice observers provided by ASPeCt (2003-2004) along with plans for participation in an upcoming AnSlope cruise in late 2004. A UK cruise to Pine Island Bay also obtained ice observations in conjunction with the Autosub programme, which have been placed in the ASPeCt data base.

Several papers using the ASPeCt data sets are now appearing regularly in the literature. As well as the phenomenological descriptions in several papers, there are also three or more recent papers that use the ASPeCt data sets as verification for numerical models and remote sensing. These were principal goals of the ASPeCt Science and Implementation Plan that are now being successfully achieved through the scientific literature.

Through participation at scientific and meetings such as the CliC-Clivar Southern Ocean Panel, suggestions have been made for ASPeCt related studies of Antarctic Sea Ice in the International Polar Year (IPY). Preliminary ideas were contributed to the organizers of the planning documents for IPY. Two principal projects were suggested. The first, an international ship-based drifting station in the sea ice of the Bellingshausen-Amundsen-Ross Seas would obtain time series measurements on air-ice-ocean interaction in that region. This region and the Western Weddell Sea are the majority perennial ice regions in the Antarctic. The second project suggested would be a circumpolar series of ice thickness traverses using ship-based autonomous underwater vehicles (such as the UK's Autosub). Several countries' ice breakers could complete a circumpolar look at winter maximum of the sea ice thickness. If resources permitted, two complete winters could be conducted during 2007-2008 allowing an interannual comparison to also be made. The ice thickness data sets would provide both an experimental determination of climatic interaction with the sea ice, as well as boundary conditions and verification for coupled model studies dealing with climate-ice-ocean interaction.

Action Groups

The REference Antarctic Data for Environmental Research (READER)

Contact: John Turner (J.Turner@bas.ac.uk)

The digitisation of the surface and upper air meteorological data is essentially finished with the monthly mean data now all being online at <http://www.antarctica.ac.uk/met/READER/>. The data set is updated periodically. The data base and mean surface conditions at the Antarctic stations is described in Turner, J, Colwell, S R, Marshall, G J, Lachlan-Cope, T A, Carleton, A M, Jones, P D, Lagun, V, Reid, P A and Iagovkina, S 2004. The SCAR READER project: Towards a high-quality database of mean Antarctic meteorological observations. *Journal of Climate* 17: 2890-2898. A paper on surface Antarctic climate change over the last 50 years is under revision with the *International Journal of Climatology*. A major achievement of the last two years has been the digitisation of the Russian upper air data. A workshop on climate variability and change throughout the Antarctic troposphere from the READER data was held at the Arctic and Antarctic Research Institute, St Petersburg, Russia in February 2004.

Plateau Astronomy Site Testing in Antarctica (PASTA)

Scientifically, the productivity of the South Pole station continues to increase, with significant new results in measurements of CMBR being reported (especially DASI and ACBAR), on the angular scales and frequency dependence of the microwave background. The sub-mm telescope AST/RO continued its productive career, and has now produced over 50 refereed papers. Neutrino experiments continue to develop, through AMANDA, IceCube and ANITA. Concordia Station at Dome C nears completion, and the first winter time measurements have been obtained at Dome C. Creating great interest is the confirmation that superb seeing regularly occurs there at night-time, with values between 0.1" and 0.2" in the visible being common. This is stimulating interest in the possibilities of constructing the next generation of optical/infrared telescopes at this site, or elsewhere on the high plateau.

Following the success of the Antarctic astronomy meetings at the IAU General Assembly the IAU has decided to reconstitute the IAU Working Group for Antarctic Astronomy. This WG was originally set-up to help with the development of the field in 1991 when activities at the South Pole, run through CARA, the Center for Astrophysical Research in Antarctica, were beginning to take off. The IAU WG will meet during SCAR, and in particular discuss whether to propose to IAU to hold an IAU Symposium or Colloquium on the subject of Antarctic Astronomy (these are the highest level of scientific meetings held within the field). Possibly such a meeting may be held during the next GA (in Prague in 2006), or as a stand-alone meeting during 2007 (when it may also benefit from IPY activities).

A three day meeting was held last from 28-30 June 2004 in Toulouse, on astronomy and astrophysics at Dome C.

Middle Atmosphere Dynamics and Relativistic Electron Precipitation (MADREP)

There has been no progress on this work.

