WP	**07**
Agenda Item:	2.1.1
Person Responsible:	D Bromwich

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SSG Physical Sciences

Executive Summary

Title: SSG Physical Sciences

Authors: David Bromwich (Chief Officer), Maurizio Candidi (Deputy Chief Officer), and Steve Colwell (Secretary). Written contributions were received from Chief Officers of Expert Groups (EGs), Action Groups (AGs), and linked activities.

Introduction/ Background:

SSG-PS is responsible for 5 EGs (1 joint), 6 AGs (2 joint), and 2 Scientific Research Programs (SRPs). During 2015 it also partially funded the ACCE advisory group. EGs **ASPeCt**, **GRAPE**, **IPICS**, **ISMASS**, and **OpMet** have many ongoing activities, with IPICS preparing for a major international conference in 2016. AGs **Ocean Acidification** and **PACT** are winding up their activities in 2015 or so and publications are expected. AG **SERAnt** wants to become an EG at the upcoming SCAR Open Science Conference. AG **SnowAnt** is active in particular with snow schools in Europe. AG **ACA** is promoting field programs aimed at fixing large errors in atmospheric models over the Southern Ocean. Reports are also included for the **ACCE** advisory group and the **AAA** SRP, but not the AG on **Remote Sensing** that is covered by SSG-LS nor the **AntarcticClimate**[21] SRP that is covered by WP13.

Important Issues or Factors:

The AG on Ocean Acidification is seeking input on where to release its major report by the end of 2015.

Recommendations/Actions and Justification:

No recommendations or actions have been received from any EG or AG.

Expected Benefits/Outcomes:

Partners:

SSG-PS will continue to work with a wide variety of partners both within and external to SCAR.

Budget Implications:

No new funding has been requested through the end of 2016. Spending of existing allocations has been slow but this is usual practice. All allocated SSG-PS funds that have not been expended or explicitly targeted for spending by end of June 2016 will be redistributed to more worthy applications, most likely participation in the 2016 SCAR Open Science Conference in Kuala Lumpur.

SSG Physical Sciences

1. Chief Officers

CO: David Bromwich (USA); Deputy CO: Maurizio Candidi (Italy); Secretary: Steve Colwell (UK)

2. Major Future Initiatives and Actions

EG-ASPeCt

1). ASPeCt data collection & testing of software prototype by the AAD, AWI and CHINARE.

2). Additions to the ship observations database (ASPeCt observations) on a continuing basis.

3). Development of the ASPeCt ship-based observation system and database for sea ice measurements taken by remote vessels (airborne and under ice), ship-based instruments and surface-based instruments and sampling.

4). Planning of and participation in the Antarctic Sea Ice Workshop, organized under the auspices of the Polar Research Board and tentatively scheduled for 2016 – This workshop will address our current understanding of processes driving Antarctic sea ice changes, whether or not these changes remain within the expected range of natural climate variability, and why climate models continue to fail at simulating observed Antarctic sea ice changes.

EG-GRAPE

- Maintenance of the GRAPE web portal
- A GRAPE special issue on "Radio Science" has been discussed with Phil Wilkinson (Radio Science editor) aiming to collect selected papers from GRAPE-URSI (not before 2016).
- The GRAPE satellite meeting and the scientific session are planned at the next SCAR OSC in Kuala Lumpur 2016. For this meeting financial support to early career scientists would be appreciated.
- A special joint session at URSI General Assembly 2017 has been planned, titled: GNSS for terrestrial applications: snow/ice, vegetation and atmosphere.

EG-ISMASS

An ISMASS Steering Committee meeting will take place on Tuesday 18 August 2015.

An ISMASS workshop on Marine ice sheet model and Ocean model coupling (MISMIP-ISOMIP-MISOMIP) is organized prior to the IGS Symposium on Contemporary ice mass change, held in Cambridge on Sunday 16 August 2015 (MISMIP: Marine Ice Sheet Model Intercomparison Project; ISOMIP: Ice-Shelf Ocean Model Intercomparison Project; MISOMIP: Marine Ice Sheet Ocean Model Intercomparison Project). During this meeting the description of the design of each experiment and the first results will be presented. It will be followed by a discussion on outstanding design questions, such as the use of basal friction laws, sub-shelf melt parametrization, and verification experiments. A timeline for submission of results will be established. Funds from ISMASS are used for organizing the workshop (room, catering and invitation of APECS members). 39 people are scheduled to attend this workshop.

