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EXECUTIVE SUMMARY

The Scientific Committee on Antarctic Research (SCAR) is the foremost, non-governmental organisation for initiating, developing, and coordinating high quality international scientific research in the Antarctic region including the study of Antarctica's role in the Earth System.

During 2008, SCAR's research continued focusing on five themes: (i) the modern ocean-atmosphere-ice system; (ii) the evolution of climate over the past 34 million years since glaciation began; (iii) the response of life to change; (iv) preparations to study subglacial lakes and their environs; and (v) the response of the Earth's outer atmosphere to the changing impact of the solar wind at both poles. Highlights of recent scientific discoveries include:

1. Decadal warming and freshening of intermediate-depth water masses across large regions of the Southern Ocean since the 1960s has likely been driven by decadal-scale changes in the major modes of Southern Hemisphere climate variability (such as the Southern Annular Mode, El Niño - Southern Oscillation and the Inter-decadal Pacific Oscillation). The same water masses show reduced oxygen content, suggesting a decline in the rate of ventilation of the Southern Ocean's intermediate layers in that period.

2. Direct sampling of Antarctic subglacial lakes is now close to becoming a reality. The subglacial lake community has proposed three programs (one each led by Russia, the UK, and the USA) to directly sample a lake beneath the Antarctic ice sheet. The Russian and UK proposals are funded and plan to enter Subglacial Lakes Vostok and Ellsworth within the next 2-4 years. The US plan to examine an entire watershed beneath the Mercer and Whillans Ice Streams beneath the West Antarctic Ice Sheet is now in review.

3. Application of traditional and molecular biological techniques to marine organisms and terrestrial microbes supports long-term persistence of biota across the Antarctic continent and continental shelf. In combination with programmes such as the Census of Antarctic Marine Life (CAML), and the increasing use of SCAR biodiversity databases, data are now available to provide a benchmark assessment of the status of Antarctic biodiversity, and objective advice on the status and threats of non-indigenous organisms.

5. The NASA THEMIS mission shown that sudden auroral brightenings (at so called substorm onsets) are associated with a global disruption in the electric currents flowing across the near-Earth magnetotail. Tests of the extent to which auroral events in both hemispheres are joined together (inter-hemispheric conjugacy) have long shown that some auroral structures are synchronous and may even pulsate in tune (i.e. are conjugate). Recent observations with ground-based all-sky TV-cameras confirm this conjugacy, but also show some non-conjugate auroras: (i) pulsating auroras in both hemispheres with different spatial appearance and period, and (ii) pulsating auroras in one hemisphere only.

SCAR organized with the International Arctic Science Committee (IASC) the first International Polar Year science conference, which took place in St Petersburg, Russia, in July, and attracted 1150 attendees. SCAR's legal status changed during the year; it is now a Company Limited by Guarantee, and a UK Charity, while still an Interdisciplinary Body of the International Council for Science (ICSU). Three SCAR Medals and Four SCAR Fellowships were awarded. SCAR continues to provide high quality independent scientific advice to the Antarctic Treaty Parties.

1. WHAT IS SCAR (for further details see www.scar.org)?

The Scientific Committee on Antarctic Research (SCAR) is the main non-governmental organization responsible for the international coordination of scientific research in the Antarctic region. SCAR is an Interdisciplinary Body of the International Council for Science (ICSU). ICSU formed SCAR in 1958 to continue coordinating the scientific research in Antarctica that began during the International Geophysical Year of 1957-58. The need for such coordination has grown as the role of Antarctica in the global system has become apparent, and continued unabated in the International Polar Year (IPY) 2007-2008, in which SCAR played a leading role. SCAR's Members currently include 35 nations and 9 of ICSU's Scientific Unions, which link SCAR to a wide range of scientific activities.

SCAR aims to improve understanding of the nature and evolution of Antarctica, the role of Antarctica in the Earth System, and the effects of global change on Antarctica. It initiates, develops, and co-ordinates high quality international scientific research in the Antarctic region and on the role of Antarctica in the Earth system. SCAR carries out a comprehensive programme of coordinated scientific research that adds value to national research in the Antarctic by enabling national researchers to work together on large-scale scientific questions. Collectively, SCAR programmes can often accomplish research objectives that are not easily obtainable by any single country, research group, or researcher.

Through its biennial Open Science Conference (co-sponsored in 2008 with the International Arctic Science Committee (IASC) in St Petersburg, Russia), SCAR provides a forum for the community of polar scientists, researchers, and students to report on the latest science, exchange ideas and explore new opportunities. SCAR and IASC are together cosponsoring the 2nd IPY Open Science Conference planned for Oslo in June 2010. SCAR also supports research Fellows and young scientists and provides a broad range of data management and information products and services.

SCAR helps to coordinate polar scientific research by leading a network of the four main bodies of the International Council for Science (ICSU) concerned with polar and/or cryosphere research: SCAR, the World Climate Research Programme (WCRP), IASC, and the International Association for Cryospheric Sciences (IACS). SCAR leverages limited resources by partnering with selected global science programmes, providing them with an Antarctic perspective. These are the World Climate Research Programme (WCRP), parts of the International Geosphere-Biosphere Programme (IGBP), the International Permafrost Association (IPA), the Global Ocean Observing System (GOOS), the Partnership for Observations of the Global Ocean (POGO), the Census of Marine Life (COML), the Global Biodiversity Information Facility (GBIF), the Scientific Committee on Oceanic Research (SCOR), and the Scientific Committee on Solar Terrestrial Physics (SCOSTEP).

SCAR also provides independent scientific advice on the knowledge and principles needed for wise management of the Antarctic environment by the Antarctic Treaty Parties (through Consultative Meetings); the Commission for the Conservation of Antarctic Marine Living Resources (CCAMLR); the Commission for the Conservation of Antarctic Seals (CCAS); the Advisory Committee of the Agreement on Conservation of Albatrosses and Petrels (ACAP); and the Council of Managers of National Antarctic Programmes (COMNAP).

2. SCAR SCIENCE

Everything SCAR does, and how SCAR is perceived as an organization, is rooted in the quality and timeliness of SCAR's scientific portfolio. Even SCAR's advice to the Antarctic treaty System can only be effective if SCAR is scientifically strong. The proof of a concept and its execution is best measured by outcomes. As one measure of quality, external reviews in 2008 of SCAR's five major scientific research programmes were highly satisfactory, reflecting the excellence of the science conducted, how that science has been communicated to the wider world, the international partnerships generated, and the diligence that has been exercised in assuring that SCAR supports the highest quality science. Annual assessment of SCAR's scientific portfolio is assured by procedures for programme planning, proposing, implementation, reporting and review, which help to ensure continuous improvement.

Renewal is essential to the continuing health of SCAR, and mechanisms are in place to ensure the generation of exiting new projects as old ones come to their end. In July 2008, the SCAR national delegates approved the phasing out of one major programme and its replacement by another at the end of 2009, along with development of a further major programme for approval in 2010. A regular Cross-Linkages workshop provides an incubator for the generation of new programme proposals.

All SCAR's scientific planning, reporting and review is carried out by volunteers. The willingness of the community to participate in assuring success is another metric of the health of SCAR, especially when people have competing demands on their time.

2.1 MAJOR SCIENTIFIC RESEARCH PROGRAMMES

SCAR's current research continues to focus on five major Scientific Research Programmes (SRPs), each addressing key issues at the frontiers of science:

- Antarctica and the Global Climate System (AGCS), a study of the modern ocean-atmosphere-ice system;
- Antarctic Climate Evolution (ACE), a study of climate change over the past 34 million years since glaciation began;
- Evolution and Biodiversity in the Antarctic (EBA), a study of the response of life to change;
- Subglacial Antarctic Lake Environments (SALE), a study of lakes buried beneath the ice sheet;
- Interhemispheric Conjugacy Effects in Solar-Terrestrial and Aeronomy Research (ICESTAR), a study of how the Earth's outer atmosphere responds to the changing impact of the solar wind at both poles.

Project Implementation Plans are available at the SCAR web site. Advances in each programme in 2007-8 are summarized below. SCAR welcomes the involvement of scientists in these programmes (enquiries to info@scar.org).

All components of the Earth System are connected. To ensure cross disciplinary interactions address pressing and socially relevant scientific questions in Earth System Science, SCAR fosters strong links among its scientific programmes and with global partners.

2.1.1 Antarctica in the Global Climate System (AGCS)

Antarctica in the Global Climate System (AGCS) focuses on: (i) how does the modern climate system work in Antarctica and the Southern Ocean?; (ii) how has it developed over roughly the last 10,000 years?; and (iii) how may it evolve over the next century. The results will be useful to the Intergovernmental Panel on Climate Change (IPCC) and others. For details see: http://www.antarctica.ac.uk/met/SCAR_ssg_ps/AGCS.htm. AGCS incorporates SCAR's International Trans-Antarctic Scientific Expedition (ITASE) and Antarctic Sea Ice Processes and Climate (ASPeCt) projects. AGCS and its sub-programmes are co-sponsored by SCAR and the World Climate Research programme (WCRP). Several IPY projects contribute to AGCS goals and vice versa. Members of AGCS have given public lectures, visited schools, prepared popular articles and made broadcasts on radio and television.

2.1.1.1 Progress

AGCS is preparing a review on Antarctic Climate Change and the Environment (ACCE), synthesizing knowledge on past present and possible future changes in Antarctica and the Southern Ocean and their impact on the biota. It will be published in 2009. A review of the State of the Antarctic and Southern Ocean Climate System (SASOCS) was published by Reviews of Geophysics early in 2009. A paper in press in the Journal of Climate shows that the interdecadal warming and freshening of mode and intermediate water masses in the Southern Ocean since the 1960s has likely been driven by changes in the major modes of Southern Hemisphere climate variability (Southern Annular Mode, El Niño-Southern Oscillation and Interdecadal Pacific Oscillation). The work is based on oceanographic observations in the Drake Passage region. Analysis of air temperatures over Antarctica from 1960-2007, using data from SCAR's READER database, shows that near-surface warming on the Antarctic Peninsula has spread into West Antarctica, reaching as far east as the Pine Island Bay-Thwaites Glacier region. It is most marked in recent years, with 2007 being the warmest. While the western Antarctic Peninsula warming is maximal in winter, and the eastern Peninsula warming is maximal in summer, the West Antarctic warming is maximal in spring. Weak near-surface warming is found over East Antarctica. Warming of the Antarctic winter troposphere, previously identified in radiosonde data, is thought due to an increase in the amount of polar stratospheric clouds. The stratosphere has been cooling as a result of greenhouse gas increases. Gap layers (partially melted, honeycomb-like ice matrices filled with seawater) form below a surface layer of snow and ice. They are common within Antarctic summer sea ice, and should be considered when analyzing melting scenarios. A paper in Geophysical Research Letters showed how "gap layers" form during melting.

AGCS has been involved in several field campaigns contributing to IPY, including:

- Multi-national traverses across Antarctica as part of ITASE to measure ice layers, bedrock, snow accumulation rates and ice flow;
- Brazilian-Chilean-USA ice core drilling on the Detroit Plateau, Antarctic Peninsula, for the Climate of the Antarctic and South America (CASA) programme;
- Oceanographic transects across the Southern Ocean and the Antarctic margins as part of the Climate in Antarctica and the Southern Ocean (CASO); and Synoptic Antarctic Shelf-Slope Interactions Study (SASSI) programmes.

