Report to the SCAR Executive on the SSG/PS. July 1st, 2007

This report refers to the developments in the Scientific Research Programmes (SRP's), and the Expert and Action Groups of the SSG/PS. It conveys information provided to the SSG/PS chair by the representative/chair of each of the initiatives, and reflects progress between the Hobart SCARXXIX assembly, and today. Full details on each program/group may be found in the annexed full reports, when available.

Scientific Research Programmes.

Antarctica and the Global Climate System (AGCS)

AGCS consists of four science themes: Decadal time scale variability in the Antarctic climate system, Global and regional climate signals in ice cores, Natural and anthropogenic forcing on the Antarctic climate system, and The export of Antarctic Climate Signals.

SCIENTIFIC HIGHLIGHTS

1-Short-circuiting of the overturning circulation in the Antarctic Circumpolar Current. The results were published in Nature in May 2007 (Naveira Garabato et al., 2007)
2-Circumpolar response of Southern Ocean eddy activity to a change in the Southern Annular Mode. This work was published in Geophy Res. Letters in 2006.
3-Antarctic temperatures over the past two centuries from ice cores. The variability and the long-term trends are strongly modulated by the SH Annular Mode in the atmospheric circulation. (Schneider et al., 2006)
4-Antarctic climate change over the Twenty First Century Ice. Submitted to J. Geophys. Res.
5-Antarctic winter tropospheric warming - the possible role of polar stratospheric clouds. Submitted to Science.

PROGRESS AGAINST PRIOR WORK PLAN

Selected achievements are listed below. The AGCS Implementation Plan is available at http://www.scar.org/researchgroups/physicalscience/agcs/.

Theme 1. a) A major study on why Antarctic sea ice extent has been increasing since the late 1970s. b) Understanding the factors that control the variability of the Southern Hemisphere Annular Mode (SAM) and its influence on the atmospheric and oceanic conditions of the Antarctic and Southern Ocean.

Theme 2. As discussed above in highlight 3, an analysis of ice core data has suggested that Antarctic temperatures have increased by about 0.2 C since the late nineteenth century.

Theme 3. a) The output from the 20 coupled climate models of the IPCC Fourth Assessment Report have provided a tremendous tool for investigation of past and possible future climate change in the Antarctic. b) Understanding the mid-tropospheric warming that was identified across the Antarctic and the amount of polar stratospheric clouds (PSCs) above the continent.

PROPOSED WORK PLAN FOR THE NEXT 2 YEARS:

The targets for 2007 and 2008 are:

Assessment of the Antarctic element of the IPCC Round 4 model predictions for the next century,
Investigation of the mechanisms responsible for changes in the SAM ,
Research on mid-tropospheric warming mechanisms above the Antarctic over the last 50 years,
State of Antarctic climate in the last several hundred years to assess natural/anthropogenic impact,
Relationship between ENSO, SAM, and the Southern Ocean,
Teleconnections between Austral * Mid-latitudes* and the Antarctic,
Obtain a 200 year array of coastal cores from Antarctica including sea-ice extent information,
Investigate marine productivity to understand sea-ice extent in proxy record,
Quantification of oceanic heat, volume, and fresh water fluxes in the southern ocean,
Interaction of the ocean on the ice sheet, ice shelves, and the atmosphere at the Antarctic margin,
Understanding the driving mechanisms in the Southern Ocean overturning,
Further drifting buoy deployments,
Contribute to the atmospheric reanalysis efforts,
Write a paper on Antarctic sea ice thickness using the ASPECT data base,
Developments of data bases, such as READER

OUTPUTS/DELIVERABLES

-Publications. A list can be found in the annexed full report.

- Workshops**. W**orkshop (jointly with POGO and CoML) on the design of a Southern Ocean Observing System, held at the SCAR OSC in Hobart. A further meeting will be held in Bremen in October 2007. Planning for a second workshop on Recent High Latitude Climate Variability, to be held in Seattle, Washington, October 2007. IASC and CliC are co-sponsoring this meeting. Report on the Antarctic Wind Field workshop published in Bull. of the Am. Met. Society in March 2007.

