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Project report

Report of the 10th Session of the CLIVAR/CliC/SCAR Southern Ocean Region Panel

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Content

ACTION ITEMS

ACTION: propose a joint PCPI and SORP workshop on "seasonal-to-decadal predictability in the SO region", explore SCAR AntClim co-sponsorship (co-chairs)

ACTION: Find out details about the Polar Prediction School plans for 2016, and propose adding Southern Hemisphere topics for a future school. (ICPO)

ACTION: Discuss activities of IIOE-2 in the Southern Indian Ocean with leadership of SOOS Indian Ocean Working Group (Isabelle Ansorge)

ACTION: SORP and/or SOOS national representatives to report on research vessels with cameras for sea-ice automatic identification.

ACTION: Find out more details on committee to be formed by the US Polar Research Board after the Antarctic Sea-Ice workshop in January, 2016. Provide input after committee is formed (Inga Smith, Joellen Russell, Lynne Talley)

ACTION: Discuss with SCAR Director on mechanism to provide an annual report to SCAR, and offer SORP input on SCAR review draft (Isabelle Ansorge, ICPO)

ACTION: SORP to review CLIVAR REOS metrics (all)

ACTION: Circulate list of SOOS national representatives (Seb Swart)

ACTION: Discuss the development of a template to maximize input from national reports, and possibl coordination of national representatives between SOOS and SORP (SOOS Secretariat, ICPO, co-chairs)

ACTION: Nominate Katsuro Katsumata as SORP representative for OOPC

ACTION: Write letter of support for SOMIP (co-chairs)

ACTION: Propose session at AGU Fall Meeting 2016 on wind forcing in the Southern Ocean (Joellen Russell, John Fyfe)

ACTION: Panel members to email ICPO with a list of events related to panel activities. ICPO to update Google docs

ACTION: Organize at least one telecon every six months

ACTION: Discuss about APECS ex-officio / liaison member to SORP (co-chairs)

ACTION: Ensure there is a SOOS liaison member on SORP (co-chairs)

1. Welcome

Lynne Talley and John Fyfe, co-chairs of the CLIVAR/CliC/SCAR Southern Ocean Region Panel (SORP) welcomed all panel members and invited experts (Appendix 1). Apologies were received from panel members Alberto Piola, Ben Galton-Fenzi, Alexander Klepikov and Alberto Naveira Garabato. Meeting participants reviewed the agenda (Appendix 2).

SORP terms of reference

John Fyfe led a discussion on the panel's Terms of Reference (TORs). SORP is cosponsored by the World Climate Research Programme's (WCRP) Climate and Ocean: Variability, Predictability and Change (CLIVAR) and the Climate and Cryosphere (CliC) projects, and the Scientific Committee on Antarctic Research (SCAR) programme. The current panel's TORs are:

"To serve as a forum for the discussion and communication of scientific advances in the understanding of climate variability and change in the Southern Ocean. To advise CLIVAR, CliC, and SCAR on progress, achievements, new opportunities and impediments in internationally-coordinated Southern Ocean research."
Specific Activities:

1. Facilitate progress in the development of tools and methods required to assess climate variability, climate change and climate predictability of the ocean-atmosphere-ice system in the Southern Ocean.
2. Identify opportunities and coordinated strategies to implement these methods, spanning observations, models, experiments, and process studies.
3. Provide scientific and technical input into international research coordination, collaborating as required with other relevant programs, including the Southern Ocean Observing System (SOOS).
4. Monitor and evaluate progress in Southern Ocean research, and identify gaps.
5. Enhance interaction between the meteorology, oceanography, cryosphere, geology, biogeochemistry and paleoclimate communities with an interest in the climate of the Southern Ocean.
6. Work with relevant agencies on the standardization, distribution and archiving of Southern Ocean observations.

One comment from participants was that Panel's TORs are generic and do not define the science priorities. Although this is true, science priorities can and will change, therefore they should not be included in the TORs but the panel should develop its science priorities and plans for the next few years. Also, it should identify interactions with other CLIVAR panels, CliC, and SCAR.

2. Links with programmes and international activities

WCRP Grand Challenges (GC). The five SCRP GCs represent major areas of scientific research, modelling, analysis and observations for WCRP and its affiliate Projects in the ensuing decade. Several panel members are involved in these GCs:

- Clouds, Circulation and Climate Sensitivity

- Melting Ice and Global Consequences
- Climate Extremes
- Regional Sea-Level Change and Coastal Impacts
- Changes in Water Availability

Clouds GC: Isabelle Ansorge is member. Joellen Russell is involved with the Southern Ocean Clouds, Radiation, Aerosol Transport Experimental Study (SOCRATES), an observational campaign for determining the role of clouds, aerosols and radiation in the climate system. This study will be a direct contribution to the Clouds GC.

