



WP 5

Agenda Item: 2.2.1

Person Responsible: M Candidi

EXCOM 2013

Barcelona, Spain 22/23rd July 2013

SSG Physical Sciences

Executive Summary

Title: SSG Physical Sciences

Authors: D. Bromwich, M. Candidi

Introduction/ Background:

The structure of SSG/PS is detailed in the SCAR web site. Several groups will be reported upon to EXCOM individually and are therefore omitted here. These are the SRP's (AAA and AntClim21), several Expert and Groups that have grown enough to deserve independent status (ISMASS and Oceans-SOOS), and those groups that are cross-SSG and have been assigned to the partner SSG; they will be dealt with in the partner SSG report (ECA, ATHENA, Acoustics, ICED, and Remote Sensing).

Important Issues or Factors:

None of relevance.

Recommendations/Actions and Justification:

Ocean Acidification:

-identify assistance for the editing and publication of the final report.

-a communication team made up of SCAR and members of the AG should be set up by Easter 2014 to develop a communication strategy for the efficient dissemination of the key findings and the scientific report.

-The AG also requests a special session at the SCAR OSC in New Zealand in 2014.

SCOSTEP: M. Candidi has resigned from the position of SCAR representative in the SCOSTEP (<http://www.yorku.ca/scostep/>) bureau; SSG/PS suggests that Dr. Annika Seppala be nominated to that position, for a term of four years, to ensure that Antarctic perspectives be included in the overall Solar Terrestrial Physics programs.

Expected Benefits/Outcomes:

Ocean Acidification:

A final report on the group activity will be launched at the SCAR OSC in 2014 (www.scar2014.com).

International Partnerships in Ice Core Sciences (IPICS):

A special joint journal issue of *Climate of the Past/The Cryosphere* based on the Giens meeting.

GRAPE (GNSS Research and Application for Polar Environment):

The *Annals of Geophysics* (www.annalsofgeophysics.eu/index.php/annals) GRAPE Special Issue, sponsored by SCAR, is in publication.

Partners:

all the groups operating within SSG/PS have wide connections to similar organisms within and outside SCAR; in particular we note:

Budget Implications:

IPICS and GRAPE request additional funding for their activities.

SSG Physical Sciences

1. Chief Officers

D. Bromwich, M. Candidi, S. Colwell.

2. Major Future Initiatives and Actions

Ocean Acidification: Chair Dr R. Bellerby, Norway.

The carbon dioxide (CO₂) concentration of the Southern Ocean is rising. The dominant source of this increase is in response to partial equilibration with the increasing atmospheric CO₂ concentrations, following worldwide fossil fuel combustion and land use changes. Subsequent shifts in chemical equilibria result in a change to the marine carbonate system and a lowering of seawater pH. This process is termed “ocean acidification” (OA). From a limited number of studies to date, it is already clear that OA is causing rapid changes in ocean chemistry.

There is concern over the future of polar marine organisms that are uniquely adapted to their extreme and cold surroundings. In an environment where development is ten times slower than that in warmer regions of the world, the ability of these (mostly benthic) organisms to adapt to these changing conditions is questionable, especially over the next 50 to 100 years. Studies investigating the impacts of ocean acidification on polar marine calcifying organisms are extremely limited. The major challenges for understanding Southern Ocean acidification are advancing the observational network and better constraining our understanding of the underlying natural variability and the mechanisms that drive it, both of which are still poor. The socioeconomic and cultural effects of Southern Ocean OA are unknown.

There is a growing international effort to observe and monitor the marine carbonate system with the emphasis moving to an integrated observing system approach based on ecosystem-carbon-climate coupling. Additionally, modeling efforts are becoming much more unified and assimilated through a multi-model approach, with regional models becoming much more utilised – often informed at the boundaries through coupling to global earth system models.

The Action Group consists of an international cross-disciplinary team of ocean acidification experts representing the fields of marine carbonate chemistry, global and regional modelling, marine ecology, ecotoxicology/physiology and paleoceanography. An equivalent effort is being conducted in the Arctic.