-Web sites: Creation of a web site (http://www.antarctica.ac.uk/met/SCAR_ssg_ps/AGCS.htm). ASPeCt has completely updated and revised its website, including a link to publications that have made specific use of the ASPeCt data archive. The web site is at: http://www.aspect.aq

-Database(s):

MET-READER (http://www.antarctica.ac.uk/met/READER/) has continued to be developed and kept up to date with recent observations.
The ICE-READER (http://www2.umaine.edu/itase/content/icereader/) data base has been updated to include additional ice core records.
The OCEAN-READER web site (http://www.antarctica.ac.uk/met/SCAR_ssg_ps/OceanREADER/) was created to provide a portal into high quality oceanographic data sets around the world.

-New technology/model developments: AGCS scientists have been active in trying to improve the representation of high latitude processes in climate models. The importance of a realistic boundary layer parameterization in a climate model was shown (King et al., 2007).

-Contributions to IPY : AGCS is involved in nine full IPY proposals: ID 180, 15, 267, 132, 152, 297, 35, 270 and the Concordiasi project, which is part of the THORPEX cluster.

-Links to other ICSU bodies or to other scientific groups: Close links have been established with the WCRP Climate and Cryosphere (CliC) project and especially the CliC Project on Global Prediction of the Cryosphere. SCAR and CliC have co-sponsored several meetings and symposia.

Iterhemispheric Conjugacy Effects in Solar Terrestrial and Aeronomy Research (ICESTAR)

Selected Scientific Highlights

-Arctic and Antarctic polar winter NOx research has been carried out on GOMOS nighttime observations of middle atmosphere NO2 and O3 profiles during eight recent polar winters in the Arctic and Antarctic. This work was published by in Geophys. Res. Lett., 34, L12810, doi:10.1029/2007GL029733.
-Auroral conjugacy studies based on global imaging in the ultraviolet wavelengths by the IMAGE and Polar satellites enabled ICESTAR researchers to examine auroral features in conjugate hemispheres. This work was published in the Journal of Atmospheric and Solar-Terrestrial Physics, 249-255, 2007.
-Global MHD simulation results are compared with Polar and SNOE observations. A comparison of ionospheric electron precipitation morphology and power from a global MHD simulation with direct measurements of auroral energy flux during several substorms was carried out. These results were published in Ann. Geophys., 24, 861-872, 2006.
-Calculations of the temporal and spatial precipitation signatures of energetic radiation-belt electrons due to pitch-angle scattering by magnetospherically reflecting (MR) whistler waves generated by lightning discharges at geomagnetic source were studied. This work was published by in the J. Geophys. Res., 111, A02205, 2006.
-Nonlinear planetary wave and tidal coupling in the mesosphere and lower thermosphere. Temperature observations from the SABER instrument on the TIMED spacecraft were used to investigate the structure and evolution of an eastward propagating zonal wavenumber disturbance with a period near two days. This work was published by in Geophys. Res. Lett., 34, L07807, 2007.

Progress Against Prior Work Plan.

All ICESTAR milestones and deliverables are listed in the ICESTAR Implementation Plan available at http://www.scar-icestar.org. Selected achievements can be found in the annexed full report. These include information on 1) publications; 2) conference presentations; 3) the ICESTAR sponsored meeting entitled Heliosphere Impact on Geospace; and 4) web/data portal products. There were no major deviations from the proposed work plan.

Proposed Work Plan for the Next Year.

During the next year, the ICESTAR programme will continue to focus on the following items:

-Continued development of data portals linking together a large number of polar sites with diverse datasets. This data portal will have visualization and data translation modules that will allow users to examine the data and download it in formats that they can easily under-stand (see GAIA and VGMO.NET above). The following data types will be provided to the portal by the associated groups: magnetometers, HF and MST radars, lidars, passive optical instrumentation, digisondes, riometers, VLF/ULF receivers, TEC measurements, and atmospheric electric field observations.
-Quantification of the role of seasonal differences in polar ionospheric conductance and the effects on magnetospheric, ionospheric, and thermospheric dynamics.
-Constraints on models based on conjugate remote sensing of inner magnetospheric dynamics.
-Characterization of the spatial and temporal properties of mesoscale convection in the ionosphere.
-Characterization of the basic state of the polar middle atmosphere.