Melting Ice GC: Several activities are already spinning up for the Melting Ice GC. One of them is the Polar Climate Predictability Initiative (PCPI). Under this activity, six initiatives have been developed (leaders in brackets, and include SORP co-chair Fyfe)

- Past polar climate variations (Sarah Gille, Julie Jones)
- Assessment of atmospheric reanalysis in polar region (David Bromwich, Jim Renwick)
- Polar predictability on seasonal to decadal timescales (Ed Hawkins, *John Fyfe*)
- CMIP5 results in polar regions (Hugues Goosse, Jennifer Kay)
- Model error (Gunilla Stevenson, Marcus Jochum)
- Jets and non-zonal circulation (Marilyn Raphael, Gareth Marshall)

Several workshops are being organised for these initiatives, with TED-like presentations. A Polar Prediction School will also take place in April 2016, but apparently it is very much focused on the Arctic. The panel has discussed some of these initiatives and one proposed activity would be to organise a joint workshop with PCPI on "seasonal-to-decadal predictability in the SO region". Including SCAR AntClim in the planning would be a natural fit.

ACTION: propose a joint PCPI and SORP workshop on "seasonal-to-decadal predictability in the SO region", explore SCAR AntClim co-sponsorship (co-chairs)

ACTION: Find out details about the Polar Prediction School plans for 2016, and propose adding Southern Hemisphere topics for a future school. (ICPO)

Climate extremes (ETCCDI) GC. The focus of this GC is apparently mostly land-based. It would be useful for SORP to review and make recommendations about extension to marine.

***CLIVAR Research Foci*.** In response to the rapid pace of scientific advances and recognizing the need for the project to be flexible and responsive to new ideas and challenges, CLIVAR has developed the concept of Research Foci (RF). These are focused research activities on topics with high potential for significant progress in the next 3-5 years and that would benefit from enhanced international coordination. Initially the CLIVAR community had identified five Research Foci. Science plans of three RF have been approved by the CLIVAR SSG and are being implemented:

(i) Decadal variability and predictability of ocean and climate variability (DCVP RF)
(ii) Planetary heat balance and ocean heat storage (CONCEPT-HEAT RF)
(iii) ENSO in a changing climate.
(iv) A fourth topic, "Regional sea level change and coastal impacts" belongs to the WCRP Grand Challenges and reports to the JSC.
(v) The science plan for a RF on upwelling systems is currently under development.

Patrick Heimbach gave a brief overview of the topics that will be discussed by the DCVP RF. Activities will focus on the hiatus and impact of volcanic eruptions on decadal variability. The group will lead the design of a Decadal Climate Prediction Project (DCPP) Model Intercomparison Project (MIP). Patrick's involvement in these activities will be via Greenland ice-sheet ocean interaction (GRISO) project.

In relation to the Upwelling RF, it is clear that the group will focus on Eastern Boundary Upwelling Systems (EBUS). However, CLIVAR's overall interest in upwelling goes beyond EBUS. SORP should discuss developing some activity on the Southern Ocean Upwelling System.

Another international activity that is being developed is the 50th Anniversary of the International Indian Ocean Expedition (IIOE-2). Lynne Talley is a member of the IIOE-2 Steering Committee. SOOS is developing a working group to discuss activities in the Southern part of the Indian Ocean. Isabelle Ansorge will be attending the IIOE-2 Conference in Goa, India, in December 2015, and volunteered to take this discussion with SOOS leadership.