AGCS recovers and archives Antarctic data, and has updated the Met-, Ice- and Southern Ocean- READER databases. The Australian Antarctic Data Centre contributes by archiving data on Antarctic sea ice and snow thicknesses collected over the past 30 years from ship expeditions. 80% of the known data is now archived. In future information on physical, chemical and biological properties of Antarctic sea ice cores will be archived.

AGCS organized the ITASE Synthesis Workshop (Castine, USA; 2-5 September), to identify climate changes that impacted the Antarctic over the past 200-1000+ years, as a basis for assessing likely future change. Workshop results will assist collaboration between ice core researchers, meteorologists, oceanographers, and climate modelers.

2.1.1.2 Plans for 2009

- Complete and publish the ACCE report.
- Investigate Tropical-Polar Interactions, with a section of ice cores from the Antarctic Peninsula and along southern South America.
- Quantify Southern Ocean circulation, heat and freshwater fluxes, and investigate the processes controlling the circulation.
- Study variability in synoptic activity over Antarctica and the Southern Ocean.
- Extend proxy data for the Southern Annular Mode.
- Hold the Antarctic Sea Ice Workshop (Lucca, Italy; 22-24 March 2009).
- Hold a workshop on 'Antarctic Climate Change and its impact on terrestrial and marine biodiversity' (Kuala Lumpur, Malaysia; 1-3 April 2009).
- Extend the Met-READER database, making meteorological observations available.

2.1.2 Antarctic Climate Evolution (ACE)

The Antarctic ice sheet began forming 34 million years ago (Ma). Its fluctuations drive changes in global sea level and climate. ACE collects and analyses geological data from selected time periods and integrates them with model results to determine the origin of the present ice sheet configuration and to assess how it grows and decays over time, as the basis for improving forecasts of future ice sheet behaviour and sea level change. ACE links to the ice core community via the International Partnership in Ice Core Sciences (IPICS); to the palaeoclimate community via the past climate change (PAGES) programme of the International Geosphere Biosphere Programme (IGBP) and the IPY programme on Bipolar Climate Machinery (BIPOMAC); to the IASC programme on Arctic Palaeoclimate and its Extremes (APEX); and to the Antarctic Geological Drilling programme (ANDRILL). The ACE website (www.ace.scar.org) moved to Montclair State University and is being updated and merged with the ACE Blog (www.antarcticclimate.blogspot.com).

2.1.2.1 Progress:

In 2008, ACE produced five key publications:

- A Special Issue on "Antarctic cryosphere and Southern Ocean climate evolution (Cenozoic–Holocene)" published in *Palaeogeography, Palaeoclimatology, Palaeoecology*, Volume 260. It includes 16 papers on palaeoenvironments and palaeoclimates around Antarctica, based on seismic research, drilling and coring.
- The book "Antarctic Climate Evolution" included in Elsevier's *Developments in Earth and Environmental Science* series (8) (November 2008). 13 chapters explore the state of knowledge concerning the ice and climate history of the Antarctic continent and its surrounding seas throughout the Cenozoic.
- A peer-reviewed review article: Siegert, M.J., Barrett, P., DeConto, R., Dunbar, R., Ó Cofaigh, C., Passchier, S. and Naish, T.: Recent advances in understanding Antarctic climate evolution. *Antarctic Science*, doi 10.1017/S0954102008000941 (2008).
- A special issue, dedicated to Professor Bruce William Sellwood, entitled "The Pliocene: a vision of Earth in the late 21st Century?", published by the *Philosophical Transactions of the Royal Society of London A*, volume 367. 10 papers explore what we know of the Pliocene Earth, and use of Pliocene analogues in considering future climate change.

- Publication of “Cenozoic East Antarctic Ice Sheet Evolution from Wilkes Land Margin Sediments”, as Integrated Ocean Drilling Program Expedition 318 Scientific Prospectus.

ACE has organized special sessions, business meetings and Town Meetings in four major scientific meetings, and co-funded travel for scientists and students to attend these meetings: (i) European Geophysical Union, Vienna; SCAR Open Science Conference, St. Petersburg; International Geological Congress, Oslo; AGU Fall Meeting, San Francisco. ACE funded a workshop (1-4 July, Granada) of the Circum-Antarctic Stratigraphy and Palaeobathymetry (CASP) Project to make palaeobathymetric maps of the East Antarctic continental margin from 40 Ma to the present, using digital seismic reflection data and rock samples. Such maps set boundary conditions for ocean circulation models and coupled atmosphere-ocean Global Climate Models (GCMs). ACE helped scientists and students participate in the “Pliocene Climate Model Intercomparison Project” (4-6 June, New York).

ACE continues to stimulate and be involved in geological drilling, supporting a planning workshop (29-30 June, Granada) for the scientific planning of the drilling by IODP of the Wilkes Land margin, Expedition 318, scheduled for January-March 2010. During the past two years, the ACE-supported ANDRILL Programme (IPY Project #256), advanced ACE objectives by recovering >2400 metres of sediment from McMurdo Sound. The cores span more than 20 million years (Ma) of climate and ice sheet history and provide numerical models with new constraints on ice sheet behaviour and Ross Sea conditions. In the 07/08 field season, a 1138 m core was re covered from southern McMurdo Sound with an expanded section of the Early-Middle Miocene including the middle Miocene climatic optima (20-14 Ma). A core workshop was held at Florida State University in April; the initial drilling report is in press; and a synthesis of the scientific results was published in the ISAES-X volume (US National Academy Press). New results are under review in a special issue of *Global and Planetary Change*, and the first set of linked data-model manuscripts are in review with *Nature*. Papers from both projects have been submitted to *GSA Bulletin* and to *Geology*. Site surveys for future potential drilling continued in Granite Harbour in the 07/08 and 08/09 field seasons. A new proposal was submitted to NSF for drilling on Coulman High beneath the Ross Ice Shelf. A drilling strategy and technical development report was prepared to define the needs for drilling through thicker, faster moving ice and in shallower water depths. The EuroANDRILL consortium proposal has advanced to the full proposal stage with the European Polar Board.

Plans to undertake deep-field airborne radar surveying of the structure of the East Antarctic ice sheet progressed, with a new ACE-focused programme emerging between the USA, UK, Australia and New Zealand to survey the ice sheet base between Dome C and the coast in 2008/09. Plans were also made for the 08/09 USA-UK-Germany-China airborne survey for the IPY Antarctica's Gamburtsev Province Project (AGAP) on Dome A.

To reach scientists beyond the Antarctic community and convey the significance of Antarctic data to palaeo-oceanographers and palaeo-climatologists worldwide, ACE and PAGES co-hosted a special session at the International Geological Congress, focusing on bi-polar records and linkages. In the January 2009 PAGES Newsletter, ACE and PAGES highlight new paleoclimatic research being conducted at both poles. ACE funded young scientists to attend the 2008 Urbino Summer School in Paleoclimatology, and is aligned with the education and outreach activities of ANDRILL (<http://www.andrill.org/iceberg/>), which includes developing K-12 teaching resources on Antarctic Climate Evolution.

2.1.2.2 Plans

- First Antarctic Climate Evolution Symposium, Granada, 7-11 September 2009, followed by publication of 1st ACE Symposium Proceedings;
- First ANTscape workshop, April 15-17 2009, Leeds;
- Special sessions and Town Meetings at international meetings (AGU, EGU);
- Annual steering committee meetings at AGU, EGU, SCAR meetings;
- Support for Urbino graduate summer school in paleoclimatology;
- Contribute to the Pliocene Paleoclimate Model Intercomparison Project (PMIP);
- Support development of a European ANDRILL consortium (EuroANDRILL);
- Apply for a Chapman or Gordon conference on bi-polar paleoclimate records.
- Reconfigure and update the ACE website.

2.1.3 Evolution and Biodiversity in the Antarctic (EBA)

EBA aims to understand the evolution and diversity of life in the Antarctic, to determine how these have influenced the properties and dynamics of present Antarctic and Southern Ocean ecosystems, and to predict how organisms and communities will respond to environmental change. EBA integrates work on marine, terrestrial and lake ecosystems. By comparing the outcome of parallel evolutionary processes over the range of Antarctic environments, fundamental insights can be obtained into evolution and the ways in which life responds to change, from the molecular to the whole organism to the biome level. EBA is both a SCAR and an IPY programme. Some 40 national, multinational and/or IPY endorsed projects contribute to EBA, including CAML (Census of Antarctic Marine Life), MarBIN (Marine Biodiversity Information Network), Aliens, TARANTELLA, MERGE (Microbiological and Ecological Responses to Global Environmental Changes in Polar Regions), the Latitudinal Gradient Project, and ICED (Integrating Climate and Ecosystem Dynamics in the Southern Ocean). CAML, MarBIN and ICED are either SCAR activities or sponsored by SCAR.

2.1.3.1 Progress:

More than 150 EBA-related publications will have been published in scientific journals in 2008. EBA Newsletters were distributed in March and October.

EBA facilitates collaboration through workshops and conferences that maximize international and multidisciplinary involvement. In 2008 these included:

- A MERGE workshop, held within the Polar and Alpine Microbiology Conference (Banff, Canada). A publication from NIPR Japan (*Polar Science*) is planned as an outcome of the meeting; EBA funded 3 keynote speakers from Korea, India and the USA.
- An multidisciplinary ICED modelling workshop (April 2008), held to characterise Southern Ocean food webs across trophic levels and geographical areas, and aiming to develop an interdisciplinary approach to Southern Ocean ecosystem modelling.
- an EBA sponsored workshop on "The polar and alpine environments: molecular and evolutionary adaptations in prokaryotic and eukaryotic organisms" (Naples, Italy – 29-30 May 29), featuring sessions on (i) the structure, function and evolution of cold-adapted protein; (ii) evolutionary biology of polar organisms; (iii) physiological and genomic adaptations to cold environments; and (iv) microbial ecology and biodiversity. The papers will be published in a special issue of *Marine Genomics*.

- EBA assistance for the inaugural meeting of the European Union's "Coordination Action for Research Activities in Life in Extreme Environments" (CAREX) project (18 March), and participation in the 2nd CAREX workshop (December, in Spain). CAREX aims to support research interests across microbes, plants and animals evolving in diverse marine, polar, and terrestrial extreme environments as well as in outer space.
- an EBA sponsored workshop on 'Antarctic Gradients' (May 2008) to examine how the Latitudinal Gradient Project approach in Victoria Land could be used in other parts of Antarctica. One outcome is a review for submission to Ecological Monographs in 2009. A follow-up workshop was held in July in St Petersburg.

EBA is organised into 5 different Work Packages. Highlights include the following:

WP 1: Evolutionary history of Antarctic organisms: EBA participants have increasingly worked with SCAR glaciologists and geologists to assess interactions between organisms and their environment through time. They are contributing to the 'Antarctic Climate Change and the Environment' (ACCE) report. Key papers have appeared in e.g. *J. Biogeog.*, and a cross-disciplinary review was submitted to *Quaternary Science Reviews*.

WP2: Evolutionary adaptation to the Antarctic environment: Microorganisms in terrestrial habitats including lakes and ponds are studied to understand their evolutionary adaptation to Antarctic conditions. The IPY-MERGE project is making a key contribution. Organisms studied include fungi, methanogens, cyanobacteria, bacteria and microalgal protists (particularly diatoms and green algae). MERGE is bipolar and includes Arctic projects. Genes and proteins in polar fish, invertebrates and bacteria enable studies of thermal adaptation at molecular level. Papers have been published in e.g. *Meth. Enzymol.*, *J. Am. Chem. Soc.*, *IUBMB Life*, *Current Protein & Peptide Sci*. Several cross-disciplinary reviews have been submitted to *Biol. Rev.*, *Marine Genomics* and *J. Fish Biol*. The discovery of the neuroglobin gene in icefish brains opens the question "what is the role of Ngb in fishes lacking hemoglobin as an oxygen carrier, as well as in many cases myoglobin"?