-Quantification of the AC and DC global atmospheric circuit.
-Collaboration between Ionospheric and Meteorological Research Groups

The multidiscipline IPY project POLENET (meteorology, glaciology, volcanology, seismology) will build and maintain an extensive Antarctic network of dual-frequency GPS receivers. Data of this network would be invaluable for the ICESTAR-IPY community which also maintains several GPS receiver stations in the Antarctic for ionospheric research. In the SCAR Cross-Linkages workshop (arranged in November 2006 in Rome) the POLENET and ICESTAR communities agreed to start collaboration in the development of GPS data sharing systems. A dedicated Working Group with POLENET, ICESTAR, and SSG-GS representatives will start the preparatory work in early 2007.

Special Issue of JASTP

A proposed special issue of JASTP will focus on the IPY #63 project objectives "ICESTAR/IHY - Helio-sphere Impact on Geospace" is planned with a publication target in the first part of 2008.

ICESTAR activities within IPY Cluster63.

The kick-off meeting of the IPY core project led by ICESTAR and IHY communities was held in Helsinki, February 5-9, 2007. 40 scientists from 14 different countries gathered at the Finnish Meteorological Institute. The IPY PO has named our project "Heliosphere Impact on Geospace".

After reviewing the current state and future challenges of polar aeronomy and solar-terrestrial research, detailed presentations were given about the objectives of the individual sub-projects. The opportunities for synergy in the activities were searched and routines for monitoring the scientific outcome were discussed. Special attention was paid to the data sharing issues as several Virtual Observatories tailored for geospace and aeronomy data dissemination have gradually started their operation.

Proposal for a new Scientific Research Program on Antarctic Astronomy

Programme Summary

Astrophysical observations require minimum interference from the Earth's atmosphere, low thermal background, low absorption, and high angular resolution. The moderate "launch costs" for Antarctic plateau observatories make them an attractive alternative to space. Astronomy from the Antarctic came of age in the last decade with a cosmological result of major significance. Balloon-borne millimetre observations of the cosmic microwave background from the first BOOMERANG flight led directly to the discovery of the zero-curvature Universe. Submillimetre astronomy has also prospered in the Antarctic: the South Pole Telescope is expected to deliver a large-area survey of the hot gas in clusters of galaxies with a uniquely uniform redshift distribution; this will probe the nature of "dark energy", the biggest constituent of a "flat" Universe.

Astronomy & Astrophysics from Antarctica is proposed as a new SCAR program aimed at understanding the overarching ecological processes in the Universe, the birth of stars and of planetary systems around other stars, the return of heavy-element enriched materials to the interstellar medium, and the formation of molecular clouds. Some themes for AAA will be exoplanet biosignatures, high angular resolution, time domain astrophysics, microwave

cosmological background radiation studies, and the physics of molecular clouds. In the next 12 months, the AAA Planning Group will consult with the community, clarify the objectives of the research in these and other proposed astrophysical themes, and create a roadmap that will allow groups to make progress towards achieving these goals.

Process

The AAA Scientific Research Programme planning group is made up of members of the existing AAA Expert Group plus other contributors. It will produce a full, formal proposal to the 2008 SCAR meeting in St Petersburg. Once the AAA Scientific Research Programme is established, the AAA Expert Group will be dissolved.

A proposed Steering Committee is suggested in the annexed full proposal.

Programme Goals: Build a data base of site-testing data that is accessible to all researchers. Increase the level of coordination and cooperation between astronomers, atmospheric physicists and meteorologists. Extend existing Antarctic site-testing and feasibility studies to potential Arctic sites; for example, in Greenland and Canada. Organise current scientific goals into a coherent set of "themes". Create a roadmap for development of major astronomical facilities in Antarctica. Stimulate international cooperation on major new astronomical facilities

Programme implementation

The inclusion of members from the Antarctic atmospheric physics and meteorology community in the Steering Committee will assist the formulation of protocols in data acquisition and archiving that allow for a freer flow of information between these communities and the astronomical community, thus minimizing wasteful duplication of effort. All of astronomy is included within the scope of the proposed AAA SRP, including optical/infrared astronomy, radioastronomy, and astro-particle physics. Links with complementary non-Antarctic facilities will be explored and possible synergies documented.