ACTION: Discuss activities of IIOE-2 in the Southern Indian Ocean with leadership of SOOS Indian Ocean Working Group (Isabelle Ansorge)

Inga Smith presented the structure of one of SORP's sponsors, the Climate and Cryosphere (CliC) project. She presented CliC's involvement in the Antarctic Sea ice Processes and Climate (ASPeCt) expert group. ASPeCT is an expert group on multi-disciplinary Antarctic sea ice zone research within the SCAR Physical Sciences program within the SCAR Physical Sciences program. Established in 1996, ASPeCt has the key objective of improving our understanding of the Antarctic sea ice zone through focussed and ongoing field programs, remote sensing and numerical modelling. The program is designed to complement, and contribute to, other international science programs in Antarctica as well as existing and proposed research programs within national Antarctic programs. ASPeCt also includes a component of data rescue of valuable historical sea ice zone information. The overall aim of ASPeCt is to understand and model the role of Antarctic sea ice in the coupled atmosphere-ice-ocean system. This requires an understanding of key processes, and the determination of physical, chemical, and biological properties of the sea ice zone. ASPeCT has developed a sea-ice automatic acquisition software to be released late 2015. Some cruises have dedicated sea-ice observers and more could be trained. Some research vessels have cameras and with automatic identification. It would be useful to have national representatives to SORP or SOOS to report which of their ships have those cameras installed.

ACTION: SORP and/or SOOS national representatives to report on research vessels with cameras for sea-ice automatic identification.

One activity that was organised by the US National Academy of Sciences Polar Research Board is an Antarctic Sea-Ice workshop Jan. 11-12, 2016, supported by NASA, ONR, and NSF. A Committee is being formed after the workshop to develop the workshop's recommendations

ACTION: Find out more details on committee to be formed by the US Polar Research Board after the Antarctic Sea-Ice workshop in January, 2016. Provide input after committee is formed (Inga Smith, Joellen Russell, Lynne Talley)

***Year of Polar Prediction**:* François Massonet briefed the panel on activities of the Year of Polar Prediction (YOPP, www.polarprediction.net/yopp). YOPP is a major international activity that will take place centered around 2018. Its goal is to enhance predictive capabilities at our poles and beyond, considering both observational and modelling aspects and actively including end-users and partners outside the scientific community. SORP has already proposed concrete contributions to YOPP, related e.g. to the identification of data needs and air-sea flux activities. A document (L. Newman et al., https://zenodo.org/record/27261?ln=en#.VgU_-8vtlBe) is available for download. One of the key outcomes from the YOPP summit was that the Southern Ocean activities are currently under-represented. It is up to SORP, SCAR/SCOR and SOOS to make sure that this situation changes. Although YOPP is organized within the framework of the World Weather Research Programme (WWRP), Southern Hemisphere activities are within the scientific community that includes the SOOS, which does not have a restriction on timescales of interest, and which is overseen by SORP. The SORP therefore takes strong interest in YOPP. To that end, Dave Bromwich will coordinate Southern Ocean activities for YOPP and should be the first person to talk to.

3. Scientific Committee for Antarctic Research (SCAR)

Jiuxin Shi gave an overview of the Scientific Committee on Antarctic Research (SCAR), one of the panel's co-sponsors. SCAR is an inter-disciplinary committee of the International Council for Science (ICSU), and it is charged with initiating, developing and coordinating high quality international scientific research in the Antarctic region (including the Southern Ocean), and on the role of the Antarctic region in the Earth system. In addition to carrying out its primary scientific role, SCAR also provides objective and independent scientific advice to the Antarctic Treaty Consultative Meetings and other organizations such as the UNFCCC (United Nations Framework Convention on Climate Change) and IPCC on issues of science and conservation affecting the management of Antarctica and the Southern Ocean and on the role of the Antarctic region in the Earth system.

Some of the SCAR groups have their activities closely linked to SORP's. The Advisory Group on Antarctic Climate Change and the Environment (ACCE) and the Expert Group on Antarctic Sea ice Processes and Climate (ASPeCt) are the main ones. Other Action Groups on Ocean Acidification and on Antarctic Clouds and Aerosols (ACA), and Expert Groups on Ice Sheet Mass Balance and Sea Level (ISMASS) and Operational Meteorology in the Antarctic (OpMet) are also related.

In 2014, SCAR organised the 1st SCAR Antarctic and Southern Ocean Science Horizon Scan. The scan assembled the world's leading Antarctic scientists, policy makers, leaders, and visionaries to identify the most important scientific questions that will or should be addressed by research in and from the southern Polar Regions over the next two decades, Six Science Priorities were defined

- Define the global reach of the Antarctic atmosphere and Southern Ocean
- Understand how, where and why ice sheets lose mass
- Reveal Antarctica's history
- Learn how Antarctic life evolved and survived
- Observe space and the Universe
- Recognize and mitigate human influences

One comment from the panel was that although SORP provides annual reports to both CLIVAR and CliC, it has not been requested to do so by SCAR. The panel recognizes that a two-way communication is important. Isabelle Ansorge is part of a SCAR review panel, chaired by Peter Liss, that has just started the process, with a draft report available from January, with the final report available from March 2016. She will make sure to include this issue, and that SCAR requests comments from SORP on the review document.