WP 3: Patterns of gene flow and consequences for population dynamics: isolation as a driving force: Work continues in the Ross Sea Sector. Among terrestrial organisms the work targets rotifers, tardigrades, nematodes, terrestrial arthropods (springtails and mites), lichens and mosses. In the marine realm, New Zealand's RV *Tangaroa* collected fish and invertebrate samples as part of an IPY- CAML voyage. Studies are planned on patterns of gene flow in populations of amphipod crustaceans.

WP 4: Patterns and diversity of organisms, ecosystems and habitats in the Antarctic, and controlling processes: Much work is being done through the Census of Antarctic Marine Life (CAML) programme. Antarctic benthic systems are not as stable as once thought. They are exposed to dynamic conditions and respond to environmental changes. In shallow water west of the Antarctic Peninsula, studies focus on the response of assemblages or key species to disturbance by sea-ice and geographical shift. Deeper offshore communities are shaped by iceberg scouring, which can alter biodiversity. Other studies work to correlate biological and physical processes in the water column and sea-ice with higher trophic levels (fish and benthos). Some assemblages show significant pelago-benthic coupling. Studies show that algae, krill and salps, which play a key ecological role as food for predators, are sensitive to atmospheric and oceanic changes. Efforts continue to clarify the tolerance of assemblages to changes in food supply. Gradients are being investigated (e.g. from shallow to deep waters, or along latitudes) to detect ecological controls and changes over time. The aim is to predict the evolution of marine ecosystems. See recent papers in e.g. *Nature*; *J. Biogeog.*, *MEPS*.

WP 5: Impact of past, current and predicted future environmental change on biodiversity and ecosystem function: Dispersal of invasive species is being investigated, their spatial dynamics are being monitored and rates of dispersal modeled. The vulnerability of endemic biota to biological invasions is being assessed, as is the effect of climate change on invasive species. Terrestrial biological diversity is being assessed for a working paper for the ATCM and a review for the scientific literature. EBA has helped evaluate human impacts on the environment, in the context of examining the effectiveness of the Environmental Protocol (Tin et al. 2009, *Antarctic Science*). EBA also contributes to the new SCAR Action Group on Prediction of Changes in the Physical and Biological Environments of the Antarctic.

In part EBA's success rests on the extent to which biological data can be maintained, archived and exchanged, much of which is done through the Australian Antarctic Data Centre, which hosts and maintains a Biodiversity Database on Antarctic and sub-Antarctic flora and fauna (<http://data.aad.gov.au/aadc/biodiversity/>). EBA also relies on other databases such as SCAR-MarBIN (below), MERGE, and the Southern Ocean Continuous Plankton Recorder Programme (SO-CPR). EBA has a portal within the Antarctic Master Directory allowing access to metadata that contribute to EBA's aims. To view the portal – go to:

<http://gcmd.nasa.gov/KeywordSearch/Home.do?Portal=eba&MetadataType=0>.

The SCAR-Marine Biodiversity Information Network (SCAR-MarBIN) supports and develops a network of databases, institutes and people and gives open access to information on marine biodiversity for science, conservation and management. SCAR-MarBIN has set up the first authoritative Register of Antarctic Marine Species (RAMS), which feeds larger taxonomic systems such as the World Register of Marine Species, the Catalogue of Life, or the Encyclopaedia of Life. RAMS includes information on 13,000+ taxa and is updated and checked by a board of specialists. MarBIN also gives access to occurrence and abundance data from 115 interoperable databases, reaching over 913,000+ records, which are also published through the Ocean Biodiversity Information System (OBIS) and the Global Biodiversity Information System (GBIF). Main ongoing developments include a new data portal to give access to new features, including access to genetic data, expeditions and experts databases, interactive identification keys, field guides and a new intuitive interface including a powerful search engine. MarBIN is funded by the Belgian Science Policy until September 2009, and seeks support to sustain its future, including: (i) forming a consortium of contributing countries under SCAR and CCAMLR and (ii) approaching private foundations for specific projects (<http://www.scarmarbin.be>). Failure of national operators to secure the future of SCAR MarBIN will have a considerable negative impact on the Antarctic marine biological research community.

Census of Antarctic Marine Life (CAML)

CAML is part of EBA and of the global Census of Marine Life. It is one of the major achievements of the IPY, having coordinated 18 major research voyages in the Southern Ocean. CAML has pioneered new understandings of the evolution and diversity of life, and provided comprehensive baseline information on Antarctic marine biodiversity that will be a benchmark against which future change in marine communities around Antarctica can be assessed. Scientific results are available via SCAR-MarBIN (above). As one example of the CAMNL approach, in early 2008, CAML scientists participated in the Collaborative East Antarctic Marine Census aboard Japan's *Umitaka Maru*, France's *L'Astrolabe* and Australia's *Aurora Australis*. They studied sea-bed communities and the deep pelagic (open ocean) zone of the region adjacent to Terre Adélie and George V Land. CAML has shown that the Southern Ocean is unexpectedly rich in marine life, contrary to expectation. The seafloor around Antarctica is now seen to be a single benthic bioregion. Molecular techniques show Antarctica to be the birthplace of many species, driven by glacial cycles

over millions of years. For example, eight genera of octopus were present in Antarctica 30 million years ago. Since then, different octopus types have repeatedly colonised the deep sea, radiating northwards when the ice retreated. Similar patterns are observed with other species, including asellote isopods (crustaceans) and pycnogonids (sea spiders). Melting ice shelves have exposed seafloor communities to light for the first time; during the first CAML expedition, on *Polarstern*, the disintegrating Larsen A and B ice shelves revealed areas of the continental shelf attracting life from deeper waters on the slope, including sponges that rapidly colonise the seafloor disturbed by ice scour. In partnership with Canada's Guelph University, CAML is 'barcoding' (analysing DNA sequences) for some 2,000 Antarctic species, with SCAR-MarBIN creating related data storage, analysis and visualization tools. Analysis of genetic variation in Antarctic and subAntarctic seas will then be possible; it will help identify new species and 'cryptic' species (species difficult to distinguish from each other). The data will contribute to the Barcode of Life data system.

During CAML voyages, a team coordinated by the Equipe Cousteau (www.cousteau.org), sent words and pictures around the world via blogs, and online and print articles (see websites of EducaPoles (www.educapoles.org/index.php?/home/), CAML (www.caml.aq), SciencePoles (www.sciencepoles.org/index.php?/home/), and the International Polar Foundation (www.polarfoundation.org).

CAML is made possible by support from a broad range of private sources and government agencies in many nations. It will end with the end of the Census of Marine Life programme in 2010. Related initiatives including barcoding and the Encyclopaedia of Life www.eol.org are expected to continue beyond 2010 if funding is available. CAML's international network of researchers in marine biodiversity will continue under the auspices of SCAR, addressing the central EBA themes of biodiversity and evolution in Antarctica.

2.1.3.2 EBA Plans for 2009

- Complete and publish the ACCE report;
- Support the investigation of environmental gradients;
- Support the collation of terrestrial biogeographical data, and its analysis in terms of Antarctic regionalisation;
- Provide advice to CEP on biodiversity and conservation within Antarctica;
- Support studies of the risks of transfer of non-native species into Antarctica;
- Support continuation of SCAR MarBIN database development;
- Support completion of relevant IPY programmes (including EBA-IPY, MERGE, CAML, Tarantella, Aliens in Antarctica)
- Contribute to a workshop on 'Antarctic Climate Change and its impact on terrestrial and marine biodiversity' (Kuala Lumpur, Malaysia; April 2009).
- Sponsor a workshop on "Genomics, Proteomics and High Technologies in Polar Biology", Rome, Italy (Spring 2009).
- Contribute to the SCAR Biology Symposium, Sapporo, Japan (July 2009).

2.1.4 Subglacial Antarctic Lake Environments (SALE)

The SALE programme promotes, facilitates and champions international cooperation to better understand subglacial aquatic environments in Antarctica. It also promotes and advances environmental stewardship in the exploration of these unique settings. SALE contributes to the IPY under the auspices of the SALE-UNified International Team for Exploration and Discovery (SALE-UNITED) programme. SALE's members are funded through their national programmes to conduct SALE science; additional funding from SCAR allows for the convening of a yearly meeting. The SALE website contains details on the

programme (<http://scarsale.tamu.edu/>). SALE produces an weekly email highlighting subglacial lake research and related topics to more than 150 scientists worldwide.

2.1.4.1 Progress

Knowledge of subglacial aquatic environments has reached a level where major proposals are now being submitted for funding by individual national programmes to directly sample the subglacial environment. These projects, if funded, will sample subglacial systems in compliance with current environmental protocols. The data obtained will provide the basis for future research and discovery. Three highlights follow:

- Subglacial Lake Ellsworth: In December 2008, the UK's Natural Environmental Research Council (NERC) awarded funding for sampling Subglacial Lake Ellsworth in 2012/2013. This £6.7 million programme involves ten UK universities and research institutes, and three US institutions. The team will use hot water drilling to penetrate the lake's ice roof without contaminating the water body below. A probe will then enter the lake and collect measurements and samples. A gravity core will collect a 2-3 m sediment core from the lake bed. Instrument development and testing, and a comprehensive environmental evaluation (for the Antarctic Treaty System), will be completed in the next three years.

- West Antarctic Ice Streams: Proposals to the National Science Foundation include:

- "Lake and Ice Stream Subglacial Access Research Drilling" (LISSARD) – to study lakes beneath Mercer and Whillans ice streams;
- "Robotic Access to Grounding-zones for Exploration and Science" (RAGES) - to study nearby hydraulically-linked ice stream grounding zones.
- "GeomicroBiology of Antarctic Subglacial Environments" (GBASE) - to study biodiversity and biogeochemical transformations within these systems.

Sampling in 2010/2011 will yield data on the glaciological, geological and microbial dynamics of these environments and test the idea that the hydrology in these environments exerts a major control on ice sheet dynamics, geochemistry, metabolic and phylogenetic diversity, and the biogeochemical transformations of major elements.

- Subglacial Lake Vostok: In 2007/08 the Russian Antarctic drilling programme at Lake Vostok included drilling in borehole 5G-1, radio-echo sounding, and seismic studies. From radio-echo sounding completed in January 2008 maps were made of the coastline of the lake and of the water layer thickness. Seismic studies of the water layer and of sediment rock thickness were also completed then. During 2008-09, radio-echo sounding was conducted beyond the lake limits and preparations were underway to conduct seismic measurements of the geological structure of the Earth's crust. The plan is to extract the stuck drill in January 2009 so that drilling operations can continue with a modified drill.

The US National Aeronautics and Space Administration (NASA) has funded development of a sub-ice robot ("Endurance") to characterize the physical and chemical environment of subglacial lakes. Endurance was deployed in late 2008 in Lake Bonney (McMurdo Dry Valleys), collecting the first 3-dimensional data on a permanently ice-covered lake. The robot also mapped the intersection of the Taylor Glacier with the water of Lake Bonney.

Belgian modellers continue to synthesize and integrate data to better understand the deglaciation history of the Antarctic ice sheet and the mechanisms involved in grounding line migration. Current research focuses on ice rises (pinning points) along coastal Dronning Maud Land (DML). Modelling used radar data to define how long the ice flow remained local on the ice rise, which constrains the deglaciation history. Results of radar and ice analyses

will show whether pinning points play a stabilizing role in the dynamics of grounding lines and the role of marine ice, to improve present-day ice sheet models that incorporate grounding line migration. Regional ice sheet model experiments focusing on the DML sector will quantify the contribution of this area to sea level rise over the last 20,000 years. The project started in late 2008 when >150km of radar data were collected and several tens of meters of ice cores were collected close to the grounding line.