Antarctic Peninsula Tropospheric-Ionospheric Coupling (APTIC)

APTIC is concerned with exploring the responses of the ionosphere to the many deep depressions that cross the Antarctic Peninsula and identifying energy transfer mechanisms. APTIC's first objective has been to assemble a database of ionospheric and tropospheric information from the Antarctic Peninsula area. In particular, it is putting together copies of vertical incidence radar records (ionograms) and scaled values from ionograms from San Martin, Vernadsky and Great Wall for selected periods representative of several geophysical conditions. This is a laborious undertaking since ionograms recorded every 15 minutes for each day during 8 months have to be considered. Ionograms have to be digitized from film records in some cases (Vernadsky and Great Wall) and have to be scaled in others (San Martin and Great Wall). But ionogram data for 1999 have been digitised and all hourly values since 1996 are available as well. Ionograms in digital form are available since 2002. On the basis of the data, a lowering of the height F2 layer has been found over 1996-2000 (corresponded to UK data for 1947-1995). A presentation of results from APTIC was made in Villefranche at the ICESTAR workshop.

SCAR and Oceanography

A meeting of the Action Group was held in Rome during October 2003 at which representatives of SCOR and IOC were present. The importance of oceanography to many aspects of SCAR science was highlighted. In Rome it was proposed that a new SCAR/SCOR

Coordinating Group on Interdisciplinary Southern Ocean Science (ISOS) be established. It was also recommended that SCAR co-sponsor the CLIVAR-CliC Southern Ocean Panel, and since the meeting an MOU has been signed to this effect. Because of the need for long-term coordination of oceanography within SCAR it is recommended below that the SCAR Action Group on Oceanography be converted into an Expert Group.

Modelling and Observational Studies of Antarctic Katabatics (MOSAK)

Runs have been carried out with a high resolution atmospheric model to produce what we believe is the best field of near-surface Antarctic winds yet created. The work has been written up and is now in press in the *International Journal of Climatology* (van Lipzig, N P M, Turner, J, Colwell, S R and Van den Broeke, M R. 2004. The near-surface wind field over the Antarctic continent. *International Journal of Climatology*).

The group at the University of Malaysia are undertaking a study of katabatic winds across East Antarctica using automatic weather station data along the transect Dome C to Cape Denison. The data have been obtained and are being quality controlled. Once completed streamlines will be produced and a time series analysis of a number of katabatic wind events will be carried out.

Antarctic Tropospheric Aerosols and their Role in Climate (ATAC)

Contact: Takashi Yamanouchi (yamanou@pmg.nipr.ac.jp)

Following SCAR XXVII Shanghai, an Action Group Antarctic Tropospheric Aerosols and their Role in Climate (ATAC) was proposed. Many national or international programs have developed research into tropospheric aerosols and already much data and knowledge has been accumulated. However, not many of the groups are known to each other and it is unclear what type of data is held or the gaps in our knowledge. The aim was to rectify this situation, to exchange information, to search and collect data, and to carry out cooperative research, including networking.

The activities in the last two years have been concentrated on collecting information on aerosol activities in Antarctica and to start discussion on future coordination and cooperation. One topic was the incorporation of the project on Polar Aerosol Optical Depth (AOD) Network from ISAC-CNR Bologna, Italy into the scientific plan of ATAC. In October 2003 a workshop was held on the Polar AOD Network, organized by ISAC-CNR. During the workshop the coordination with the ATAC working group was discussed. Another highlight of the activities was the discussion of ground-based coordinated activities during the airborne campaign AGAMES (Antarctic Trace Gas and Aerosol Airborne Measurement Study) at Neumayer and Kohnen in 2005/06.

During SCAR XXVIII Bremen a workshop of the ATAC Action Group was held. The following areas were discussed: Firstly, the status of the preparation for AGAMES 2005/06 and the involvement of ground-based activities. Secondly, Dr. Vitale from ISAC-CNR presented the status of the Polar AOD network. In the course of the discussion information was exchanged on present aerosol activities in Antarctica. Finally, the members of the ATAC working group agreed to the proposal from T. Yamanouchi (NIPR Tokyo, Japan), that the future activities will be part of a larger programme: Antarctica and the Global Climate System (AGCS).