ACTION: Discuss with SCAR Director on mechanism to provide an annual report to SCAR, and offer SORP input on SCAR review draft (Isabelle Ansorge, ICPO)

SCAR is organising their 34th Open Science Conference in Kuala Lumpur, Malaysia in August 2016. There are several sessions that are of interest to SORP. Francois Massonnet is a co-convener of session S1 "Antarctic in the global system - drivers and response". Kenny Matsuoka is a co-convener of session S9 "Status and trends in Antarctic sea ice and ice shelves". Seb Swart, SOOS Physical Sciences Vice-Chair, suggested that session S3 could be a joint SOOS-SORP-IBCSO[1] session, with the title "Sustained efforts for observing, mapping and understanding the Southern Ocean and its role in current and future climate". Since the SCAR Conference programme is already being in development, this proposal needs to be approved by the SCAR Secretariat.

ACTION: Propose change in Session 3 of the SCAR Conference to be jointly organised by SOOS-SORP-IBCSO (Seb Swart)

4. Southern Ocean Observing System (SOOS)

Seb Swart showed the panel the structure of SOOS and discussed some activities that are linked with SORP. He reported on the "Air-Sea Fluxes for the Southern Ocean: Strategies and Requirements for Detecting Physical and Biogeochemical Exchanges" workshop that took place immediately before the SORP meeting in Frascati. Air-sea flux measurements pose significant challenges in the Southern Ocean because of the remote location, high sea state, and icing conditions of the region. Recent technological developments have given new hope to the prospects for obtaining high-quality flux observations in high-latitude conditions. The workshop considered a broad range of these new technologies, including wave gliders, unmanned aerial vehicles, aircraft observations, new moorings (the Southern Ocean Flux Station, the Ocean Observatories Initiative moorings in the southeast Pacific and the Argentine Basin), and shipboard flux covariance measurements with the eventual possibility correcting for airflow distortion around the ship. In situ observations are critical but need to be interpreted in a broader context that can come from satellite observations and from reanalysis or state estimation.

Three specific recommendations emerged from the air-sea flux workshop. First was the importance of including air-sea heat and momentum fluxes in the list of Essential Climate Variables (ECVs), with specific requirements for accuracy and precision of measurements. Second participants recommended development of a pilot study focused on a targeted measurement campaign in a compact region near a mooring, along with related satellite data assessment and assimilation efforts. The objective to target a small region will allow evaluation of eddy-scale spatial variability in fluxes, since these scales play a significant role in determining the representativeness and underlying physics

[1] International Bathymetric Chart of the Southern Ocean program

behind individual flux observations. Finally, participants supported the development of a SOOS Capability Working Group to oversee activities related to the first and second recommendations. SOOS will also endorse the development of new observation technologies.

It was pointed out that the Marine Mammals Exploring the Oceans Pole to Pole (MEOP) project provides a vast amount of data during wintertime so the suggested pilot study could be in a region that would complement data collected by MEOP. Although this is a valid point, the main issue is that the choice of the site also depends on resources and logistics.

SORP can also provide linkages for SOOS, particularly to the state estimation groups, to climate modeling community. One important aspect that the CLIVAR modelling and ocean synthesis communities are always requesting is the definition of metrics so that models and synthesis products can be tested against. The CLIVAR Repository for Evaluating Ocean Simulations (REOS) has metrics that have been requested from basin panels. Those need to be reviewed and an interactive process needs to be developed so feedback is provided.

ACTION: SORP to review CLIVAR REOS metrics (all)

Another discussion was on the role of national representatives in both SORP and SOOS. In SOOS, these national representatives fill gaps in the Scientific Steering Committee (SSC) regarding country representation but not all countries have representatives. SOOS also request the national representatives to provide annual reports of countries' activities but there has been mixed success in receiving those reports. National reports to SORP can complement those sent to SOOS because they include modelling activities. However, a more efficient way would be the development of a common template to be sent to SOOS national representatives.