A major model intercomparison initiative on West Antarctic Glacier-Ocean Models (and linked with the MISOMIP-ISOMIP initiative) will have its second meeting in May 2016 at the New York University Campus in Abu Dhabi, United Arab Emirates (organized by David Holland). This is a CliC and ISMASS endorsed initiative.

ISMASS proposes to organize a plenary session at the next SCAR OSC meeting in Malaysia, involving SRP AntClim21, PAIS and SERCE and focusing on the interactions between the different groups. All SRP representatives have been involved in this process.

ISMASS is considering revisiting the ISMASS Nature review paper (to be discussed more thoroughly during the SC meeting in August.

EG-IPICS

Planning has been continuing apace for the second IPICS Open Science Conference (OSC) to be held March 7-11, 2016 in Hobart (Australia). The organizing committee, led by Tas van Ommen, has now opened registration, and we expect around 200 delegates. The early career offshoot of IPICS, ICYS (Ice Core Young Scientists) will hold a symposium on the day before the OSC, and there will be numerous side meetings. Papers from the OSC will be published in a special joint issue of Climate of the Past and The Cryosphere (Eric Wolff is chief editor for the volume). Extensive support will be available for early career scientists (ECS) to attend in Hobart, and the SCAR funding that has been provided for IPICS is dedicated to ensuring the attendance of ECS and appropriate keynote and invited speakers.

At the OSC, it is expected that two new initiatives will be pursued in addition to established ones. One will be to promote better coordination for non-polar cores. Of more interest to SCAR is an "ice core heritage" initiative (being driven by Jerome Chappellaz) which plans to drill ice cores from high-altitude non-polar glaciers, which already provided very useful geochemical information but which are in danger now due to global warming, and store such core for the future in a cold secure location in Antarctica. Scientists from France, Italy, USA, China, Russia, South America and Switzerland could be involved.

The project to obtain “oldest ice” (Ice cores up to between 1-1.5 million years) is gaining a lot of traction, with at least 3 initiatives being planned (multiple cores are needed). Such work requires extensive geophysical survey work, and a high logistic and technological input. Because this project is exclusively Antarctic, it might warrant particular attention from SCAR, and we have highlighted its importance in responses to the SCAR/COMNAP Roadmap exercise.

AG-Ocean Acidification

The OA AG will deliver its final report before the end of 2015. The SSG is invited to suggest a suitable occasion/conference for the official release.

AG-SERAnt

SERAnt will hold a satellite meeting in Kuala Lumpur to discuss how to proceed and to appoint responsible people for the continuation of its activity.

AG-SnowAnt

The 2nd Snow Science Winter School will take place in Switzerland (February 14-20, 2016).

A session on snow-firn processes is proposed to the European Geosciences Union General Assembly 2016 with a specific focus on open questions of snow and firn processes on ice sheets, especially Antarctica.

For the SCAR biannual conference 2016 we propose a session "Processes and conservation of snow and firn in Antarctica: How much do we know, and how much should be care?"

3. Major Activities and Significant Progress

EG-ASPeCt (Antarctic Sea-ice Processes and Climate)

Chief Officers: Marilyn Raphael and Steve Ackley

ASPeCt data base progress:

1. A data acquisition and analysis software for bridge-based observations of the nearby (within approx 1 km radius) has been developed at the Australian Antarctic Division (AAD), Hobart, Australia. The data acquisition is aligned with the former manual log and follows WMO [1970] nomenclature. The tool is designed for use in Arctic and Antarctic sea ice. Currently the first in field trials of the software are underway, with the public release intended for 2015. *SCAR funds were used in this effort.*

Related: in response to an ASPeCt submitted resolution passed at the 2014 SCAR Delegates meeting in Auckland, New Zealand, the SCAR president is charged to draft a letter to national representatives of COMNAP to request that "national programmes which operate shipping in the sea-ice zone participate, where possible, in the underway sea ice data collection according to the ASPeCt protocols". This resolution at this time effectively coincides with the release of the full ASPeCt ship-based observation software.

2. The ASPeCt-Bio ice core database is being further developed (through activities of SCOR-BEPSII, Biogeochemical Exchange Processes at the Sea-Ice Interfaces) and is currently being extended to include carbonate system parameters and trace-metal parameters. Sea ice core nutrient data, both in pack ice and landfast sea ice are also being included. Some 1250 measurements from various areas off Antarctica have been collated.