During 2008 SALE has:

- built a community via workshops, meetings, and sessions at scientific meetings;
- identified major scientific and technological goals for SALE research and exploration through active engagement of the community;
- held regular meetings that serve as forums for the discussion of science and technology amongst national programmes;
- educated the public through extensive coverage of SALE science in the press;
- provided a framework for developing a code of conduct for Antarctic subglacial exploration. SCAR has formed an action group to finalize this plan;

The number of SALE-related papers in peer-reviewed journals is increasing each year (see lists of publications by year at <http://scarsale.tamu.edu/selected-publications>). Two major review papers were published in 2008, summarizing much of what is known about subglacial ecosystems. Many papers have been published in Science and Nature on various aspects of SALE science during the last few years.

2.1.4.2 Plans for SALE

- SALE meeting in Brussels, Belgium in June 2009. The outcome will be summarized in a white paper and submitted for publication in a journal.
- SALE meetings will include students, on the advice of the local organizers and APECS representatives.
- Continue to propose and organize sessions at major earth and polar science meetings and venues (e.g. AGU, EGU).
- An AGU Chapman Conference on “Exploration And Study Of Antarctic Sub-glacial Aquatic Environments” has been funded for Washington, DC, in 2010.

2.1.5 Inter-hemispheric Conjugacy Effects in Solar-Terrestrial and Aeronomy Research (ICESTAR)

ICESTAR is creating an integrated, quantitative description of the upper atmosphere over Antarctica and of its coupling to the global atmosphere and the geospace environment.

2.1.5.1 Progress

ICESTAR continues to provide leadership in IPY Project # 63 - *Heliosphere Impact on Geospace*, which includes 29 international research groups and is jointly managed by the International Heliophysical Year (IHY) group. The ICESTAR/IHY team convened the 2008 Polar Gateways Arctic Circle Sunrise conference at Barrow, Alaska, during the first week of local polar sunrise, January 23-29, 2008, to address the earth, planetary, and heliophysical science and future exploration of polar and icy worlds in the solar system. The event held satellite sessions in NASA Centers, US universities, research institutes around the Arctic Circle (in Norway, Sweden and Russia) and Antarctica, communicating between sites through video- and teleconferences. Discussions included some on the advantages of polar icy regions for testing instrumentation for different planetary missions and outer solar system exploration. Presentations were web broadcast through the videoconferencing facilities of the University of Alaska, Fairbanks. Several educational sessions arranged in Barrow Point were also made available for the US participating schools through the NASA Digital

Learning Network (see the Arctic Sunrise home site at <http://polargateways2008.gsfc.nasa.gov/>).

Riometers are emerging as an important tool in both space science and space weather. Riometers measure the ionospheric opacity for radiomagnetic noise that comes from distant stars and galaxies. The intensity of this noise depends on the ionization level in the ionosphere and thus riometers can be used to monitor solar activity effects in the upper atmosphere. Global networks of imaging and single beam riometers support studies of high energy central plasma sheet and radiation belt electron precipitation, dynamic magnetospheric processes such as dispersionless injections, the effect of geospace processes on high latitude atmospheric composition and dynamics, and the effects of polar cap high energy proton precipitation on communications. The growing global network of riometers facilitates studies of processes involving the production, transport, and loss of high-energy magnetospheric particles at all spatial scales. Many of these cheap instruments could be deployed in dense continent-wide networks. Agreements between data providers, under the auspices of the IPY-ICESTAR and GLORIA (GLObal RIometer Array) initiatives, and facilitated by the GAIA Virtual Observatory, are on the verge of enabling ready access to these data. The Third International Workshop on Riometry was held on June 22, 2008 at the Zermatt Resort in Midway Utah. See <http://www.riometer.org> for details.

The ICESTAR team helped to develop the Global Auroral Imaging Access (GAIA) data portal; see <http://gaia-vxo.org>. GAIA is a virtual observatory for dealing with data from geospace optical and riometer systems. While these two instruments differ in observational technique, they both remotely sense auroral precipitation. GAIA is a network-based set of tools for browsing summary data from All-Sky Imagers (ASIs), Meridian Scanning Photometers (MSPs), and riometers worldwide. It provides indexes for direct access to data. Over 10,000,000 summary images are registered in the GAIA database. They and the associated metadata provide a link to hundreds of “imager years” of data from observational programs in at least seven countries. Version 2 of GAIA was rolled out before summer 2008, with at least an order of magnitude more summary data, mirror sites at Lancaster, the Finnish Meteorological Institute, and Natural Resources Canada, tools for creating value added data products (e.g., movie making tools, and calibration information), ingestion of data in real-time, and direct access to some full-resolution data (NORSTAR, for example). This program is the virtual observatory component of the IPY Auroral Optical Network (AON) and GLORIA projects, and falls under the ICESTAR IPY umbrella.

ICESTAR held a dedicated session in the Open Science Conference in July. 13 articles on ICESTAR-related research from the Greenland Space Science Symposium (part of the ICESTAR-IHY IPY programme) were published in 2008 in a special issue (vol. 70, issue 18) of the *Journal of Atmospheric and Solar Terrestrial Physics*, on “Transport processes in the coupled solar wind–geospace system seen from a high-latitude vantage point”.

In 2007, the community using the system of European incoherent scatter (EISCAT) radars arranged a workshop in Åland (Finland), accompanied by a two-week summer school to teach students to use the radar facilities. 100 abstracts were submitted. A special issue with papers from the workshop was planned for 2008 in *Annales Geophysicae*.

2.1.5.2 Plans for 2009

The aim is to deliver a wide variety of products ranging from a better scientific understanding of the polar atmosphere to a data portal that will enable scientists to create a systems-view of the polar region, including:

- Continued development of the GAIA data portal;
- Quantifying the role of seasonal differences in polar ionospheric conductance and the effects on magnetospheric, ionospheric, and thermospheric dynamics;

- Constraining models based on conjugate remote sensing of inner magnetospheric dynamics;
- Characterizing the basic state of the polar middle atmosphere;
- Quantifying the AC and DC global atmospheric circuit;
- Holding a team meeting in Brazil.

2.2 SPECIFIC SCAR RESEARCH AREAS

2.2.1 Life Sciences Group

The Standing Scientific Group for the Life Sciences (SSG-LS) is responsible for a number of activity areas aside from EBA and SALE (above).

(i) Higher Predators: The Expert Groups on Seals and Birds have been merged to become the Expert Group on Birds and Marine Mammals. The group will meet in 2009, where the provisional Terms of Reference will be examined. An evaluation of the group will be made after 2 years and be reported to the SSG-LS meeting at XXXI SCAR in 2010.

(ii) Human Biology and Medicine: A recent request to national committees has led to recruitment of 3 new members. Meetings have been held jointly with COMNAP's MEDINET group. The Expert Group continues to promote its activities and its members undertake the majority of the medical research carried out in the Antarctic.

(iii) ICED (Integrating Climate and Ecosystem Dynamics in the Southern Ocean): The ICED Science Plan and Scientific Steering Committee have been formally approved by the Global Ecosystems Dynamics programme (GLOBEC) and the Integrated Marine Biogeochemistry and Ecosystem Research programme (IMBER) (see www.iced.ac.uk). A list of nominees for the ICED Scientific Steering Committee is being considered.

A number of meetings were held:

- ICED held its first modelling workshop in April 2008 at Old Dominion University in Norfolk, Virginia. The workshop aimed to begin developing circumpolar ecosystem models to predict responses to variability and change. Three newsletter articles were published (IMBER, EBA and CCPO Circulation); a report is being drafted and will be available on the ICED website; and a scientific paper is in preparation for submission to a high profile journal in 2009.
- A presentation on ICED was made at the ESSAS (Ecosystem Studies of Sub-Arctic Seas) Annual Science Meeting, Nova Scotia, Canada, September 2008, enabling discussion of potential areas for collaboration on polar ecosystem issues;
- An ICED/ESSAS session on Climate Influences and Biological Controls in High Latitude Marine Ecosystems was part of the IGBP Conference in Cape Town in May 2008, facilitating discussion and synthesis of current research on control mechanisms and feedbacks in the marine ecosystems of the Southern Ocean;
- Results from the ICED modelling workshop were given at the Advances in Marine Ecosystem Modelling Research (AMEMR) meeting, Plymouth, June 2008;
- A joint session on Polar Marine Ecosystems: Status and Change was convened by ICED and CAML for the Open Science Conference in St Petersburg, in July 2008.
- Several ICED-related presentations were made at the EUR-OCEANS final meeting in Rome, Italy, November 2008. A final report has been submitted highlighting ICED achievements in partnership with the EUR-OCEANS Southern Ocean System.

Two recent EUR-OCEANS funded projects (*EUR-OCEANS Southern Ocean System and ICED data rescue projects*) contributed to the data synthesis aims of ICED. Southern Ocean

species distribution and abundance data were retrieved from historic cruises spanning 1925-85. Data have been submitted to EUR-OCEANS WP 2.2 and included in the PANGEA database. We are building on these projects to further ICED data activities.

For the ICED-IPY project a web-based system has been developed for collating information on relevant field activities. This information is fed to a live virtual globe layer (GoogleEarth). This is the first stage developing a useful tool for coordinating existing fieldwork and targeting potential future fieldwork. The map layer is linked to a database to ensure integration with other relevant IPY ocean projects. Developing a GoogleEarth layer to display long-term ecosystem monitoring sites in the Southern Ocean will contribute to the Southern Ocean Observing System (SOOS) (see below).

Future plans include:-

- Publication and PR for the ICED Science Plan/Implementation Strategy;
- Establish the steering committee and convene the first meeting;
- Follow up the first modelling workshop in terms of developing outputs;
- Hold an ICED-IPY event in Portugal, probably 2010;
- Further develop the GoogleEarth approach.
- Contribute to the GLOBEC synthesis meeting in June 2009.

(iv) The Action Group on Continuous Plankton Recorder Research (CPR-AG): The Southern Ocean CPR Survey (SO-CPR) is progressing well. The 2007/08 season was the most successful to date, with 90 tows around Antarctica using eight vessels from seven countries. This included tows in the Amundsen Sea and Bellinghousen Sea, which have received little attention in the past. 25,000 nautical miles or 5000 sample records will be added to the CPR data set and to CAML (Census of Antarctic Marine Life). New Zealand's Ministry of Fisheries has secured funding for the next five years to run CPRs on toothfish fish vessels operating between NZ and the Ross Sea. This will improve sampling in the western Pacific region. The South American LA-CAML consortium will join the SO-CPR Survey this season 2008/09, with tows across Drake Passage. CPR data are being used by a global study that has observed a general shift in dominance from large to smaller copepod species. The SO-CPR Survey observed a change from krill to small copepods in the sea ice zone around year 2000. In 2004/05, a massive increase in foraminiferan numbers occurred; this group increased from a long-term average of 2% to >50% numerical dominance. CCAMLR uses the data in its bioregionalisation research, a first step towards the possible development of Marine Protected Areas. At XXX SCAR (July 2008) the CPR Action Group was elevated to Expert Group status due to the expansion of this work, its long-term nature, and its linkages and successes. The SO-CPR Survey is now an official SCAR Product.