Progress generated by the Crosslinkage SSG meeting

Proposal from ICESTAR (SCAR SRP), SSG-LS,SSG-GS, POLENET (IPY project). (Full details can be found in the annexed proposal)

The UAMPY (Upper Atmosphere Monitoring for Polar Year) program is part of the Cluster63 IHY program. The proposed project will provide a unique ability to monitor polar scintillation globally. Scintillation is a significant concern for trans-polar navigation and communication. The potential exists for numerous new studies - both scientific and practical investigations. UAMPY proposes to create the necessary international cooperation to develop a polar upper atmosphere observation network of GPS receivers, in both hemispheres. It will allow unprecedented observation of the polar ionosphere, with extended auroral and polar coverage, making possible the mapping of features from mid to polar latitudes and the studies of associated polar ionospheric processes.

Efforts will mainly be addressed to:

- Coordinate the existing experimental observations to monitor upper atmosphere phenomena;
- Increase coverage with the installation of scintillation receivers **over the poles**;
- Collect data in a robust database and archive for scientific and for Space Weather objectives;
- Study and develop the ionospheric scintillation modelling and the simulation of physical processes causing structuring of the high-latitude ionosphere;

- Design a server for the remote control and management of the instrumentation, for hosting the database and for retrieving added value products (plots, maps, etc.).

The **POLENET** and ICESTAR - **UAMPY** Communities could have **mutual benefits** in terms of:
- Ionospheric imaging over Antarctica (planned by both the projects).
- Exchange of data and expertise for the application of tomography to other fields of interest for both the communities (e.g. 3D water vapour reconstruction).
- Exchange of technologies to install and manage remote GPS stations.
- Possibility to host instruments in the polar stations represented by the two communities.

Expert Groups.

Astronomy and Astrophysics in Antarctica (AAA)

This group http://www.phys.unsw.edu.au/jacara/aaa.php has been inactive since Hobart, and is merged into the new proposed Scientific Program Planning Group on Antarctic Astronomy.

ISMASS (Ice Sheet Mass Balance and Sea Level)

The ISMASS objectives are: Revitalized approach towards assessment of Antarctic mass balance, Develop framework for synthesizing field data, remote sensing, and modeling, Focus on ongoing rapid changes and future behavior, Expand focus to include Greenland Ice Sheet

A Community Modeling Initiative is under way to: Improve understanding of processes associated with rapid ice-sheet changes, Develop quantitative prognostic models, Incorporate these smaller-scale processes into whole ice-sheet models, Bring together various modeling groups/efforts, Stronger interaction between data collection and modeling efforts, Ensure data collection is geared towards improving physical understanding, Ensure modeling efforts are driven by data, Develop broader programmatic initiative. It is motivated by the *IPCC Summary For Policy Makers (2007):* **"**Dynamical processes related to ice flow not included in current models but suggested by recent observations could increase the vulnerability of the ice sheets to warming, increasing future sea level rise. Understanding of these processes is limited and there is no consensus on their magnitude."

Rationale for Modeling Initiative: Towards the next generation of ice-sheet models, Reducing uncertainties in sea-level forecasts, Assess probability of non-linear ice-sheet response, Coordinate various ongoing efforts

Implementation strategy: Planning meeting at AGU (Dec. 2006), Draft Plan circulated and presented at various meetings (spring 2007), Finalize Strategic Plan (summer 2007), Distribute Strategic Plan for community input, Modeling workshop (June 2008). A SCAR/IASC workshop on ice sheet mass balance and sea level is being considered in connection with the July 2008, St Petersburg Open Science Conference

The SCAR/SCOR Oceanography Expert Group

Background information on the SCAR/SCOR Oceanography Expert Group (EG-Ocean), including terms of reference, membership, reports etc., can be found at: http://www.clivar.org/organization/southern/expertgroup/index.htm. The EG-Ocean had its last

meeting in Hobart on July 10-11, 2006. The report is available directly from: http://www.clivar.org/organization/southern/expertgroup/Expt_group_2.pdf. Several different issues were tackled during the meeting, for example, as a direct result of a recommendation made by the EG-Ocean the Southern Ocean READER portal of temperature, salinity and ocean current data is now on-line (http://www.antarctica.ac.uk/met/SCAR_ssg_ps/OceanREADER/). Further developments are planned for the future. The group also maintains a website devoted to linking together projects and cruises of an interdisciplinary nature: http://www.clivar.org/organization/southern/SCAR_SCOR/index.htm. Requests were made to the community at large (including SCAR, SCOR, IOC and CLIVAR contacts) for information to populate the pages. One of the main outcomes of this meeting was the decision that the EG-Ocean should take the lead in developing a post-IPY sustained Southern Ocean Observing System (SOOS), something that is also seen as a priority by the CLIVAR/CliC/SCAR Southern Ocean region panel as well as being a direct recommendation of the XXX Antarctic Treaty Consultative Meeting (Delhi, April 30-May 11, 2007). As a result of this a SOOS planning workshop is being held in Bremen on 1-3rd Oct., 2007 (http://www.clivar.org/organization/southern/expertgroup/SOOS_workshop.htm). A draft SOOS plan developed during the workshop will be available for discussion by March 2008. Presentation and further discussion of the plan will occur at an expanded meeting of the SCAR/SCOR Oceanography Group during the SCAR Ocean Science Conference in St Petersburg (July 2008).