4. REVIEW OF RECOMMENDATIONS FROM SCAR XXVII, SHANGHAI

Recommendation SCAR XXVII-6 Scientific activities on King George Island

The problem of lack of coordination of observational programmes on King George Island is still with us. SSG/PS suggested that one way forward would be to establish a multi-disciplinary, cross-SSG Action Group on King George Island science. Such a group could carry out much of its work by email, but it would be useful to have a workshop of King George Island science at SCAR XXIX

Recommendation SCAR XXVII-11 Drifting buoys

SCAR is now co-sponsoring the International Programme for Antarctic Buoys, but the number of buoys in the Southern Ocean is far from sufficient. More countries need to be involved in the deployment of buoys. We need buoys to improve the global coverage for improved weather and climate studies.

Recommendation SCAR XXVII-12 Concerning Meteorological Reports from Dome C

There is still a shortage of upper air meteorological data from interior Antarctica, especially as there is now no radiosonde data from Vostok. Meteorological records from Dome C are expected to commence on a routine basis later in 2004. Radiosounding (expected each 12 hours) will commence at the end of the 2004-2005 austral summer season.

Recommendation SCAR XXVII-13 Concerning Antarctic weather data monitoring

The WMO carries out assessments of Antarctic meteorological data on the GTS each February. Jon Shanklin, the new Chair of the SSG/PS Expert Group on Operational Meteorology, who is also on the WMO Executive Council of the Working Group on Antarctic Meteorology, agreed to provide feedback to operators on the data volumes on the Global Telecommunications System and any problems identified.

Recommendation SCAR XXVII-14 Concerning ice core storage and curation

A Workshop was organized by Joan Fitzpatrick and Todd Hinkley, NICL, on August 21-22, 2003 in Milan, Italy. Twenty five attendees representing twelve countries attended this inaugural meeting of InterICE, and participated in an exchange of information regarding ice core transport, storage, and curation. The University of Milan, Bicocca, hosted this meeting. As a final overview of the different groups that attended this first meeting brief reports from attendees are present on the Interice website(<http://scarwgg.usgs.gov/interice/interice3.html>) regarding the following points of interest: Field Procedure, Accession Procedures, Storage Procedures, Curation Procedures, Deaccession Strategies, Processing of Ice Cores, and Shipping considerations. A summary report of the meeting was published by Todd Hinkley in EOS.

In addition, as a result of this recommendation, a meeting (InterIce) was held in Maryland, USA in March 2004, at which it was recommended that a new SCAR Expert Group be formed on Ice Drilling Technologies (see report and new resolution below for further details).

Recommendation SCAR XXVII-15 Concerning met data from Automatic Geophysical Observatories (AGO)

It has been very difficult to obtain data in real time (South Pole is an exception), although off-line data are usable later. Jon Shanklin has been asked to raise the question of obtaining

AGO data via the WMO Executive Council of the Working Group on Antarctic Meteorology. Vladimir Papitashvili explained that while he was a Secretary of the STAR WG, he contacted WMO and requested the formats in which the AGO meteo data could be provided as received at Augsburg College (Minneapolis, USA). Unfortunately, no proper contacts were established between the interested parties. Currently the U.S. AGO program is renewed and a new leader Dr. Allan Weatherwax (aweatherwax@siena.edu) should be contacted by someone from WMO.

Recommendation SCAR XXVII-16 Concerning the importance of magnetometer data

This resolution played an important role in the proposals to national funding agencies justifying the expansion of autonomous magnetometer arrays in the Antarctic. Currently all Antarctic magnetometer data are digital and most of these data are available from the national Antarctic programs and hosting institutions.

Recommendation SCAR XXVII-17 Concerning continued support of existing observatories

While the continuation of all previously existing instrumentation has not been maintained, a variety of new instrumentation is operating and in the planning stage so that the capacity for ground based observations in Antarctica is improving. The resolution should lapse."

Recommendation SCAR XXVII-18 Concerning site testing for astronomical observation

Site testing continues, and requires one more year at Concordia. Different types of testing are required, and the effort should be extended to other locations including Dome A.

Recommendation SCAR XXVII-19 Concerning metadata records

The Antarctic Master Directory (AMD) now has 3,000 metadata files, although this is still only ~10% of what is available. Of the 27 countries involved in SCAR, 16 have now established Antarctic Data Centres.

Recommendation SCAR XXVII-20 Concerning drilling above Lake Vostok

Additional studies are ongoing into the Lake Vostok site.

5. NEW PROGRAMME PROPOSALS

SSG/PS has submitted two programme proposals to the Delegates on Antarctica and the Global Climate System (AGCS) and Inter-hemispheric Conjugacy on Environmental, Solar–Terrestrial and Atmospheric Research (ICESTAR). At this moment we are not considering any additional programmes.