(v) Cross-SSG Action Group on Prediction of Changes in the Physical and Biological Environments of the Antarctic: This new Action Group was created at XXX SCAR in July 2008, and members are now being appointed. A report of the initial meeting in late 2008 is on the website.

(vi) Cross-SSG Action Group on Code of Conduct for the Exploration and Research of Subglacial Aquatic Environments (AG-CCER-SAE): This new Action Group was created at XXX SCAR in July 2008, and members have been appointed.

(vii) Cross-SSG Action Group on King George Island: The Terms of Reference and membership of this Action Group were revised at XXX SCAR in July 2008, and new members have been appointed. A paper has been developed for discussion with COMNAP in 2009.

(viii) Action Group on Biological Monitoring: The AG Biological Monitoring produced the report “Practical Biological Indicators of Human Impacts in Antarctica” in 2006, and was disbanded in 2008.

(ix) Environmental code of conduct for terrestrial scientific field research: The SSG-LS has produced a unified code of conduct for fieldwork anywhere in the Antarctic, including protected areas, to help scientists avoid introducing alien propagules into the Antarctic. This has involved extensive consultation within the SCAR community and with COMNAP. It will be submitted as an Information Paper to the ATCM and CEP in April 2009, and has been available on the SCAR web site since autumn 2008.

(x) Global Ocean Ecosystems Dynamics (GLOBEC): SCAR continued its co-sponsorship of the Southern Ocean GLOBEC project of the IGBP.

(xi) Global Biodiversity Information Facility (GBIF): In 2008 SCAR obtained Associate Participant status in GBIF. SCAR will be involved in the governing of GBIF and in implementing GBIF’s goals and work plan.

(xii) Action Group on Antarctic Fuel Spills (AGAFS): In the wake of the sinking of the MV Explorer on 23 November 2007, SCAR created an Action Group on Antarctic Fuel Spills (AGAFS). AGAFS will address issues that might arise related to the fate and effects of fuel releases in Antarctica. The group will respond when specific advice is requested.

(xiii) SCAR Biology Symposium: Preparations are underway for the 10th SCAR Biology Symposium (26 – 31 July 2009), which will be held at Hokkaido University, Sapporo, Japan. See web site for details.

2.2.2 Geosciences Group

The Standing Scientific Group for the Geosciences (SSG-GS) contains several Expert and Action Groups aside from the Scientific Research Programmes ACE and SALE.

(i) The Expert Group on Geodetic Infrastructure of Antarctica (GIANT) provides a common geodetic reference system for all Antarctic scientists and operators. It also contributes to global geodesy for studying the physical processes of the earth and the maintenance of the precise terrestrial reference frame, and provides information for monitoring the horizontal and vertical motion of Antarctica. The SCAR GIANT team is a leader in the bipolar IPY POLENET (Polar Earth Observing Network) project, to which GIANT contributes the Antarctic GPS component.

(ii) Solid Earth Response and influences on Cryospheric Evolution (SERCE) Scientific Programme Planning Group: This team is developing a scientific research programme that will capitalize on GIANT, on the former Antarctic Neotectonics (ANTEC) programme terminated in July 2008, and on developments made by the IPY POLENET programme in 2007-2009. Delegates at XXX SCAR approved the formation of SERCE as a planning group to develop a full proposal for consideration at SCAR in 2010. The drive for SERCE recognizes that neotectonic motion across Antarctica will occur due to displacements on active structures, deformation associated with active volcanism, and glacio-isostatic adjustment (GIA) of the Earth in response to changes in ice mass load. Predicted vertical motions due to GIA exceed 4 mm/year over large areas of the continent and range up to 20 mm/year - rates that can be measured with precision by GPS. Discovering modern structural displacements (for example across the West Antarctic rift system) and testing different GIA models requires a distributed array of GPS stations across the continental interior. GIA is the response of the Earth to past and present-day changes in

ice sheets and glaciers. In most parts of Antarctica it is the main process causing neotectonic crustal motions. GIA models combine an ice sheet history with an assumed Earth rheology to predict past and present crustal motion, sea-level change, and changes to the Earth's gravitational field. To obtain more accurate earth models for GIA predictions, we need to know how the physical properties and thermal structure vary laterally and with depth in the East and West Antarctic crust and mantle. Many of the needed GPS measurements of crustal motion are being made by POLENET for the IPY period. Deployment of GPS stations in optimal positions with respect to historical and modern ice mass changes, and at sufficiently high spatial resolution, will provide robust constraints on ice models, improving our ability to predict sea-level change. SERCE will provide the internationally coordinated approach to data analysis and synthesis necessary to optimize the science outcomes of these new data sets. That will enable the GIA component to be removed from satellite signals that include a GIA component, so providing a more accurate picture of ice mass balance.

SERCE aims to improve understanding of the solid Earth response to cryospheric and tectonic forcing by:

- Integrating and synthesizing geodetic observations obtained from the multinational POLENET geophysical network during IPY to obtain a vertical and horizontal velocity field across the continent.
- Integrating and synthesizing seismological data obtained from the POLENET geophysical network during IPY to map Antarctic lithospheric and upper mantle structure and rheological properties.
- Synthesizing available observations and carrying out glaciological modelling to improve understanding of Antarctic Ice Sheet (AIS) evolution since the Last Glacial Maximum (LGM).
- Developing improved models of glacial isostatic adjustment (GIA) constrained by vertical crustal motion observations (objective 1), improved earth structure (objective 2), and improved ice sheet history (objective 3).
- Improving the estimates of present-day ice mass balance obtained from satellite observations. [Provision of improved constraints on the rates of gravitational change and crustal uplift due to GIA will remove one of the largest uncertainties in analysis of satellite data for present-day change].
- Documenting ice sheet boundary conditions and subglacial processes from seismological and glacial surface motion observations.
- Determining seismicity levels in Antarctica and linking them to cryospheric and tectonic processes.
- Improving understanding of neotectonic processes through analysis of improved earthquake catalogues and horizontal crustal motion observations.
- Improving understanding of ionospheric and tropospheric processes through analysis of new POLENET space-geodetic observations.

The SERCE programme planning group will convene a multidisciplinary workshop to establish priority research themes and groups for the SERCE programme probably in April, 2009, before or after EGU, to be held in Modena, Italy.

(iii) Joint SSG-GS/SSG-PS Action Group on GPS for weather and space weather forecast:

The POLENET and ICESTAR communities working on the IPY project for Upper Atmosphere Monitoring are cooperating to achieve (i) ionospheric imaging over Antarctica; (ii) exchange of data and expertise for the application of tomography to other fields of interest (e.g. 3D water vapour reconstruction); (iii) exchange of technologies to install and manage remote GPS stations; and (iv) the possibility of hosting instruments in the polar stations. Initial work has been dedicated to first attempts to exchange data and expertise on ionospheric imaging and on the mitigation of ionospheric effects on Global Navigational

Satellite System (GNSS) signals. A feasibility study is in process on the use of Antarctic measurements for estimating water vapour. Global tropospheric models for water vapour retrieval were implemented in the analysis of geodetic observations to improve the estimation process of zenith total delay with GPS data. Comparisons with old models are being carried out with alternative techniques such as radiosondes, for estimating water vapour content. Common data sets from different techniques and overlapping observations periods have been identified and adopted as benchmarks on which cross checking can be performed and integrated water vapour can be computed. Papers and posters have been presented at workshops and meeting during the year. Representatives of the group met during the AGU Fall Meeting in San Francisco in fall 2008. A workshop is planned for May 2009 (in Italy) to stimulate international collaboration on the use of GPS for neutral/ionized atmosphere investigations over Arctic and Antarctica, to coordinate the efforts on data management, and to optimize the use of existing facilities.

(iv) Expert Group on the International Bathymetric Chart of the Southern Ocean

(IBCSO): Southern Ocean bathymetry defines ocean gateways and barriers, drives ocean currents and ocean mixing, controls thermohaline circulation with Antarctic bottom water formation, and so influences global climate. The IBCSO group aims to produce the first bathymetric map of the Southern Ocean to address those topics. The Intergovernmental Oceanographic Commission (IOC) of UNESCO and the International Hydrographic Organization (IHO) accept IBCSO as a regional ocean-mapping program and provide assistance through the Hydrographic Commission on Antarctica. The GIS-based IBCSO is also a contribution to the IOC/IHO General Bathymetric Chart of the Oceans (GEBCO). IBCSO and its new SCAR sister project Antarctic Bedrock Topography (BEDMAP2) aim to create a seamless bathymetric and topographic database. New single and multi-beam data were collected and processed by the Alfred Wegener Institute during *R/V Polarstern* cruises in the Weddell Sea/Drake Passage and the Lazarev Sea. Other contributions were made by Australia (South Indian Ocean), New Zealand (Ross Sea and adjacent Southern Ocean), Ukraine (Antarctic Peninsula), and the United States (Amundsen Sea). Additional bathymetric data or grids are provided by Russia (South Indian Ocean), Spain (Scotia Sea), the United Kingdom (South Atlantic) and international research programs (Bellinghousen and Amundsen Sea). A preliminary inventory of ship tracks with existing *NBPalmer*, *Polarstern*, and *JCRoss* multibeam data is now available from the Marine Geoscience Data System (MGDS) at Lamont-Doherty Earth Observatory. Presentations on IBCSO and its relevance to other projects were given to the GEBCO Guiding Committee (Tokyo, May 2008), the SCAR Standing Scientific Group on Geosciences (St Petersburg, July 2008) and the Hydrographic Commission on Antarctica (Rio de Janeiro, October 2008). During the year, SCAR distributed a Circular Letter to National Delegates regarding the importance of bathymetric data acquisition in Antarctic waters and asking for their nomination of national representatives to the IBCSO board. Only three nominations arrived, from Italy, Spain and Sweden in 2008. It is necessary to restart the nomination process for the IBCSO Board. For more details see www.ibcso.org.

(v) The Antarctic Digital Magnetic Anomaly Project (ADMMap) aims to map Antarctica's magnetic anomaly field to aid in understanding geological processes. It is managed jointly with IAGA (International Association of Geomagnetism and Aeronomy). ADMMap contributes data to the World Magnetic Anomaly Map (for details see: <http://www.geology.ohio-state.edu/geophys/admap>). During 2008, the release of a CD to the World Data Centers with the latest completed ADMMap compilation was approved, pending the inclusion of minor updates. This compilation is ADMMap-1999 to indicate the latest year of survey data that the compilation holds. Plans were made to commemorate the CD release with a special issue of ADMMap papers in a peer-reviewed journal in 2009. Work on the next compilation is underway. More than 2 million line kilometers of new aeromagnetic and ship survey data since 2000 are becoming available for inclusion in the database. In addition, a number of new surveys will be completed as part of the IPY. Furthermore, CHAMP satellite magnetic

observations are now being collected at altitudes of about 300-325 km. In view of these data developments, a new generation ADMAP compilation will be made available soon after the end of the IPY. The new compilation, tentatively entitled ADMAP-2010, will be a significant ADMAP contribution to the legacy of the IPY.