ACTION: Circulate list of SOOS national representatives (Seb Swart)

ACTION: Discuss the development of a template to maximize input from national reports, and possibl coordination of national representatives between SOOS and SORP (SOOS Secretariat, ICPO, co-chairs)

Ocean Observations Panel for Climate (OOPC)

CLIVAR regional panels have a representative; and SORP can provide input on Essential Climate Variables (ECVs) and Essential Ocean Variables (EOVs) to OOPC on behalf of SOOS. OOPC is also requesting that each CLIVAR panel appoints a liaison in order to minimize rotation of attendees to their meeting. Katsuro Katsumata attended the last OOPC meeting and agreed to continue as SORP liaison to OOPC. EOVs that are biogeochemical are considered by the IOCCP, and SORP/SOOS should also provide recommendations to IOCCP.

ACTION: Nominate Katsuro Katsumata as SORP representative for OOPC

5. Science Talks

Kenny Matsuoka gave a talk on Antarctic ice rises and rumples. Locally grounded features in ice shelves, called ice rises and rumples, play a key role buttressing discharge from the Antarctic Ice Sheet and regulating its contribution to sea level. Ice rises typically rise several hundreds of meters above the surrounding ice shelf; shelf flow is diverted around them. On the other hand, shelf ice flows across ice rumples, which typically rise only a few tens of meters above the ice shelf. Ice rises contain rich histories of deglaciation and climate that extend back over timescales ranging from a few millennia to beyond the last glacial maximum. Numerical model results have shown that the buttressing effects of ice rises and rumples are significant, but details of processes and how they evolve remain poorly understood. Fundamental information about the conditions and processes that cause transitions between floating ice shelves, ice rises and ice rumples is needed in order to assess their impact on ice-sheet behavior. Targeted high-resolution observational data are needed to evaluate and improve prognostic numerical models and parameterizations of the effects of small-scale pinning points on grounding-zone dynamics.

François Massonnet presented some latest findings on sea-ice data assimilation. He explained that the reasons behind the increase in total Antarctic sea ice extent since the late 1970s, and to a larger extent the highly regionalized patterns, remain elusive. Data assimilation allows to estimate variables that are more difficult to observe, such as sea ice thickness. A sensible data assimilation method comprises two aspects: (1) it weighs model estimates and observations according to their respective uncertainties and (2) it transfers information to observable variables to the whole state (e.g. from concentration to thickness). We find a significant increase in total sea ice extent since the 1980s but with high regionalized patterns (such as for ice concentration). Sea ice data assimilation can be extended to estimate model parameters.

Riccardo Farneti presented results on CORE-II simulations relevant to the Southern Ocean. The second phase of the Coordinated Ocean-ice Reference Experiments (CORE-II), organized by the CLIVAR Ocean Model Development Panel (OMDP), is resulting in several publications focusing on different oceanic regions and processes. Using many different state-of-the-art global ocean-sea ice models forced with the same atmospheric state spanning 1948-2007, CORE-II studies aim to present a comprehensive overview of ocean-sea ice climate model simulations with respect to observations, and theoretical and previous modelling studies. More information can be found here: http://www.clivar.org/clivar-panels/omdp/core-2. Two studies, recently published in the CORE-II virtual special issue in Ocean Modelling, focus on the Southern Ocean region in models with resolution varying from coarse to eddy-permitting. The first one assesses the representation of the Antarctic Circumpolar Current (ACC) and Meridional Overturning Circulation (MOC). The authors quantify the degree of eddy saturation and eddy compensation in the models, a topic that has sparked the interest of both theoreticians and modellers in the last few years not only in the pursuit of its physical understanding but also because of the fundamental role that the Southern Ocean plays in a warming climate. Given the relatively small wind changes that occurred during the past 50 years, it shows that most models experienced weak ACC transport sensitivity to changes in winds, and they were considered to be in an eddy saturated regime. Larger differences arise when considering changes in the MOC, with a majority of models exhibiting significant strengthening of the MOC. Only eddy-permitting models and models using a parameterization with a three-dimensional time varying coefficient showed some degree of eddy compensation, as well as weaker changes in isopycnal slopes and associated ACC trends. Also, both ACC and MOC interannual variability was largely controlled by the Southern Annular Mode (SAM) in the CORE-II runs. The second study focuses on the representation of water mass properties and sea-ice processes. Recent multi-model analyses have shown large discrepancies in mixed layer depths and

sea-ice trends (for example, models failing to capture increases in sea ice in the Ross Sea). The mixed layer depth is tightly linked to the flux of water masses into the ocean interior. Results show the CORE-II state likely influences the current climate summer and winter mixed layer depths and positions, the upper ocean temperature and salinity biases versus observations, and the summer sea ice concentration. However, the individual ocean and ice model density fields and parameterisations (such as overflow processes and mesoscale mixing schemes) dictate the exchange between water masses, and the decadal trends in the winter mixed layers and sea ice. Biases in the CORE-II state (e.g., winds over the Antarctic continent), primarily due to insufficient observations, also contribute to the models' misrepresentation of recently observed climate trends.