Action Groups

PAntOS

The Pan Antarctic Observations Network has undergone deep revision during the time since Hobart; the leader, V. Papitashvili, has had to resign as a consequence of the conflict of interest arising from his new position within NSF; Scott Palo, of the University of Colorado, and Jonathan Shanklin, British Antarctic Survey, have accepted to co-chair the group, until they will reorganise their work in St. Petersburg.

The current implementation plan is available at
http://www.scar.org/researchgroups/physicalscience/PAntOS_Plan_20.pdf.
Some steps will have to be taken before PAntOS can be assumed to have achieved its goals. Web-based discipline-oriented templates will be provided, where the Group members can fill appropriate boxes identifying "current and planned observation networks over the Antarctic". This might be the most time-consuming work where help from the wider community of Antarctic researchers will be needed.

As the existing networks are identified (assumed deadline December 2007), key variables will need to be identified for observation in the Antarctic over an extended period of time. This work would require an international workshop (Spring 2008) where the layout and content of PAntOS' summarizing document must be agreed upon. This would allow the group reporting to XXX SCAR on further steps in configuring "the multidisciplinary Pan-Antarctic Observations Network encompassing the Antarctic Continent and the surrounding Southern Ocean".

The Delhi ATCM Resolution (May 2007) regarding observing systems provides a guide to what Antarctic Treaty nations are being asked to do. This resolution recognizes a coordinated Antarctic observing system network as an important component to "support long-term monitoring and sustained observations of the Antarctic environment and the associated data management as a primary legacy of the IPY, to enable the detection, and underpin the understanding and forecasting

of the impacts of environmental and climate change".

Environmental Contamination in Antarctica (ECA).

The possibility to study records of atmosphere, snow and ice composition as a function of time and the improved knowledge of interaction among ice/atmosphere/water, make Antarctica the ideal place to monitor the global environment, to study processes controlling the transport and dispersion of micro-components at global level, and to assess their relationships with climate changes.

A workshop was held in Venice, June 14-16, 2007, to analyse data availability and coordinate studies on the Environmental Contamination in Polar Regions. Priorities for environmental contamination research in Antarctica were identified: Inventory and assessment of existing published data, Identification of knowledge gaps, Identification of key research requirements. Action Items emerging from the workshop are listed in the detailed report.

HIGHLIGHT: A recommendation on Existing Reliable Data emerges from the workshop.

Reliable time series for heavy metals and lead isotopes exist for recent centuries at three locations that are within a few hundreds kilometers from the coast: Coats Land, Law Dome, Victoria Land. There are also reliable data for near-surface snow, collected 1980s to 2000s, in various locations from shallow snow pits, e.g. the Antarctic Peninsula, the Lambert Glacier and Adelie Land. Different sets of metals have been determined at these locations; they include Cu, Cd, Zn, Pb and Pb isotopes. In some sites data are available for various other metals, such as Cr, V, U, Mo, Bi, Ag, Ba, Mn, Hg. There are also very few data for organo-lead compounds. In addition data exist now on past natural level of heavy metals and lead isotopes, both for the Holocene, the previous interglacial periods and glacial times, back to 420 kyr before present.

Priorities for Future Research: Time series for the last few centuries for heavy metal and isotopes at inland plateau locations (the few time series previously published for DC and South Pole are unreliable for heavy metals); Geographical variations of heavy metals and isotopes across Antarctica, especially along transects from the coast to inland plateaus; Elements for which we have very few data, such as Hg, platinum group elements, Se, As, Sb, ..; Speciation studies; Seasonal variations studies using shallow snow pits or firn cores.