(vi) The Expert Group on Antarctic Permafrost and Periglacial Environments (EGAPPE) coordinates, communicates and exchanges data amongst Antarctic permafrost researchers within SCAR and the International Permafrost Association (IPA). It works closely with the IPA working group on Antarctic Permafrost and Soils. The activities of both are described under the acronym, ANTPAS, the Antarctic Permafrost and Soils group (see <http://erth.waikato.ac.nz/antpas/>). During 2008 the Group hosted a workshop at the Ninth International Conference on Permafrost (Fairbanks, Alaska, June 2008), and another at the SCAR Open Science Conference (July 2008). It continued developing legends for soil and permafrost map units, and prepared provisional soil and permafrost maps of (i) Transantarctic Mountains, and (ii) permafrost maps of the Andes and King George Island. It published more than 50 papers in refereed journals pertaining to soils and permafrost in Antarctica, in the period 2006-2009. It maintained the EGGAPE database at Waikato University (<http://erth.waikato.ac.nz/antpas/>). Members monitored the active layer depth, permafrost temperatures in boreholes, and soil climate in the McMurdo Dry Valleys, North Victoria Land, and South Shetland Islands. In 2009 the Group will participate in the Vth International Conference on Cryopedology in Russia, 14-20 September. It will continue to develop a Cryosol session with an Antarctic focus for the International Union of Soil Scientists meeting (Brisbane, 2010), and prepare electronic versions of soil and permafrost maps and databases of the Transantarctic Mountains and Antarctic Peninsula.

(vii) The Sub-Ice Geological Exploration (SleGE) Action Group was transformed into an Expert Group by the Delegates at XXX SCAR in July 2008. SleGE goals are to:

- Evaluate and synthesize potential geological targets for subglacial sampling;
- Determine areas of high scientific interest to define targets for future surveying for geological sampling;
- Provide a forum to exchange ideas on potential geological targets and communicate plans of national and multinational campaigns for surveying and sampling;
- Provide a forum for reviewing existing ice drilling and geological sampling technology and establishing plans for developing new technologies to achieve the desired surveying and sampling.

Recent and on-going programmes or activities are presented below with brief descriptions:

Workshop on Fast Access Drilling and Ice Sheet Bed Sampling: US scientists held a workshop as a follow-on to the one held in 2002, termed FASTDRILL (www.es.ucsc.edu/~tulaczyk/fastdrill.htm). The follow-on meeting, "Workshop on Fast Access Drilling and Ice Sheet Bed Sampling", focused on the technology required for recovering basal ice and sub-ice geological materials. The workshop discussions covered three specific topics: 1) the utilization and melding of conventional hot-water drilling with new technologies, e.g. coiled-tubing drilling, for accessing subglacial environments; 2) techniques for sampling sediment-laden ice, sediment and rock at the grounded ice sheet bed, especially in the WAIS Divide deep borehole; and 3) technologies allowing "clean" access to the subglacial bed and the recovery of subglacial samples free of contamination. The discussion in topic (1) was guided by a concept for a new smart hot-water based soft coiled-tubing drill system; that in topic (3) will rest on the NAS/NRC report, "Exploration of Antarctic Subglacial Aquatic Environments: Environmental and Scientific Stewardship."

WAIS Divide Basal Science and Implementation Plan: The US ice-coring programme WAIS Divide aims to recover basal debris-rich ice and subglacial material including water,

sediment and bedrock. On September 2, 2008, a sub-committee of the science steering committee produced the “WAISDivide Basal Science and Implementation Plan” laying out science and sampling objectives. The US ice core drilling office will be tasked to build the required sampling equipment if approved by NSF. The document is available at www.waisdivide.unh.edu/news/WAISBasalPlanFinal2Sept08.pdf.

Other Planned Subglacial Drilling Efforts Likely to Include Geological Sampling:

Various ice coring and drilling initiatives are being planned and are likely to include recovery of geological materials. These include Subglacial Lake Ellsworth (lake sediment core), Dome A (bedrock sample of the Gamburtsev Mountains), the International Partnerships in Ice Core Sciences (IPICS) (several planned sites), and US initiatives to access near-grounding-line lakes on Whillans Ice Stream (lake sediment and till recovery). Efforts also include programs designed to recover subglacial sediment from below ice shelves, including the international ANDRILL program. The Pine Island Glacier (PIG) program, and a US Siple Coast program also plan to recover short cores of sediment from below ice shelves.

(viii) Seeps and Vents ANTArctica (SAVANT) Action Group The Seeps and Vents Action Group was created at XXX SCAR in July 2008 to investigate biological communities associated with seamounts, cold seeps and hydrothermal vents, cold water coral and sponge communities. These are of interest to CCAMLR, which is charged with developing management practices for Vulnerable Marine Ecosystems (VMEs) in Antarctic waters; VME's may include vent communities (Conservation Measure 22-06). Seamounts can be mapped using global data sets such as satellite gravity, and local compilations of ship-based bathymetry. These activities are underway under the auspices of the IBCSO Project (see above). Location of cold seep and hydrothermal vent communities is more difficult and will require a range of ship-based techniques. Existing geophysical data can be used to identify areas likely to contain such features. The Action Group will identify areas within the CCAMLR region likely to contain Vulnerable Marine Ecosystems around cold seeps and hydrothermal vents. It aims to:

- Compile a guide for the identification of fluid escape features to assist in detecting possible seep sites;
- Compile a guide for identifying cold seep and hydrothermal vent organisms;
- Review seismic reflection data to detect possible areas of shallow and leaking gas;
- Review echo sounder data for evidence of possible gas flares from active vents;
- Review multibeam and sidescan data for fluid escape structures on the sea floor;
- Review biological data for evidence of organisms associated with cold seeps or hydrothermal vents;
- Provide locations of areas of possible fluid seepage and biological communities to CCAMLR for incorporation in a GIS.

Activities so far include contacting potential participants, particularly those involved in research into seeps and hydrothermal vents. A pilot study reviewing echo sounder data for evidence of gas flares in the water column has begun.

2.2.3 Physical Sciences Group

The Standing Scientific Group for the Physical Sciences (SSG-PS) reported a number of highlights aside from those associated with its SRPs - AGCS and ICESTAR (above).

(i) International Partnership in Ice Coring Science (IPICS): A steering committee meeting was held in April 2008. Science plans for the three start-up projects are available; the fourth one the NEEem drilling in Greenland, is underway (but of less interest to SCAR). IPICS will hold a workshop to start implementation of the 3 projects in summer 2009.

(ii) Astronomy and Astrophysics from Antarctica (AAA) Scientific Research

Programme Planning Group (SRPPG): With the declaration by the United Nations that 2009 will be the International Year of Astronomy, it is fitting that the international Astronomical Union (IAU) has been admitted to membership of SCAR as an ICSU scientific union member. A session on astronomy and astrophysics was held at the Open Science Conference in July. The SCAR Delegates approved establishment of the AAA-SRPPG, (http://www.phys.unsw.edu.au/JACARA/AAA_SRP_webpage/). The Planning Group will work during 2009 to establish four working groups covering: (i) Site testing, validation and data archiving; (ii) Arctic site testing; (iii) Science goals; (iv) Major new facilities. The full SRP will start at the beginning of 2010. During 2008, China began constructing a permanent station at Dome A, which will join Dome C and the South Pole as one of the best sites on earth for astronomical observations.

(iii) Operational Meteorology: The Expert Group on Operational Meteorology in the Antarctic provides a point of contact between many groups undertaking meteorological work in the Antarctic. Through liaison with the World Meteorological Organisation (WMO) it has ensured that the amount of real-time data available from Antarctic sites has increased, with data from several new Automated Weather Stations (AWS) now available on the WMO Global Telecommunications System (GTS). It continues to extend the Met-READER database. The Group's web pages provide news and information about Antarctic meteorological activities. There is evidence that many ships operating in Antarctic waters do not make meteorological reports. SCAR and the International Maritime Organisation (IMO) should co-operate to improve the situation to the benefit of mariners, tourists and science.

(iv) Environmental Contamination in Antarctica (ECA) Action Group: The Group met in St Petersburg in July 2008 to discuss the following themes:

- Contamination in terrestrial water and soil environments;
- Heavy metal occurrence in snow and ice;
- Presence and distribution of Persistent Organic Pollutants (POPs) in environmental matrices;
- Trace elements in water and sediment of the Southern Ocean.

The workshop identified the following priorities:

- Integrate the ECA data base into JCADM (below) through a dedicated portal;
- Recognize and separate local sources (bases, aircrafts, ships, traverses) from global contaminant signatures by identifying proxies of the potential sources;
- Optimize the use of samples collected for environmental characterization purposes and warranty reliable data by defining the role of specimen banks (international collaboration) and organizing proficiency tests for trace contaminant determination in environmental matrices;
- Organize the third ECA workshop, in Venice (June 2009) to complete datasets for environmental contaminants and define topics for joint research projects.

(v) Polar Atmospheric Chemistry at the Tropopause (PACT): This new Action Group was formed at XXX SCAR in July 2008, to improve understanding of the distribution and variability of ozone in the polar upper troposphere – lower stratosphere (UTLS) region, and the feedbacks of ozone changes to polar climate. PACT will produce a database consisting of information derived from existing high latitude ozonesonde measurements, including:

- High resolution profiles of ozone mixing ratio and partial pressure in the vicinity of the tropopause;
- The height of the chemical tropopause;
- Ten-day forward and backward trajectory information at selected potential temperature surfaces intersected by the ozonesonde profiles.

The information will aid model studies of the UTLS region, particularly validating heating and cooling rates and trace gas transport fluxes. Data will be made available through the

Australian Antarctic Data Centre and the International Global Radiosonde Archive (IGRA). A web site to provide details and data is under construction.

(vi) The joint SCAR/SCOR Oceanography Expert Group: The Group's main focus has continued to be on developing a design plan for a Southern Ocean Observing System (SOOS). A SOOS meeting was held during XXX SCAR in July. The meeting aimed to present "strawman" plans for different aspects of the SOOS, and to agree on key recommendations and actions to move the process forward (for full report see http://www.clivar.org/organization/southern/expertgroup/SOOS_report.pdf). The Expert Group recently revised its membership, and since the St Petersburg meeting has been working on a SOOS planning document, a first draft of which will shortly be available for comment by the community. SOOS is co-sponsored by SCAR, SCOR, the Census of Antarctic Marine Life (CAML), the Partnership for Observation of the Global Oceans (POGO), the Global Ocean Observing System (GOOS), and WCRP. The US National Oceanic and Atmospheric Administration (NOAA) provided significant funding.

(vii) CLIVAR/CliC/SCAR Southern Ocean Implementation Panel (SOIP): The Panel is concerned with the development and assessment of the Southern Ocean Observing System (SOOS) activities, and works alongside the WCRP/SCAR International Programme for Antarctic Buoys (IPAB), which deploys drifting buoys on the sea ice. These two panels provide the practical side of SOOS development, and so complement the work of the Oceans Expert Group. The Panel meets every 18 months to 2 years and did not meet in 2008, though its members did provide input to the plans for SOOS (above). For 2009, a key activity will be defining research needs for a SOOS and evaluating the SOOS plan for adequate sampling of the climate system. Outcomes will feed into the OceanObs09 meeting in Venice (21-25 September 2009). There will be an SOIP Panel meeting from 16-18 February 2009 in Sydney Australia to address: (i) SOOS evaluation; (ii) Carbon science within SOOS; (iii) Climate and Carbon process study development; (iv) A report on the state of the southern climate system variations and key modes; (v) Gaps in climate modeling; and (vi) Atmosphere and Ocean reanalysis and fluxes in the Southern Ocean/Ice system.

(viii) Pan Antarctic Observations Network (PantOS): The group met during XXX SCAR to take forward development of PantOS. Key components include SOOS and the Cryosphere Observing System (CryOS)(see SCAR web site for details).