Workshop participation

1. Participation in the COMNAP Sea Ice workshop COMNAP Sea Ice Challenges Workshop (May 2015) - the aim of the workshop was to explore the sea ice challenges our National Antarctic programs are experiencing in some parts of Antarctica right now and especially the past few seasons. ASPeCt members gave presentations on the science and logistics and participated in the discussions

2. ASPeCt Participated in the Antarctic Roadmap Challenge COMNAP workshop (logistic requirements for the SCAR Horizon Scan).

EG-GRAPE (GNSS Research and Application for Polar Environment) – Joint with SSG-GS.

Chief Officer: Georgiana De Franceschi

From October 2014 (after the SCAR OSC in NZ) a GRAPE Business Meeting and a scientific session have been organized during the last URSI AT RAS Conference (Gran Canaria, Spain, 18-22 May 2015) www.at-rasc.org. The Business Meeting (on Monday 18 May afternoon) was attended by more than 30 colleagues from different URSI Commissions (mainly from Commission G-Ionospheric Radio and Propagation). During the meeting, SCAR Horizon Scan and scientific priorities were presented and discussed focusing on the GRAPE future contribution to this. A task force will be soon established to start a process toward a possible proposal leading to a SRP based on GRAPE and enlarged to other interested polar communities. The scientific session (on Tuesday 19 May afternoon) was also quite interesting and more than 10 papers were submitted as oral presentations.

EG-IPICS (International Partnership in Ice Core Sciences)

Chief Officers: Eric Wolff and Ed Brook

Progress continues on the existing priority projects of IPICS. IPICS2k is pursued mainly through the PAGES Antarctic2k project, which is now led by Barbara Stenni. There will be a workshop in Venice in September 2015 to plan publications on temperature, accumulation rate and maybe sea ice. Publication of high profile papers from the WAIS Divide project has been a highlight for IPICS40k; the papers have brought new understanding of millennial scale climate change and carbon dynamics. A white paper has been

produced for the last interglacial project: this takes on strong significance as it has become clear that the last interglacial provides a testbed for the effect of high polar temperatures on ice sheets and sea level. Oldest ice is discussed above: a further geophysics workshop to plan survey of sites particularly in the Concordia region was held in the last year.

EG-ISMASS (Ice Sheet Mass Balance and Sea Level)

Chief Officers: Catherine Ritz and Frank Pattyn

A meeting on 'Constraining Uncertainty in Greenland Ice Sheet surface mass balance model output and in situ validation' was organized by E. Hanna in Sheffield, May 2015 (http://www.climate-cryosphere.org/activities/groups/ismass/meetings/uncertainty-greenland-ice-sheet-models) and sponsored by WCRP (CliC)/co-sponsored by ISMASS. The objectives of the meeting were (i) to prompt more comprehensive spatial comparisons between surface mass balance (SMB) model output from the several different SMB modeling approaches (RACMO2, MAR, SnowModel, Hanna et al. PDD approach) and (ii) to discuss how major discrepancies between GrIS SMB model estimates (e.g. relating to precipitation/snow accumulation amounts in inland south-east Greenland) can be better reconciled through the improved use and implementation of in situ validation observations, including (but not limited to) weather stations, ice radar and shallow ice cores. Participating scientists came from several different countries including the UK, Netherlands, Belgium, Denmark, USA - including representation from NASA - and Chile. The delegates included representation of all the SMB models used in the recent Intergovernmental Panel on Climate Change's (IPCC) Fifth Assessment Report (Working Group I, Chapter 13 on Sea Level Change). The workshop established a clear action plan, which can be found on the CliC website.

A GIA modelling symposium was organized in Fairbanks, Alaska (USA) in May 2015 (http://www.gia2015.org/). This meeting was not co-sponsored by ISMASS, but related to ISMASS activities and advertised on the ISMASS website.

EG-OpMet (Operational Meteorology in the Antarctic)

Chief Officer: Steve Colwell

Continues to maintain we pages that are updated on a weekly basis with news, information and data monitoring at http://www.antarctica.ac.uk/met/jds/met/SCAR_oma.htm

OPMet co-hosted a workshop on Antarctic meteorology in Cambridge from the 17-19 June 2015 which was held at SPRI (Scott Polar Research Institute); the website for the meeting can be found at http://amrc.ssec.wisc.edu/meetings/meeting2015/index.shtml. The meeting was attended by about 50 delegates from 10 different countries.