6. REVIEW OF ACTION, EXPERT AND PROGRAMME PLANNING GROUPS

The SSG reviewed all its Action, Expert and Programme Planning Groups. The recommendations of the SSG are summarised below:

READER	to be incorporated into AGCS
PASTA	continue as an Action Group for two more years
MADREP	incorporate into ICESTAR

APTIC	incorporate into ICESTAR
SCAR and Oceanography	to become an Expert Group
MOSAK	continue as an Action Group for two more years
ATAC	to be incorporated into AGCS
STEPS	incorporate into ICESTAR
AAA	continue as an Expert Group
Operational Meteorology	continue as an Expert Group
ISMASS	to remain as an Expert Group
ITASE	to be incorporated into AGCS
ASPECT	to be incorporated into AGCS
AGCS PPG	disband as work completed
ICESTAR PPG	disband as work completed

7. PROPOSALS FOR NEW GROUPS

An Expert Group on Oceanography

Because of the need for long-term coordination of oceanography within SCAR it was recommended that the SCAR Action Group on Oceanography be converted into an Expert Group.

A new Action Group on King George Island science

To attempt to overcome the lack of coordination of observational programmes on King George Island we recommend the establishment of a multi-disciplinary, cross-SSG Action Group on King George Island science.

A new Expert Group on Ice Drilling Technologies

To facilitate communication among international ice drilling communities, to create an international forum for strategic development of new ice drilling and borehole testing concepts and technologies and continued improvement of existing technologies, to provide a pool of expertise to address SCAR issues related to ice drilling and coring, and to enhance international cooperation and communication on large- and small-scale ice core recovery projects.

8. NEW RECOMMENDATIONS TO SCAR (INTERNAL)

Recommendation SCAR XXVIII – 1 An Expert Group on Oceanography

Recognizing the importance of oceanography to many areas of SCAR science;

Recognizing the greater need for liaison with external organisations over oceanography now that SCAR is a co-sponsor of the CLIVAR-CliC/SCAR Southern Ocean Panel;

The SSG on Physical Sciences

Recommends that SCAR establishes an Expert Group on Oceanography.

Recommendation SCAR XXVIII – 2 A new Action Group on King George Island science

Recognizing the importance of King George Island to many areas of science;

Noting the large number of research stations that are located on the island;

Recognising the benefits of co-ordinating many of the scientific activities carried out on the island;

The SSG on Physical Sciences

Recommends that SCAR establishes a cross-SSG Action Group on King George Island.

Recommendation SCAR XXVIII – 3 A new Expert Group on Ice Drilling Technologies

Recognising the advances in ice drilling and borehole technologies over the past 15 years; but

Noting the serious technological challenges that have been experienced in drilling the deep ice cores in Antarctica;

Recognising the major scientific advances that have come from ice core data;

The SSG on Physical Sciences

Recommends that SCAR establishes an Expert Group on Ice Drilling Technologies.

9. NEW RECOMMENDATIONS TO SCAR (EXTERNAL)**Recommendation SCAR XXVIII – 4 Concerning site testing for astronomical observations**

Recognizing the advantage to astronomy of the unique observing conditions on the Antarctic Plateau;

Recognizing the exceptional atmospheric conditions measured at Dome C and the South Pole;

Noting that potentially the best observing site on the planet, Dome A, remains uncharacterized;

Noting that comprehensive data on the site conditions are an essential pre-requisite to the establishment of new observatories;

SCAR encourages responsible organizations and National Programmes to deploy the necessary instrumentation to high Antarctic Plateau sites to acquire the data needed to fully characterize them for potential future astronomical observing programs.

Recommendation SCAR XXVIII – 5 Concerning drifting buoys

Recognizing the importance of air pressure and temperature data from the sea ice zone to global weather prediction models and climate research and the fact that the number of deployed measuring platforms are still far below the need of the envisaged network density;

SCAR urges National Committees to support the International Programme for Antarctic Buoys (IPAB) by provision of platforms and deployment possibilities. In particular in the view of the IPY 2007/2008 an enhanced observation period is needed as a contribution to determine the present environmental status of the sea ice covered part of the Southern Ocean.