(ix) The SCAR Expert Group on Ice Sheet Mass Balance and Sea Level (ISMASS): ISMASS, which is now a joint programme with IASC, aims to revitalize the approach towards assessing methods and uncertainties in estimating Antarctic Ice Sheet mass balance. Many recent events suggestive of rapid ice-sheet change cannot be reproduced by the current generation of whole ice-sheet models on which the predictions issued by the IPCC are primarily based. 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 held in July as part of XXX SCAR 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 forcings (such as change in surface mass balance, loss of buttressing from floating ice shelves and ice tongues, and rising sea level). The Workshop was co-sponsored by SCAR, CReSIS, WCRP/CliC, and IASC/WAG, and made possible with support from several agencies. Attendees participated in drafting a Science Plan outlining a community strategy for the next 5-10 years to address current inadequacies in prognostic ice-sheet models. A draft version of the Science Plan is being

finalized. A Summer School, to be held in 2009, aims to improve ice-sheet models used to predict sea level change, and to train young researchers.

(x) International Symposium on Glaciology in the International Polar Year: This meeting, which is co-sponsored by SCAR, is due to be held 27-31 July, 2009 in Northumbria University, Newcastle, UK.

3. DATA AND INFORMATION MANAGEMENT

(i) Antarctic Data Management:

One of SCAR's goals is to facilitate free and unrestricted access to Antarctic scientific data and information in accordance with article III-1c of the Antarctic Treaty. This was the task of the Joint SCAR-COMNAP Committee on Antarctic Data Management (JCADM) (<http://www.jcadm.scar.org>). On January 1 2009, the Joint Committee on Antarctic Data Management (JCADM) becomes a SCAR Standing Committee (SC-ADM), (<http://www.scadm.scar.org>). SC-ADM will take on all of the objectives of the former joint committee. During 2008 a draft SCAR Data and Information Strategy was circulated by JCADM to SCAR delegates for review. Subsequently an ad-hoc Action Group was established to edit and finalise the document prior to its presentation to EXCOM in 2009. This Strategy will set the direction for SCAR data management activities over the next 5 years and emphasises the need to leverage established regional, global and thematic data-centric networks to improve data management capability within SCAR science programmes. To further enhance collaboration and integration with other data networks and facilities, SCAR has sought membership of the ICSU Strategic Coordinating Committee on Data and Information (SCCID) to be established in 2009 as a consequence of ICSU's review in 2007/2008 of global scientific data management and the ICSU World Data Centre System (WDCS). A JCADM representative participated as part of the ICSU review team to ensure that deliberations adequately addressed SCAR and IPY data issues. In July 2008, JCADM held its annual meeting as part of XXX SCAR and in conjunction with the IPY Data Committee. A 2008 independent review of JCADM was generally positive, and made a number of recommendations that have now been incorporated into the SC-ADM work plan. Two new initiatives were launched by JCADM in 2008 to improve communication between data management and science practitioners: (i) a periodic newsletter; (ii) a dedicated metadata/data portal for the SCAR Evolution and Biodiversity in the Antarctic (EBA) research program. This style of dedicated portal could be easily replicated for other key SCAR science research programs.

(ii) Antarctic Geographic Information:

The SCAR Standing Committee on Antarctic Geographic Information (SC-AGI) met during the XXX SCAR meeting in July. The SCAR Composite Gazetteer for Antarctica (CGA) is now hosted on the Australian Antarctic Division web site. Italy continues to liaise with SCAR members in compiling the composite gazetteer and uploading data to the database in Australia from Italy. The redevelopment of the SCAR CGA required considerable resources from both Australia and Italy and took about one year. The database was expanded allowing additional information such as photographs and coordinate information for named features to be shown. Users can determine the accuracy of the coordinates or the confidence users have in the location of a name.

The King George Island, Web Map Server (WMS) while fully functional, is not being maintained and the challenge is to find a new home for it.

SC-AGI now has 23 confirmed national representatives with an additional eight national contacts for Antarctic names and five national contacts for Geographic Information. The

challenge is to get members actively involved. A SC-AGI intersessional meeting may be held in Santiago, Chile in September 2009.

4. INTERNATIONAL POLAR YEAR

SCAR continues to make a significant contribution to the International Polar Year (IPY)(2007 – 2009), which ends on March 1 2009. The immediate past SCAR President and current SCAR Executive Director are members of the Joint ICSU/WMO Committee for the IPY (the IPY-JC), which also contains several eminent scientists from SCAR science programmes. They contributed to writing 'The State of Polar Research', which summarises progress to date and will be published early in 2009. SCAR is either leading or involved in 70% of the Bipolar or Antarctic natural science projects approved by the IPY Joint Committee. SCAR's 5 scientific research programmes lead project clusters for the IPY, and the Chief Officer of JCADM is co-chair of the IPY Data and Information Management Subcommittee. IPY activities include three major scientific conferences, the first of which was the Joint SCAR/IASC Open Science Conference in St Petersburg (8-11 July 2008) on: "*Polar Research – Arctic and Antarctic Perspectives in the International Polar Year*". There were 1150 attendees, and 1068 presentations (526 oral and 542 posters); this compares with the 624 presentations at SCAR's conference in Hobart (2006) and 540 in Bremen (2004). The IPY-JC met in St. Petersburg immediately before the conference. Recognising that the IPY is about education and outreach as well as about science, SCAR hosted as part of the XXX SCAR Meeting an IPY Open Forum (July 7), a one-day workshop of the Association of Polar Early Career Scientists (APECS)(July 7), and a conference session on Education and Outreach in the context of the IPY. SCAR is also assisting in development of an archive documenting the development of the IPY, and the Executive Director published paper in Polar Record on the IPY. The Executive Director also participated in meetings of the Heads of national Arctic and Antarctic IPY Secretariats (HAIS), as a means of assisting international coordination of IPY activities. At their meeting in Moscow in July 2008, SCAR Delegates considered how SCAR might take on responsibility for managing aspects of the IPY legacy. Developing observing systems is one element (e.g. SOOS – see above). SCADM (see above) will take on responsibility for aspects of IPY data and information management. SCAR is now a co-sponsor with IASC of APECS (mentioned earlier), to facilitate the development of young polar researchers. SCAR and IASC formed a Bipolar Action Group (BipAG) to advise SCAR and IASC governing bodies on the roles SCAR and IASC might play in managing the IPY legacy. BipAG met during the XXX SCAR meeting in July, and provided a report to the SCAR Delegates. SCAR and IASC are assisting in the organisation of the 2nd IPY conference, which takes place in Oslo in June 2010.

5. SCIENTIFIC ADVICE TO ATCM, CEP, CCAMLR AND ACAP

Through its status as Observer, SCAR continues to be the primary source of independent scientific advice to the Antarctic Treaty Consultative Meeting (ATCM) and the Committee on Environmental Protection (CEP). SCAR participated in the XXXIst ATCM in Kiev in June 2008. The SCAR Lecture, on 'Space Weather and its Effects' was delivered by Prof. Lou Lanzerotti (available from <http://www.scar.org/communications/>). SCAR presented 3 Working Papers and 5 Information Papers. SCAR's advice is provided through the Standing Committee on the Antarctic Treaty System (SC-ATS). In May 2008 SCAR conducted a review to increase the efficiency and effectiveness of its interactions with the CEP and ATCM. An Action Group under the leadership of Clive Howard-Williams (NZ) addressed these matters at a meeting in Cambridge. The Chairman of the CEP was part of the group.

Also in May 2008 a SC-ATS workshop was held in Cambridge to study all available data on the Southern Giant Petrel so as to provide the XXXI ATCM in Kiev (June 2008) with the latest information on this species (Working Paper 10). The paper recommended delisting the species and the recommendation was accepted. The ATCM meeting papers from SCAR are at <http://www.scar.org/treaty/atcmxxxi/index.html>.

SCAR is also an Observer to the Commission for the Conservation of Antarctic Marine Living Resources (CCAMLR). Graham Hosie (Australia) - represented SCAR at the 27th annual CCAMLR meeting in Hobart (October 2008). Several of SCAR's marine biology programmes provide strong links to CCAMLR's interests, especially SCAR's Census of Antarctic Marine Life (CAML) programme, the SCAR Continuous Plankton Recorder (CPR) programme, EBA, and SCAR's Marine Biodiversity Information Network (MarBIN). The work of SCAR's Ocean Expert Group is also relevant to CCAMLR, as is that of the Expert Groups on Higher Predators. SCAR is assisting CCAMLR in developing the concept of bioregionalisation of the Southern Ocean.

Recognising the expertise of the SCAR Bird Group, SCAR is invited as an Observer to meetings of the Advisory Committee on Albatrosses and Petrels (ACAP). ACAP contributed to the SC-ATS Southern Giant Petrels workshop in May 2008. A SCAR observer attended the ACAP meeting in August in Cape Town.

6. OTHER DEVELOPMENTS

(i) History: The SCAR History Action Group held a session with oral papers and posters on "Polar History and Institutionalisation of Polar Research - The International Polar Years" during the XXX SCAR meeting in July 2008. The Proceedings of the second history workshop (Santiago, 2006) will be printed by the Chilean Antarctic Institute in early 2009; the proceedings of the third workshop (Columbus, 2007) will be published as electronic version by the Byrd Polar Research Institute in 2009. Papers of the history session at the XXX SCAR meeting (St. Petersburg, 2008) will be published in *Polar Record* and in a book on the history of the International Polar Years by Springer. In 2009 the SCAR History Group will organise a workshop and present posters on "Lessons from the Past" during the Antarctic Treaty Summit in Washington DC on 3 December 2009.

(ii) Capacity Building, Education and Training (CBET): SCAR's main contributions to Capacity Building, Education and Training are through its Fellowship Programme and through working closely with the Association of Polar Early Career Scientists (APECS), which SCAR co-sponsors. In 2008/2009 SCAR funded three standard fellowships and supported an additional fellowship under the IPY 6th Continent Initiative programme that was funded by the International Polar Foundation. SCAR is committed to expanding its fellowship programme through both external as well as internal sources. In 2008 India contributed \$5000 to the Fellowship programme for 2009/10.

SCAR continues to work closely with APECS, acting both in an advisory manner and by co-sponsoring APECS initiatives of relevance to SCAR, like the IMPETUS workshop on techniques in polar ocean observation and monitoring held in St Petersburg in November 2008. As approved by the Delegates in XXX SCAR, representatives of APECS have been invited to send an observer to XXXI SCAR as well as to nominate local representatives to SCAR science meetings where appropriate.

SCAR is an Associate Member of the International Antarctic Institute (IAI), which is a "virtual" university comprising the Antarctic science courses of a number of universities and institutes around the world, led by the University of Tasmania.

SCAR has also been chosen by the Tinker Foundation to be the administrative organisation for the Martha Muse Prize for Science and Policy in Antarctica, a \$100,000 unrestricted yearly prize that will be given to an individual who has demonstrated excellence in Antarctic science or policy.

7. ADMINISTRATIVE ACHIEVEMENTS

Consistent with the requirement of its parent body, ICSU, during the year SCAR gained independent legal status as a Company Limited by Guarantee and is now a UK Charity.

In recent years, SCAR has led the development of a network of the four main bodies of ICSU concerned with research in the Polar Regions and/or the cryosphere. SCAR co-sponsors with the World Climate Research Programme (WCRP) the Climate and Cryosphere programme (CliC). SCAR works closely with IASC on bipolar issues of common interest, and SCAR and IASC jointly sponsored the IPY Open Science Conference in Russia in July 2008. SCAR and IASC signed an agreement with the International Association for Cryospheric Sciences (IACS) of the International Union for Geodesy and Geophysics (IUGG). This 4-component network will help to ensure that polar scientific research is effectively coordinated.