AG-ACA (Antarctic Clouds and Aerosols)

Chief Officer: Tom Lachlan-Cope

The AG in conjunction with the International Commission on Polar Meteorology has been mostly concerned with the large errors in atmospheric models over the Southern Ocean. U.S., Australian and UK groups have been active in proposing campaigns to observe clouds and aerosols over the Southern Ocean and SSG-PS money has been used to foster the collaboration between these groups by funding travel. It is hoped that other countries involved in Southern Hemisphere meteorology will be brought into these projects.

AG-Ocean Acidification - Joint with SSG-LS.

Chief Officer: Richard Bellerby

OA AG Southern Ocean Expert meeting, 27-28 January 2015, Denver, USA.

Richard Bellerby, Coleen Suckling, Elizabeth Shadwick, Scarlett Trimborn, Mario Hoppema, Nicole Lovenduski, Andrew Lenton, Haruko Kurihara, Claire Lo Monaco, Eugene Murphy, and Andrew Constable. Southern Ocean Acidification. Invited presentation, ATCM, Sofia, 1-10 June 2015.

The current OA AG will no longer continue in its present form after the year end. The AG is open and willing for further discussion on the form of any continuation. It is timely for an integrative assessment around climate change and ocean acidification – but perhaps that is already covered in ICED. However, this does not involve the social, economic and political science that is becoming of great interest around this topic.

AG-PACT (Polar Atmospheric Chemistry at the Tropopause)

Chief Officers: Andrew Klekociuk and Gennady Milinevsky

Analysis and write-up of results for PACT continues. One Ph.D. student (at the Taras Shevchenko National University of Kyiv) is assisting with this task. The activities of the AG are expected to be completed during 2015/16.

AG-Remote Sensing - Joint with SSG-LS

Chief Officer: Hans-Ulrich Peter

See SSG-LS report for the details.

AG-SERAnt (Sun Earth Relations in Antarctica)

Chief Officer: Maurizio Candidi

The Action group has been established in Auckland to bridge between the end of ICESTAR (Inter-hemispheric Conjugacy Effects in Solar-Terrestrial and Aeronomy Research) and the establishment of a new framework Expert group for Solar Terrestrial Physics (STP). A draft proposal for the delegates, to be presented in Kuala Lumpur has been circulated among the members M. Candidi, A. Seppala, A. Weatherwax and G. DeFranceschi; they are requested to provide feedback by end of August, in order to widen the list to all perspective participants.

AG-SnowAnt (Snow in Antarctica)

Chief Officer: Martin Schneebeli

The 1st European Snow Science Winter School took place in Finland from February 14-20, 2016. 6 students working or planning to work in the Antarctic participated. The interest in the winter school was very high, only 50% of the applications could be considered due to space limitations.

The presentation by M. Schneebeli at IUGG in Prague was well received.

The SnowAnt-webpages have been updated

Advisory Group-ACCE (Antarctic Climate Change and the Environment)

Chief Officer: John Turner

ACCE has responsibility for coordinating research across SCAR on past and potential future climate change over the Antarctic continent and in the Southern Ocean and potential impact on the biota. It brings together scientists working in the physical and biological sciences who advise the SCAR Delegates on areas where research is needed.

A key output of ACCE was the publication in 2009 of the 500 page report entitled Antarctic Climate Change and the Environment. This document has now been converted into an online wiki (http://acce.scar.org/wiki/Antarctic_Climate_Change_and_the_Environment) that allows the text to be updated. The ACCE wiki was launched at SCAR XXXIII in Auckland, New Zealand and since then ACCE has been establishing a number of editors to keep the document up to date.

Each year ACCE produces a paper for the ATCM on recent advances in Antarctic research related to climate change and the impact on the marine and terrestrial biota. In 2015 our contribution was designated Information paper 092 “Antarctic Climate Change and the Environment – 2015 Update” and presented at ATCM XXXVIII in Sophia, Bulgaria in June. The paper is available via the ATCM web site (www.ats.aq).

It was agreed at SCAR XXXIII that a cross-programme workshop would be held on "Interactions between biological and climate processes in the Antarctic". The theme of this meeting is very relevant to the goals of ACCE so the members of the AG are heavily involved in the planning of the meeting, which will be held over 16-18 September 2015 in Barcelona, Spain.