Recommendation SCAR XXVIII-6 - Concerning continued support of existing geospace observatories

Recognising:

- the great importance of the understanding of Geospace and the Space Weather Environment to technological systems in space and on the ground
- the uniqueness of the polar regions and especially Antarctica for multipoint observations of such environment
- the importance of synthesis of different types of data to obtain a complete picture of the Geospace environment

Noting the imminence of the International Polar Year

SCAR recommends to the operators of national polar programs that, in time for the IPY, they establish and maintain networks of HF radars, magnetometers, and auroral instruments over as wide and complete a spatial range as possible.

Recommendation SCAR XXVIII - 7 On the transmission of space weather data

Noting that

- The understanding of space weather is crucially important to the operations of spacecraft on which much modern technology depends
- Arrays of instruments in the polar regions, producing very large quantities of data, are key ground-based facilities for understanding space weather
- The provision of processed data products in real time from northern hemisphere stations has become a very important tool for space weather understanding
- Complementary data in real time from Antarctica is needed for better understanding of the mechanisms controlling space weather

SCAR urges National Operators of Antarctic programmes to place a high priority on the provision of broad band satellite communications facilities for the transmission of solar weather data in real time.

Recommendation SCAR XXVIII - 8 Mesosphere-Stratosphere-Troposphere / Incoherent Scatter (MST/IS) Radar

Noting that

- the planetary waves, gravity waves and atmospheric tides are of crucial importance on the various dynamical processes in the polar middle atmosphere, including the formation and termination of Antarctic ozone hole and coupling between the lower and upper atmospheres; and
- planetary-scale katabatic winds that are unique phenomena generated on the extremely cold surface of Antarctic continent affect significantly the tropospheric circulation in the Southern Hemisphere; and
- our limited knowledge of the physics of clouds that appear only in the polar stratosphere and mesosphere which are important for monitoring natural and anthropogenic effects on climate; and
- Mesosphere-Stratosphere-Troposphere / Incoherent Scatter (MST/IS) radars are the only observational tools capable of quantitative evaluation of dynamics of the atmosphere from the troposphere to the ionosphere; and that inter-hemispheric

differences in topography and hence waves sources, and different separation between the geographic and geomagnetic poles in each hemisphere means that the response to dynamical coupling from below and downward coupling from the magnetosphere will be different between hemispheres; and that there are no MST/IS radar systems in the entire Antarctic region, which leaves a major gap in the global radar network,

SCAR recommends to National Programmes that MST/IS radars be established at the earliest opportunity in the Antarctic in order to fill this gap, and thereby provide invaluable data for the international science community.

Recommendation XXVIII - 9 On upper air meteorological data from the Antarctic Peninsula

Noting the limited amount of radiosonde data that are available from the Antarctic Peninsula region and

Noting the importance of this area as a region of marked climatic change over recent decades and

Noting the importance of upper air observations for operational numerical weather prediction; *SCAR urges* National Operators of Antarctic Programmes based in the Antarctic Peninsula to re-activate routine radiosonde measurements.

Recommendation SCAR XXVIII-10 Concerning drilling above Lake Vostok

Being aware that the proposal to drill a further 50 m in the existing borehole at Vostok Station to extract additional accretion ice, as a proxy for sampling the lake water, has significant scientific value;

Noting that there is uncertainty about possible lake contamination during further drilling;

Noting also that the intention of all interested parties is to ensure proper stewardship of subglacial lake environments;

SCAR recommends continued study of environmental and other factors before further drilling towards Lake Vostok is undertaken in the existing borehole.

Recommendation SCAR XXVIII - 11 Concerning meteorological reports from Dome C

Recognizing the importance of surface and upper air meteorological observations over the plateau of East Antarctica for numerical weather prediction;

Noting the loss of upper air data from Vostok Station and the fact that South Pole Station is the only source of such data from the interior of the continent;

Noting the importance of upper air meteorological data for many studies over the interior of the Antarctic during the IPY;

SCAR recommends that the Italian and French National Committees urge their National Programmes to institute 6 hourly surface and 12 hourly upper air observing programmes.

10. ELECTION OF OFFICERS

The Chief Officer, Deputy Chief Officer and Secretary had all been elected for four year terms at SCAR XXVII so no election was necessary in Bremen.

Jon Shanklin was elected as Chair of the Operational Meteorology Expert Group.