The OA Action Group will:

- define our present understanding of the contemporary rates and future scenarios of Southern Ocean acidification;
- document ecosystem and organism responses from experimental perturbations and geological records;
- identify present and planned observational and experimental strategies;
- identify gaps in our understanding of the rates and regionality of ocean acidification and;
- define strategies for future Southern ocean acidification research.

The SCAR OA AG would like to point out that the SCAR OA report will cover the chemical and biological changes and effects but that there are no plans for a socioeconomic review of AO in the Southern Ocean.

International Partnerships in Ice Core Sciences (IPICS): Chair: Eric Wolff, BAS, Cambridge, UK.

Ice cores provide information about past climate and environmental conditions on timescales from decades to hundreds of millennia, and direct records of the composition of the atmosphere. As such, they are cornerstones of global change research. With the completion of major projects in Greenland and

Antarctica over the last 15 years, the international ice coring community is planning for the next several decades. The costs and scope of future work create the need for coordinated international collaboration. Developing this international collaboration is the charge of IPICS, the International Partnerships in Ice Core Sciences, a planning group currently composed of ice core scientists, engineers, and drillers from 22 nations.

*The 7th International Workshop on Ice Drilling Technology, which is endorsed by IPICS, will be held at the University of Wisconsin, Madison, WI, USA, from 9-13 September 2013.

*A workshop on radar layers, organised by Dorthe Dahl-Jensen, will be held in May 2013, and will include work on assembling data for the oldest ice project.

*The call for proposals for the next IPICS OSC will go out in mid-2013.

ASPeCt annual report - CliC SSG 9 in Potsdam, Germany, February, 2013. Marilyn Raphael, UCLA, USA.

In 2013, ASPeCt expects to be quite busy. Important organizational tasks to be completed are the finalization of the Science Implementation Plan and the review paper, which is currently in draft form. This has been the subject of a Workshop held in March 2013 at the GRC (Gordon Research Conference) in Ventura, California. ASPeCt also participates in the planning and execution of two important events, the Sea ice Workshop in June, 2013 and the WCRP Grand Challenge Cryosphere Workshop scheduled for October, 2013. Both Workshops will be held in Tromsø, Norway. To make sure that its work advances, ASPeCt will also continue its tradition of holding opportunity meetings at conferences scheduled by other organizations where ASPeCt research may be presented.

ASPeCt's future plans also include finalizing the sea ice core database and coordinating user interfaces for data access through the AAD data Centre. Additions to the ship observations data base (ASPeCt observations) are being made on a continuing basis, and sea ice thickness and sea ice core properties databases are being developed.

GRAPE (GNSS Research and Application for Polar Environment): Chair Dr. G. DeFranceschi, Italy.

The goal of the Expert Group GRAPE, built on the previous Action Group GWSWF (GPS for Weather and Space Weather Forecasting), is to continue and intensify the international efforts to build and coordinate a robust network of collaborations in order to answer a variety of space weather related needs through ad hoc data sharing and model development.

-A new project proposal has been submitted in April 2013 to the Italian National Program for Antarctic Research. The project, named DemoGRAPE and born into GRAPE, aims at implementing a demonstrator to provide, on selected case studies, an empirical assessment of the delay and corruption induced by the ionosphere on satellite signals in the polar regions. DemoGRAPE will demonstrate the usefulness of the proposed system for several scopes, from the applications to positioning, to space weather, to solid Earth and polar cap dynamics investigation, to the monitoring of cryosphere evolution, etc... DemoGRAPE will experiment the use of Cloud computing platform to create an innovative technological tool. The proposal is supported by international partners already involved in GRAPE (UK, Brazil, Poland, South Africa, USA) that expressed their interest in data/algorithms sharing and offering their polar infrastructures to host experimental equipment for ionospheric monitoring and for the ICT platform to be developed in CLOUD environment.

Polar Atmospheric Chemistry at the Tropopause (PACT). Chair A. Klekociuk, Australia.