John Fyfe discussed with meeting participants some hypotheses on the Antarctic sea ice increase. This increase can be due ozone depletion, ice sheet retreat, or internal variability.

6. Modelling discussions: CMIP6, MIPs

John Fyfe gave the latest information on the CMIP6 framework and activities timeline. Most of forcing descriptions will be ready by January 2016. He also presented the list of CMIP6 endorsed MIPs. Based on the assessment of the 10 CMIP6 endorsement criteria that were agreed by the WCRP Working Group on Coupled Modellling (WGCM), the CMIP Panel and WGCM co-chairs have now endorsed 21 Model Intercomparison Projects (MIPs). The revised and final MIP proposals for the endorsement process can be found in CMIP6-EndorsedMIPs_Summary_150819_Sent.pdf.
The CMIP6 design will be described in a Geoscientific Model Development special issue with submissions of an overview paper and the CMIP6-Endorsed MIP contributions envisaged by end of March 2016. The description of the experiments and forcing data sets presented in this special issue will define CMIP6 in detail.

Joellen Russell presented the effort to develop a Southern Ocean MIP (SOMIP). She presented the details of the effort, which already has commitment from several modelling centres to produce model outputs for that intercomparison. SOMIP's overall goal is to reduce uncertainties in climate projections by defining the role of the oceans in climate with regards to the Southern Ocean, especially the role of winds, buoyancy and stratification in determining the global impacts of warming. Although SOMIP is not part of the CMIP6 endorsed MIPs, it has the commitment of some modelling centres to produce results for the intercomparison. It may help in this process if the panel can officially support the initiative so other centres may also agree to provide results.

ACTION: Write letter of support for SOMIP (co-chairs)

The panel also discussed the need to further understand wind forcing in the Southern Ocean and a suggestion was made to propose a session at AGU Fall Meeting 2016

ACTION: Propose session at AGU Fall Meeting 2016 on wind forcing in the Southern Ocean (Joellen Russell, John Fyfe)

Panel business

Panel members discussed membership issues and inter-sessional activities to be developed. It was suggested that the panel tries to organise teleconferences at least once every six months in order to keep the momentum of the discussions. Also, it is important that members keep the ICPO informed of events related to panel activities. The ICPO will keep the Google Docs spreadsheet updated with that information.

ACTION: Panel members to email ICPO with a list of events related to panel activities. ICPO to update Google docs

ACTION: Organize at least one telecon every six months

Regarding membership, it is important to have a member as SOOS liaison. At the moment, this role is fulfilled by Alberto Naveira-Garabato, whose term is expiring in 2015. It was also discussed the possibility to give APECS an ex-officio seat in the panel. An alternative would be to appoint a current panel member as liaison to APECS. These membership issues should be further discussed by the co-chairs in time for the CLIVAR membership rotation process at the end of 2015.

ACTION: Discuss about APECS ex-officio / liaison member to SORP (co-chairs)

ACTION: Ensure there is a SOOS liaison member on SORP (co-chairs)

Appendix A: Agenda

Day 1 – Thursday 24 September 2015

09:00 - Welcome, introductions, new members, and arrangements for meeting (Talley/Fyfe/Caltabiano)

09:15 - SORP terms of reference (Fyfe)
09:20 - Highlight 2014-2015 activities and potential future activities (Talley)

09:40 - Strategic mapping of panel activities (Talley)
Connections with CLIVAR, CliC, SCAR, WCRP, WWRP panels and initiatives
09:45 CLIVAR: http://www.clivar.org/clivar-panels (Heimbach, Talley, Fyfe)
10:10 CliC: http://www.climate-cryosphere.org/ (Smith - ASPeCt, Massonnet)

10:30 – Coffee break

11:00 - Connections with CLIVAR, CliC, SCAR, WCRP, WWRP panels and initiatives (continued)
11:00 SCAR: http://www.scar.org/ (Shi, Matsuoka)
11:20 SOOS: http://www.soos.aq/ (Katsumata, Swart)
11:40 COMNAP Antarctic Roadmap: https://www.comnap.aq/Projects/SitePages/ARC.aspx (Talley)
11:45 PCPI/SPARC http://www.climate-cryosphere.org/wcrp/pcpi
SPARC http://www.climate-cryosphere.org/wcrp/pcpi (John Fyfe)
12:00 YOPP (PPP - WWPP): http://www.polarprediction.net/en/yopp.html (Massonnet, Heimbach).