11. BUDGET PROPOSALS FOR 2005 AND 2006

After discussion, noting the poor financial situation in which SCAR finds itself, and assuming that a total amount of US\$40,000 is available for each SSG, the Physical Science SSG agreed upon the following delegation of funds to each of its Programmes, Expert Groups and Action Groups:

2005 2006

1. ICESTAR Programme	15,000	15,000
2. AGCS Programme	15,000	15,000

Additional to the programme bids:

3. APTIC/STEPS	1,500	1,500
4. Ice Drilling Technology Workshop	1,000	0
5. SCAR/SCOR Interdisciplinary SO Science (for Ocean Expert Group)	2,000	2,000
6. IGOS Partners Cryosphere Theme	1,000	1,000
7. IAPSO/IABO Cairns workshop	2,000	0
8. Astronomy	1,500	1,500
9. King George Island science coordination	1,000	2,000
10. Workshop on the Antarctic wind field	0	2,000
TOTAL	\$ 40,000	\$ 40,000

12. ACTION TIMETABLE FOR THE NEXT TWO YEARS

Our programme of activities for the next two years is clearly dependent on whether our two programme proposals are accepted by the Delegates, but assuming this is the case, we would highlight the following activities:

2005

- AGCS - Determine the natural climate variability of key elements of the Antarctic climate system from long climate model runs
- AGCS - Preliminary assessment produced of atmospheric, and especially Southern Ocean, conditions in AOGCMs.
- AGCS - Production of data on air mass origins reaching ice core sites
- ICESTAR - Collect information and coordinate observations at the existing instrumental arrays in the Arctic and Antarctic aiming specifically at interhemispheric studies, including global development of the magnetic storms and substorms over the polar regions.
- ICESTAR - Promote the deployment of new instruments where current gaps exist.
- ICESTAR – Identify available metadata description and value-added products of Antarctic geospace data on the Internet

- Annual meeting of the AGCS Steering Committee
- Development of the ice core data base
- Workshop on the variability of the Antarctic climate system
- Workshop on historical oceanographic data for the Southern Ocean (if funds permit)

2006

- AGCS - Determine the natural climate variability of key elements of the Antarctic climate system from long climate model runs
- AGCS - Preliminary assessment produced of atmospheric, and especially Southern Ocean, conditions in AOGCMs.
- AGCS - Production of data on air mass origins reaching ice core sites
- ICESTAR - Continue to collect information and coordinate observations at the existing instrumental arrays in the Arctic and Antarctic
- ICESTAR - Develop and implement the ICESTAR metadata catalogue and Virtual Data Portal.
- ICESTAR – Identify a strategy for linking existing on-line sites together and provide on-line services for all known geospace data and products.
- Annual meeting of the AGCS Steering Committee (probably held adjacent to SCAR XXIX, Hobart)
- Development of the ice core data base
- Workshop on the representation of the Antarctic and the Southern Ocean in models
- Workshop of the origins of signals in ice cores (if funds permit)
- Workshop on Antarctic katabatic winds and their interaction with the ocean environment

Appendix 1. List of Members and Officers 2002-04

Officers

Dr John Turner	(UK)	(J.Turner@bas.ac.uk)	Chief Officer
Dr Maurizio Candidi	(Italy)	(candidi@ifsi.rm.cnr.it)	Deputy Chief Officer
Dr Jo Jacka	(Australia)	(jglac@bigpond.com)	Secretary

Members

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Lt A Lluberas	(Uruguay)	

Appendix 2. List of sub-groups 2002-04

Programme Planning Groups

Antarctica and the Global Climate System (AGCS)

Contact: John Turner (J.Turner@bas.ac.uk)

Interhemispheric Conjugacy Effects in Solar-Terrestrial and Aeronomy Research (ICESTAR)

Contact: Alan Weatherwax (aweatherwax@siena.edu)

Expert Groups

Solar-Terrestrial Processes and Space Weather (STEPS)

Contact: Umran Inan (inan@nova.stanford.edu)

Antarctic Astronomy and Astrophysics (AAA)

Contact: John Storey (j.storey@unsw.edu.au)

Operational Meteorology in the Antarctic.