The group aims at including northern hemisphere stations to the database of ozonesonde measurements. A publication summarizing the group activity results is in preparation and it is expected that the database and related analysis will be completed in the near future.

3. Major Activities and Significant Progress

Ocean Acidification.

Global average long-term ocean acidification projections are intimately linked with future atmospheric CO₂ levels, however the local expression of this global ocean acidification is much more heterogeneous, as local oceanic processes alter the average expectations of future ocean acidification. Evidence has mounted over the past years showing the importance of these ‘bottom-up’ local oceanic processes, both natural and anthropogenic, to altering the rate of ocean acidification from the long-term atmospheric top-down perspective.

Pelagic systems are changing fast, especially in the productive, euphotic zone. Autotrophic production may be changing biogeochemical cycling in the surface Southern Ocean through increased primary productivity and a changing stoichiometry of oceanic primary production. This will have consequences both for energy flow and biogeochemical transfers through the ocean ecosystem. Calcifying plankton such as pteropods have been shown to be adversely effected by current Southern Ocean acidification (Bednarsek, N. et al., 2012) . These organisms are prominent players in the Southern Ocean ecosystem (Hunt et al., 2008), both as predator and prey, and control to a significant degree the export of carbon and other elements to the intermediate and deep ocean.

There is a growing international effort to observe and monitor the marine carbonate system with the emphasis moving away from purely physico-chemical approach to an integrated observing system approach based on ecosystem-carbon-climate coupling (e.g. Feely et al., 2009). Additionally, modeling efforts are becoming much more unified and assimilated through both a multi-model approach (paper) and that regional models are becoming much more to the fore – often informed at the boundaries through coupling to global earth system models.

International Partnerships in Ice Core Sciences (IPICS)

The main event of 2012 was the IPICS Open Science Conference, held at Giens, France from 1-5 October 2012. This was a highly successful meeting, organised with great care by a team led by Jerome Chappellaz. 230 scientists from 23 nations attended, and heard 5 days of plenary talks and posters, along with excellent informal discussion.

IPICS has 4 priority science projects (which remain valid) and a technical group. Progress on the 4 priorities is summarised as follows:

*Oldest ice (Antarctica) project: much enthusiasm for the concept has been generated, but the actual locations and modes of operation have not yet been agreed. A workshop was held on 6-7 October (attached to the IPICS OSM) at which 27 attendees from 11 nations discussed all the issues around finding a suitable site. A paper summarising the data needed and the criteria for site selection is in preparation, an additional meeting about radar tracing has been organised, and various actions have been set in train to advance progress towards this project.

*Last interglacial (NEEM): the first major paper on NEEM has been published in Nature. It is planned to incorporate new Antarctic interglacial information into this project.

*IPICS-40k: Further syntheses of different sites have appeared in the last year, and the new WAIS Divide data is starting to appear. Further sites (Roosevelt Island and Fletcher Promontory) have been drilled in the last two years, and others are in planning.

*IPICS2k: The Antarctic 2k synthesis has completed its first product, which is incorporated into the PAGES2k synthesis. Further work is continuing on the Antarctic data. IPICS also agreed to make an increased focus on non-polar cores.

*Technical group: an ice core drilling meeting is being planned for 2013.

The IPICS SC agreed to investigate setting up a new priority project on the use of ice cores to understand ice structure and dynamics. We also identified early career scientists who will plan activities for ECS in ice cores (they are in contact with APECS).

Antarctic Ice Rises Workshop: Richard Hindmarsh, British Antarctic Survey, Kenny Matsuoka, Norwegian Polar Institute

The aim of this interdisciplinary workshop on Antarctic ice rises is to look at all aspects of their physical science to bring an Earth Systems Science perspective to their major controls of Antarctic ice-sheet dynamics. Recent studies have highlighted the important role of the ice rises, the grounded ice surrounded by ice shelves, in both supporting the ice shelf and buttressing upstream glaciers. This is particularly significant in the Antarctic coastal regions, which are seen as crucial foci of continental changes in ice mass balance. Ice rises also provide a unique platform for reconstructing the highly-variable coastal climate by obtaining and analyzing ice cores. Given their crucial role, ice rises are not well studied, and part of the reason for this is their understanding requires cross-disciplinary integration. The researchers involved in ice-rise research are distributed across nations and disciplines and are not well coordinated. The goal of this workshop is to develop a summary of the current challenges of ice-rise research, share community-wide understandings of the current status of knowledge beyond each discipline, and identify and produce.