12:15 - National activities (Talley, Caltabiano)
Brief reports as handout
Discussion of expectations and roles of national representatives, terms of reference

13:00 – Lunch

OBSERVATIONS
14:00 – Science talk
Southern Ocean sea ice observational research (Inga Smith, panel member)
14:20 - Observational programs: Overview (Talley)
14:30 - SOOS planning and structure; data management; coordination
Observational summary for Southern Ocean (Seb Swart, invited)

15:30 – coffee break

16:00 - Science talk
Antarctic ice rises and rumples community paper (Kenichi Matsuoka, panel member)
16:20 - Summary of SOOS high latitude air-sea flux workshop (Sept 22-23) (Sarah Gille, invited)
16:40 - GCOS and GOOS: EOVs and ECVs (Katsumata)
17:00 - Satellite information for Southern Ocean (Gille)

17:30 – Close of day

Day 2 – Thursday 25 September 2015

STATE ESTIMATION
09:00 – Ocean synthesis/state estimation/reanalysis (Heimbach, Massonnet)
09:30 - GSOP intercomparison project (Tony Lee input)
10:00 - SOOS/SOSE (Russell, Talley)

10:30 – Coffee break

MODELLING
11:00 – Science talk and discussion
CORE-II simulations relevant to the Southern Ocean (Riccardo Farneti, invited)
11:30 - Science talk:
Influence of recent Antarctic ice sheet retreat on simulated sea ice area trends (Fyfe)
11:45 - CMIP6 endorsed MIPS relevant to the Southern Ocean (Fyfe)
12:15 – Science talk
Southern Ocean model metrics (Russell)
12:30 - Southern Ocean MIP overview and discussion (Russell)

13:00 – Lunch

14:00 – Planning for 2015-2016
Expected projects for SORP input
YOPP
SOOS
SOMIP
How do we work with all of the panels and initiatives?
Delegation of SORP members to liase with each panel and head each project

Workshop topics?

17:00 – Close of day

Appendix B: List of attendess

Name	Country	Role
Lynne Talley	USA	Panel Co-Chair
John Fyfe	Canada	Panel Co-Chair
Patrick Heimbach	USA	Panel Member
Inga Smith	New Zealand	Panel Member
François Massonnet	Belgium	Panel Member
Isabelle Ansorge	South Africa	Panel Member
Katusuro Katsumata	Japan	Panel Member
Joellen Russell	USA	Panel Member
Jiuxin Shi	China	Panel Member
Kenny Matsuoka	Norway	Panel Member
Riccardo Farneti	Italy	Invited expert
Ronald Buss de Souza	Brazil	Invited expert
Luciano Pezzi	Brazil	Invited expert
Seb Swart	South Africa	Invited expert
Nico Caltabiano	China	ICPO

Appendix C: National activities report - China

National activities report
Country: China
Contributor(s) (writer(s)): Jiuxin Shi
Date: Sept. 23, 2015

Receipt of material prior to Sept. 22, 2015 will ensure inclusion in meeting discussion. Receipt of material prior to Oct. 15, 2015 will ensure inclusion in meeting report and contribute to future SORP discussions, as well as input to the SOOS and other CLIVAR/CliC/SCAR activities.

Purpose of material gathered for the SORP: To build an overview of
- observational, modeling, state estimation initiatives relevant to the SORP

(This can include a list of activities, maps showing where work has been done, major international project involvement, etc.)

A. Recent and ongoing activities

Does your country have a national committee tasked with oversight of Southern Ocean climate science?
No.

What major activities have been carried out in the last several years or are in progress now? Contact information for the projects would be useful.

1. Observational

In the past 5 years, most Chinese observations in the polar region were supported by the Chinese Polar Environment Comprehensive Investigation and Assessment Programme (2011-2015). Totally 4 cruises have been accomplished by the Chinese National Antarctic Research Expedition (CHINARE) aboard R/V *Xuelong*, CHINARE28(2011/2012)~CHINARE30(2014/2015).
Main observational activities are summarized as following:
• Hydrographic section observation
CTD/LADCP and water samplings were conducted at sections in regions around Prydz Bay (mainly in February of 2013 by CHINARE 29, in February and March of 2015 by CHINARE31, Fig. 1) and South Shetland Islands (in January of 2012 by CHINARE28, in February of 2014 by CHINARE30, Fig. 2). Micro-structure profiler (VMP200) were deployed at parts of these sections.