SCAR's communications continued to be focused through the SCAR web site, and the SCAR quarterly Newsletter. There were on average 130,000 hits per month on the SCAR web site for 2008, continuing the pattern of year-on-year increases. SCAR also published a SCAR brochure and poster, both available on the SCAR web site.

8. SCAR'S SERVICES AND PRODUCTS

For the benefit of the wider community SCAR provides several services and products underpinning the work SCAR scientists do. These can be useful to other communities too (CCAMLR or COMNAP, for instance). Many of these services and products do not (yet) have particularly high visibility (even on the SCAR web page). The list includes:

Antarctic Data Directory System (ADDS) (part of JCADM and therefore the responsibility of Taco de Bruin, Netherlands)

Reference Antarctic Data for Environmental Research (READER) (part of AGCS under the responsibility of Steve Colwell, UK)

Antarctic Digital Database (ADD) (part of SC-AGI and under the responsibility of Paul Cooper, UK)

Antarctic Biodiversity Database (managed for SSG-LS by the Australian Antarctic Division, under the responsibility of Dave Watts)

Marine Biodiversity Information Network (MarBIN) (under SSG-LS and the responsibility of Bruno Danis, Belgium)

Composite Gazetteer of Antarctica (an element of SC-AGI and now managed by the Australian Antarctic Division, with input from Roberto Cervellati, Italy)

Seismic Data Library System (SDLS) (managed for SSG-GS at the US Geological Survey under the responsibility of Alan Cooper, USA)

Geodetic Data including: Master index for Antarctic positional control; Geophysical and geodetic observatories; and Geodetic Control Database; (managed for SSG-GS by Reinhard Dietrich, Germany)

Antarctic Map Catalogue (managed by the Australian Antarctic Division, under the responsibility of Henk Brolsma)

Antarctic Bedrock Mapping (BEDMAP) (managed for SSG-GS/SSG-PS by David Vaughan, BAS, UK)

Tide gauge data (managed at the Proudman Oceanographic Laboratory, under the responsibility of Phil Woodworth, UK)

International Bathymetric Chart of the Southern Ocean (IBCSO) (managed for SSG-GS under the responsibility of Norbert Ott, Germany)

Antarctic Digital Magnetic Anomaly Project (ADMMap) (managed for SSG-GS under the responsibility of Marta Ghidella, Argentina)

The SCAR King George Island Geographical Information System (KGIS) (managed for SC-AGI under the responsibility of Steffen Vogt, Germany)

The Continuous Plankton Recorder database (CPS) (managed for SSG-LS under the responsibility of Graham Hosie, Australia)

The Feature Catalogue (managed by SC-AGI, through Henk Brolsma, Australia)

The Ocean READER database (part of AGCS under the responsibility of Mike Meredith, UK)

The Ice READER database (part of AGCS under the responsibility of Paul Mayewski, USA)

Sea Ice Database (part of AGCS and ASPeCt, and the responsibility of Tony Worby, Australia).

LIST OF ACRONYMS

AAA	Astronomy and Astrophysics from Antarctica SRP Planning Group
AC	Alternating Current
ACAP	Advisory Committee on Albatrosses and Petrels
ACCE	Antarctic Climate Change and the Environment
ACE	Antarctic Climate Evolution
ADD	Antarctic Digital Database
ADDS	Antarctic Data Directory System
ADMAP	Antarctic Digital Magnetic Anomaly Project
AGAFS	Action Group on Antarctic Fuel Spills
AG-CCER-SAE	Action Group on Code of Conduct for the Exploration and Research of Subglacial Aquatic Environments
AGCS	Antarctica in the Global Climate System
AGU	American Geophysical Union
AIS	Antarctic Ice Sheet
Aliens	Aliens in Antarctica (non-native species, IPY project)
AMEMR	Advances in Marine Ecosystem Modelling Research
ANDRILL	Antarctic Geological Drilling Project
ANTEC	Antarctic Neotectonics
ANTPAS	Antarctic Permafrost and Soils Group
AON	Auroral Optical Network (IPY project)
APECS	Association of Polar Early Career Scientists
APEX	Arctic Palaeoclimate and its Extremes (IASC programme)
ASI	All-Sky Imager
ASPeCT	Antarctic Sea Ice Processes and Climate
ATCM	Antarctic Treaty Consultative Meeting
AWS	Automated Weather Stations
BEDMAP	Antarctic Bedrock Mapping
BiPAG	Bipolar Action Group
BIPOMAC	Bipolar Climate Machinery (IPY programme)
CAML	Census of Antarctic Marine Life
CAREX	Coordination Action for Research Activities in Life in Extreme Environments (EU project)
CASA	Climate of the Antarctic and South America
CASO	Climate in Antarctica and the Southern Ocean
CBET	Capacity Building, Education and Training
CCAMLR	Convention on Conservation of Antarctic Living Marine Resources
CCAS	Commission for the Conservation of Antarctic Seals
CCPO	Climate Change Projects Office (UK)
CD	Compact disc

CEP	Committee for Environmental Protection
CGA	Composite Gazetteer of Antarctica
CliC	Climate and Cryosphere Programme
COML	Census of Marine Life
COMNAP	Council of Managers of National Antarctic Programmes
CPR	Continuous Plankton Recorder
CPR-AG	Continuous Plankton Recorder Action group
CReSIS	Center for Remote Sensing of Ice Sheets
CryOS	Cryosphere Observing System
DC	Direct Current
DML	Dronning Maud Land
DNA	Deoxyriboneuclic Acid (genetic information)
EBA	Evolution and Biodiversity in the Antarctic
ECA	Environmental Contamination in Antarctica Action Group
EGAPPE	Expert Group on Antarctic Permafrost and Periglacial Environments
EGU	European Geophysical Union
EISCAT	European Incoherent Scatter radars
ESSAS	Ecosystem Studies of Sub-Arctic Seas
EU	European Union
EuroANDRILL	European ANDRILL consortium
EXCOM	SCAR Executive Committee
FASTDRILL	Fast Access Drilling and Ice Sheet Bed Sampling
GAIA	Global Auroral Imaging Access
GBASE	GeomicroBiology of Antarctic Subglacial Environments
GCM	Global Climate Model
GEBCO	General Bathymetric Chart of the Oceans
GBIF	Global Biodiversity Information Facility
GIA	Glacio-isostatic adjustment
GIANT	Geodetic Infrastructure for Antarctica
GIS	Geographic Information Systems
GLOBEC	Global Ocean Ecosystems Dynamics
GLORIA	GLObal RIometer Array
GNSS	Global Navigational Satellite System
GOOS	Global Ocean Observing System
GPS	Global Positioning System
GSA	Geological Society of America
GTS	Global Telecommunications System (WMO)
HAIS	Heads of national Arctic and Antarctic IPY Secretariats
IACS	International Association for Cryospheric Sciences
IAGA	International Association of Geomagnetism and Aeronomy
IAI	International Antarctic Institute

IASC	International Arctic Science Committee
IASC-WAG	IASC Working Group on Arctic Glaciology
IAU	International Astronomical Union
IBCSO	International Bathymetric Chart of the Southern Ocean
ICED	Integrated Climate and Ecosystem Dynamics in the Southern Ocean
ICESTAR	Inter-hemispheric Conjugacy Effects in Solar-Terrestrial and Aeronomy Research
ICSU	International Council for Science
IGBP	International Geosphere-Biosphere Programme
IGY	International Geophysical Year
IGRA	International Global Radiosonde Archive
IHO	International Hydrographic Office
IHY	International Heliophysical Year
IMBER	Integrated Marine Biogeochemistry and Ecosystem Research
IMO	International Maritime Organisation
IMPETUS	Techniques in Polar and Ocean Observation and Monitoring
IOC	Intergovernmental Oceanographic Commission (of UNESCO)
IODP	Integrated Ocean Drilling Program
IPA	International Permafrost Association
IPAB	International Programme of Antarctic Buoys
IPCC	Intergovernmental Panel on Climate Change
IPICS	International Partnership in Ice Core Science
IPY	International Polar Year
IPY-JC	IPY Joint Committee
ISAES	International Symposium on Antarctic Earth Science
ISMASS	Ice Sheet Mass Balance and Sea Level
ITASE	International Trans-Antarctic Scientific Expedition
IUGG	International Union for Geodesy and Geophysics
JCADM	Joint Committee on Antarctic Data Management
KGIS	King George Island Geographical Information System
LGM	Last Glacial Maximum
LISSARD	Lake and Ice Stream Subglacial Access Research Drilling
MarBIN	Marine Biodiversity Information Network
MEDINET	Antarctic Medical Officers Network (COMNAP)
MERGE	Microbiological and Ecological Responses to Global Environmental Changes in Polar Regions
MSP	Meridian Scanning Photometer
NAS	National Academy of Sciences (US)
NASA	National Aeronautics and Space Administration (US)
NERC	Natural Environmental Research Council (UK)
NOAA	National Oceanic and Atmospheric Administration (US)

NORSTAR	Optical and radio facility designed to remote sense auroral precipitation
NRC	National Research Council (US)
NSF	National Science Foundation
OBIS	Ocean Biodiversity Information System
PACT	Polar Atmospheric Chemistry at the Tropopause
PAGES	Past Climate Change Programme of IGBP
PANGAEA	Publishing Network for Geoscientific & Environmental Data
PAntOS	Pan Antarctic Observations Network
PCPBEA	Prediction of Changes in the Physical and Biological Environments of the Antarctic Action Group
PIG	Pine Island Glacier
POGO	Partnership for Observations of the Global Ocean
POLENET	Polar Earth Observing Network
POPs	Persistent Organic Pollutants
RAGES	Robotic Access to Grounding-zones for Exploration and Science
RAMS	Register of Antarctic Marine Species
READER	REference Antarctic Data for Environmental Research
SALE	Subglacial Antarctic Lake Environments
SALE-UNITED	SALE-UNified International Team for Exploration and Discovery
SASOCS	State of the Antarctic and Southern Ocean Climate System
SASSI	Synoptic Antarctic Shelf-Slope Interactions Study
SAVANT	Seeps and Vents ANTArctica Action Group
SCAR	Scientific Committee on Antarctic Research
SC-ADM	Standing Committee on Antarctic Data Management
SC-AGI	Standing Committee on Antarctic Geographic Information
SC-ATS	Standing Committee on the Antarctic Treaty System
SCCID	ICSU's Strategic Coordinating Committee on Data and Information
SCOR	Scientific Committee on Oceanic Research
SCOSTEP	Scientific Committee on Solar Terrestrial Physics
SDLS	Seismic Data Library System
SERCE	Solid Earth Response and influences on Cryospheric Evolution
SIeGE	Sub-Ice Geological Exploration Action Group
SO-CPR	Southern Ocean Continuous Plankton Recorder Programme
SOIP	Southern Ocean Implementation Panel
SOOS	Southern Ocean Observing System
SRP	Scientific Research Programme
SSG	Standing Scientific Group
SSG-GS	SSG on Geosciences
SSG-LS	SSG on Life Sciences
SSG-PS	SSG on Physical Sciences

TARANTELLA	Terrestrial ecosystems in ARctic and ANTarctic: Effects of UV Light, Liquefying ice, and Ascending temperatures
THEMIS	Time History of Events and Macroscale Interactions during Substorms
UN	United Nations
UNESCO	UN Educational, Scientific and Cultural Organisation
UTLS	Upper troposphere – lower stratosphere
VME	Vulnerable Marine Ecosystem
VO	Virtual Observatory
WCRP	World Climate Research Programme
WMO	World Meteorological Organization
WMS	Web Map Server