After funding of 10k USD from SCAR SSG-PS was received, and supplemental funding from the research council of Norway (43k USD) and from CliC (9.3k USD) were added, support was offered solely for participants in early career stages and from countries in economic transition. CliC also provides workshop logistics support and APECS sponsors two outreach/education sessions together with social hours in the evening. Now the workshop web site is running at <http://www.climate-cryosphere.org/index.php/meetings/ice-rises-2013/> and registration is open until June 24th. Nice plenary speakers were invited and the session schedule will be finalised in July.

ASPeCt annual report - CliC SSG 9 in Potsdam, Germany, February, 2013.

In 2012 ASPeCt has continued and has almost completed its reorganization. This was facilitated by opportunity meetings at several conferences and by a dedicated Workshop held in July 2012 at the SCAR OSC in Portland, OR. At that Workshop ASPeCt members also highlighted the scientific activities that they have been doing under the ASPeCt umbrella as well as their plans for continued research. Some of these details are posted on the ASPeCt website (aspect.antarctica.gov.au) which is now hosted by the Australian Antarctic Division (AAD) and managed by ASPeCt member Dr. Petra Heil. In the future, ASPeCt's data pages will be migrated to a new server (data.aad.gov.au), also hosted by the AAD.

ASPeCt convened special sessions at the 2nd International Polar Year Conference, Montreal April 2012, at the SCAR OSC in Portland, OR, July 2012 and at the Fall AGU meeting in San Francisco, in December 2012. Steve Ackley, co-Chair of ASPeCt, was appointed to the Science Steering Committee of the Southern Ocean Observing System (SOOS) as the sea ice representative and in this role led a forum on identifying Essential Observing Variables (EOVs) and their state of readiness for Antarctic Sea, at the AGU Fall Meeting, 2012.

GRAPE (GNSS Research and Application for Polar Environment):

-The GRAPE WEB has been designed and issued in October 2012, www.grape.scar.org, and will be maintained by INGV team. INGV received 3000USD from SCAR (SSG PS) in January 2013 to support this action.

-The Annals of Geophysics (www.annalsofgeophysics.eu/index.php/annals) GRAPE Special Issue collects recent reports on work performed in the polar regions and on the datasets collected in time by the instrumentation deployed across various countries. This collection will set the starting point for further research in the field, especially in the perspective of the new and very advanced space system that will be available in the next few years. Papers will be found

that describe the initiatives to deploy instrumental arrays to observe the ionospheric scintillation phenomenon, to build hardware/ software structures to store the relevant data and to make it available in appropriate formats. Other papers deal with more proper scientific analyses of the available data, ranging from the analysis of the relation between scintillation and conditions in the interplanetary medium to the evaluation of the effects taking place in the near Earth regions, in the inner magnetosphere and in the statistical representation of ionospheric conditions. A climatological description of the scintillation scenario is given both for the polar regions and for the mid-latitudes. Finally a different, but no less relevant, analysis is given with respect to the water vapor content and its effects at tropospheric levels.

ICESTAR Expert Group on Interhemispheric Conjugacy in Solar Terrestrial and Aeronomy Research: Chair A. Weatherwax, Siena College, USA

Fall AGU Meeting session SA005: Geospace Exploration from Antarctica: Antarctica offers a unique location to observe vast region of geospace for a variety of research dedicated to studying the earth's atmosphere, its space environment, and solar-terrestrial interactions. Space Physics and Aeronomy research efforts in Antarctica are collectively directed towards improving our understanding of the mechanisms which couple solar processes to the polar geospace environment. This session solicits papers on recent advances in space physics and aeronomy focusing on the Antarctic region. Inter-hemispheric and conjugacy studies as well as studies incorporating Antarctic observations in the global context are also welcome.