Contact: Jon Shanklin (J.Shanklin@bas.ac.uk)

Ice Sheet Mass Balance and Sea Level (ISMASS)

Contact: Jo Jacka (jo_jac@antdiv.gov.au)

The International Trans-Antarctic Scientific Expedition (ITASE)

Contact: Paul Mayewski (paul.mayewski@maine.edu)

Antarctic sea-ice processes and climate variability (ASPeCT)

Contact: Steve Ackley (sackley@pol.net)

Action Groups**The REference Antarctic Data for Environmental Research (READER)**

Contact: John Turner (J.Turner@bas.ac.uk)

Plateau Astronomy Site Testing in Antarctica (PASTA)

Contact: John Storey (j.storey@unsw.edu.au)

Middle Atmosphere Dynamics and Relativistic Electron Precipitation (MADREP)

Contact: Andrew Carleton (carleton@essc.psu.edu)

Antarctic Peninsula Tropospheric-Ionospheric Coupling (APTIC)

Contact: Alberto Foppiano (foppiano@udec.cl)

SCAR and Oceanography

Contact: Michele Colacino (colacino@atmos.ifa.rm.cnr.it)

Modelling and Observational Studies of Antarctic katabatics (MOSAK)

Contact: Azizan Abu Samah (samahabu@yahoo.com)

Antarctic Tropospheric Aerosols and their Role in Climate (ATAC)

Contact: Takashi Yamanouchi (yamanou@pmg.nipr.ac.jp)

Appendix 3. List of acronyms

AAA	Antarctic Astronomy and Astrophysics
ACBAR	Arcminute Cosmology Bolometer Array Receiver
AGCS	Antarctica and the Global Climate System
AGO	Automatic Geophysical Observatories
AMANDA	Antarctic Muon And Neutrino Detector Array
AMD	Antarctic Master Directory
AMISOR	Amery Ice Shelf Ocean Research
ANITA	Antarctic Impulsive Transient Antenna
AnSlope	Antarctic Slope
ANTEC	Antarctic Neotectonics
AOD	Aerosol Optical Depth
AOGCM	Atmosphere-Ocean General Circulation Model
APTIC	Antarctic Peninsula Tropospheric-Ionospheric Coupling
ASPeCT	Antarctic Sea-Ice Processes and Climate
AST/RO	Antarctic Submillimeter Telescope and Remote Observatory
ATAC	Antarctic Tropospheric Aerosols and their Role in Climate
CARA	Center for Astrophysical Research in Antarctica
CD-ROM	Compact Disc – Read Only Memory
CECS	Center for Energy and Climate Solutions
CliC	Climate and Cryosphere
CLIVAR	Climate Variability and Predictability Programme
CMBR	Cosmic Microwave Background Radiation
COMNAP	Council of Managers of National Antarctic Programmes
DASI	Degree Angular Scale Interferometer

ENSO	El Niño – Southern Oscillation
GA	General Assembly
GLOCHANT	Group of Specialists on Global Change and the Antarctic
GTS	Global Telecommunications System
IAU	International Astronomical Union
ICESat	Ice, Cloud and Land Elevation Satellite
ICESTAR	Interhemispheric Conjugacy Effects in Solar-Terrestrial and Aeronomy Research
IGBP	International Geosphere–Biosphere Programme
IHDP	International Human Dimensions Programme on Global Environmental Change
IOC	Intergovernmental Oceanographic Commission
IPAB	International Programme for Antarctic Buoys
IPEV	Institut Polaire Français Paul Emile Victor
IPY	International Polar Year 2007–08
ISMASS	Ice Sheet Mass Balance and Sea Level
ISOS	Interdisciplinary Southern Ocean Science
ISPOL	Ice Station <i>Polarstern</i>
ITASE	International Trans-Antarctic Scientific Expedition
MADREP	Middle Atmosphere Dynamics and Relativistic Electron Precipitation
MOSAK	Modelling and Observational Studies of Antarctic Katabatics
MOU	Memorandum of Understanding
MST/IS	Mesosphere-Stratosphere-Troposphere / Incoherent Scatter
NASA	National Aeronautical and Space Administration
NICL	National Ice Core Laboratory
PACA	Physics and Chemistry of the Atmosphere
PASTA	Plateau Astronomy Site Testing in Antarctica (
PNRA	Programma Nazionale di Ricerche in Antartide
PPG	Programme Planning Group
READER	REference Antarctic Data for Environmental Research
SALE	Subglacial Antarctic Lake Exploration
SAR	Synthetic Aperture Radar
SCOR	Scientific Committee on Oceanic Research
SPPG	Scientific Programme Planning Group
SSG	Standing Scientific Group
SSG/PS	SSG on Physical Sciences
STAR	Solar-Terrestrial and Aeronomy Research
STEPS	Solar-Terrestrial Processes and Space Weather
WCRP	World Climate Research Programme
WG	Working Group
WMO	World Meteorological Organisation