SRP- AAA (Astronomy & Astrophysics from Antarctica)

Chief Officer: John Storey

The broad objectives of the Astronomy & Astrophysics from Antarctica (AAA) Scientific Research Program are to coordinate astronomical activities in Antarctica in a way that ensures the best possible outcomes from international investment in Antarctic astronomy, and maximizes the opportunities for productive interaction with other disciplines.

AAA last met at the time of the last SCAR Open Science Conference in Auckland in 2014. The key outcomes of this meeting included a plan to implement the recommendations of the external review, and to begin the preparation of a response to the Antarctic Roadmap program.

It was also resolved to replace about half the steering committee now, with younger people and women being particularly encouraged to volunteer. The remainder of the steering committee are to be turned over in two years' time. The new committee has an excellent gender balance, and now includes a representative from APECS.

AAA will hold the third of its scientific workshops August 2015 on the big island of the Hawaii. The timing and location of this event has been chosen to take advantage of the large meeting of our sister body, the International Astronomical Union (IAU), being held in Honolulu. AAA has also organized an exhibition booth for the two-week duration of the IAU meeting. This booth will be staffed by volunteers, and aims to raise the profile of both SCAR and Antarctic astronomy within the broader astronomical community.

SRP - AntarcticClimate^{21} (Antarctic Climate Change in the 21st Century)

Chief Officer: Nancy Bertler

Extensive report is available under WP13.

4. Budgetary Implications

Through the end of 2016 there are no new budget requests that cannot be handled from discretionary SSG-PS funds.

Appendices

ISMASS

All ***ISMASS*** documents can be downloaded from the ISMASS/CliC website: http://www.climate-cryosphere.org/activities/groups/ismass.

Selected Publications: by EG-ASPeCt members or publications that use ASPeCt data.

Beitsch, A., S. Kern, and L. Kaleschke, Comparison of SSM/I and AMSR-E sea ice concentrations with ASPeCt ship observations around Antarctica. *IEEE Transaction on Geoscience and Remote Sensing*, **53**(4), 10.1109/TGRS.2014.2351497, 2015.

Kern, S., M. Zygmuntowska, K. Khovorostovsky, G. Spreen, N. Ivanova, and A. Beitsch, D4.1 Product Intercomparison and Validation Report, ESA CCI Sea Ice ECV Project Report, SICCI-PVIR, Issue 1.0, Nov. 2014.

Saenz, B. T., and K. R. Arrigo, Annual primary production in Antarctic sea ice during 2005–2006 from a sea ice state estimate. *J. Geophys. Res. Oceans*, **119**, 3645–3678, doi:10.1002/2013JC009677, 2014.

Williams, G., T. Maksym, J. Wilkinson, C. Kunz, C. Murphy, P. Kimball and H. Singh. Thick and deformed Antarctic sea ice mapped with autonomous underwater vehicles. *Nature Geoscience* doi:10.1038/ngeo2299, 2014.

EG-GRAPE Publications

Prikryl P., Jayachandran P. T., Mushini S. C., and Richardson I. G., High-latitude GPS phase scintillation and cycle slips during high speed solar wind streams and interplanetary coronal mass ejections: A superposed epoch analysis. *Earth, Planets and Space*, **66** :62, 2014.

Prikryl, P., Ghoddousi-Fard, R., Spogli, L., Mitchell, C. N., Li, G., Ning, B., Cilliers, P. J., Sreeja, V., Aquino, M., Terkildsen, M., Jayachandran, P. T., Jiao, Y., Morton, Y. T., Ruohoniemi, J. M., Thomas, E. G., Zhang, Y., Weatherwax, A. T., Alfonsi, L., De Franceschi, G., and Romano, V., GPS phase scintillation at high latitudes during geomagnetic storms of 7–17 March 2012 – Part 2: Interhemispheric comparison. *Ann. Geophys.*, **33**, 657-670, doi:10.5194/angeo-33-657-2015, 2015.

Raulin, J. P., Trottet, G., Gimenez de Castro, C. G., Correia, E., and Macotela, E. L., Nighttime Sensitivity of Ionospheric VLF Measurements to X-ray Bursts From a Remote Cosmic Source. *J. Geophys. Res.: Space Physics*, DOI:10.1002/2013JA019670, 2014.