Expert Group on Operational Meteorology in the Antarctic (OpMet); Chair S. Colwell, BAS, UK.

Over the past couple of year the group concentrated on establishing links between other groups working in the same area of operational meteorology in Antarctica. The main links are to the Antarctic Meteorological Observation, Modeling, and Forecasting Workshop group which holds annual meeting in June or July and SCAR provides some funds to pay for accommodation for representatives from some countries to attend. Also a link between SCAR and the WMO EC-PORS (Panel of Experts on Polar Observations, Research and Services) where it is possible to carry out monitoring of the meteorological observations that come from Antarctica via AnTON (Antarctic Observing Network) which helps to identify problems with the data that is currently coming out from Antarctica, for more information see: http://www.wmo.int/pages/prog/www/WIGOS_6_EC_PORS/EC_PORS_4/Doc3.2.1_AntON.doc Establishing these links means that the groups are now working together better and we have seen an improvement in the quality and quantity of observations coming from Antarctica.

Activity report:

In January a successful CMET balloon campaign was carried out at the ABOA station, partly funded by SCAR SSG-PS funds. The balloons were launched by a team from FMI and remotely controlled by Smith College, MA, USA, in collaboration with the Norwegian Meteorological Institute. The campaign is summarised in the referenced poster. One of the flights is the longest polar flight on record by a controlled meteorological balloon. See also: <http://www.science.smith.edu/cmet/>

Polar Atmospheric Chemistry at the Tropopause (PACT)

Work for PACT has continued on finalising a database on tropopause region parameters that is being derived using all available ozonesonde measurements poleward of 50° latitude. The ozonesonde data have been obtained from the World Ozone and Ultraviolet Radiation Data Centre (WOUDC; <http://www.woudc.org/>), the Network for the Detection of Atmospheric Composition Change (NDACC; <http://www.ndsc.ncep.noaa.gov/sites/>) and the National Oceanic and Atmospheric Administration's Earth System Research Laboratory (<http://www.esrl.noaa.gov/gmd/ozwv/ozsondes/index.html>). The

earliest data currently used are from Syowa in Antarctica (1966), although the majority of information comes from the 1990s and later years.

During the reporting period, we increased the number of southern hemisphere stations to 9, and are in the process of including northern hemisphere stations to complete the database.

Documentation and data are available from the PACT web site at the Australian Antarctic Data Centre Data Centre (<http://data.aad.gov.au/aadc/pact/>).

Action Group on Clouds and Aerosols: Chair T. Lachlan-Cope, BAS, UK.

The group has not met since the SCAR meeting in Portland. It planned that a meeting should be held during the IAMAS/IACS Atmosphere and Cryosphere Assembly in Davos in July 2013. This meeting has a large session clouds at high Action Group on Clouds latitudes and so this should be an ideal time to get those interested in Antarctic clouds together in one place.

The group's long term goal is to organise an international large scale campaign to investigate clouds and aerosols in Antarctica although the present economic climate will not make this easy. It is hoped that a large scale campaign will be discussed during the Davos meeting, and a more complete report will be given after that.

Budget implications.

Ocean Acidification:

The AG would like advice from SCAR on how to obtain funding for salaries to cover the writing efforts of the AG from their national bodies

International Partnerships in Ice Core Sciences (IPICS)

In 2013 and 2014, it can be anticipated that meetings will be held to consolidate the site selection and planning for oldest ice. In addition the ice drilling workshop is foreseen in 2013. Steering Committee business will be done by email, or by adding a day to an existing meeting attended by many members. A financial contribution to these activities from SCAR would be welcome and would ensure that participation could be widened.

GRAPE (GNSS Research and Application for Polar Environment):

The Annals of Geophysics special issue regarding the proceedings of the GRAPE meeting in Portland has been completed, and the group requests funding to cover the expenses for this SCAR sponsored publication.

for long term observations and predictions of change