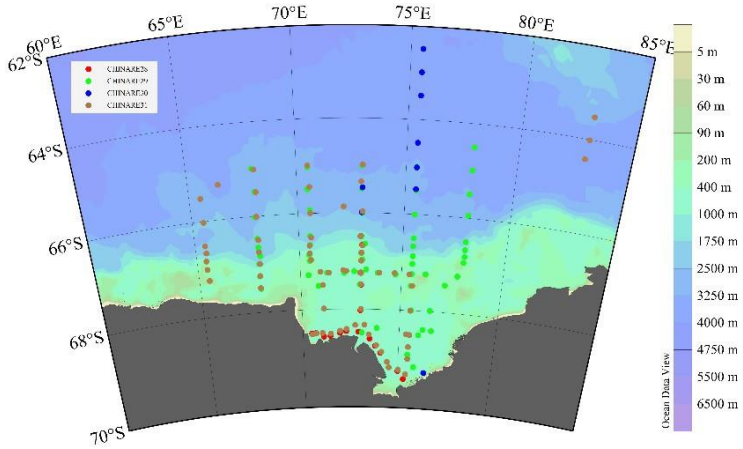


Fig. 1 CTD stations in the region of Prydz Bay

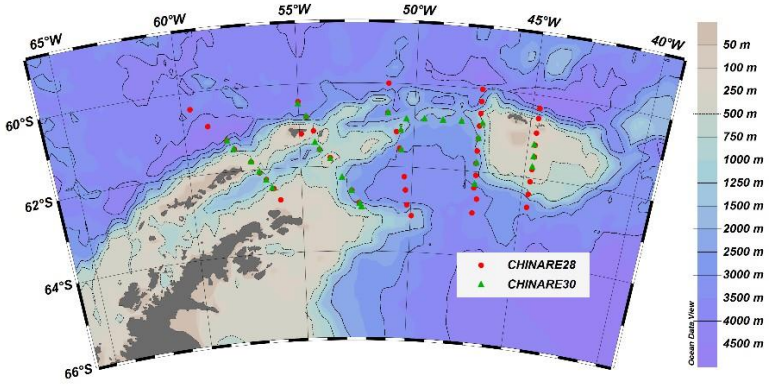


Fig. 2 CTD stations in the region of South Shetland Islands

• Mooring

Moorings with CTD, ADCP/current meters were deployed and recovered at several locations in Prydz Bay (Fig. 3). Year-long records have been collected at locations #1 (December 2010~December 2011, February 2014~ February 2015), #2(February 2012~February 2015), #3 (February 2012~February 2013) and #4 (February 2014~February 2015). New moorings were deployed at locations #1, #4 and #5 in February of 2015 and will be recovered in next cruise, around March of 2016.

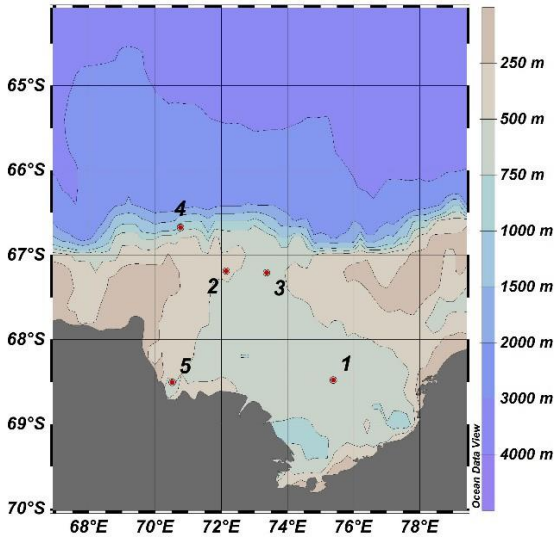


Fig. 3 Mooring locations in the region of Prydz Bay

• Expendable probes observation

Expendable probes (XBT/XCTD, radiosonde) were launched at transects between Fremantle - Prydz Bay, Ross Sea/Dumont D'Urville Sea - Hobart/Christchurch (Fig. 4 and 5) and a transect (SR1) in Drake Passage (by CHINARE28 and CHINARE30).

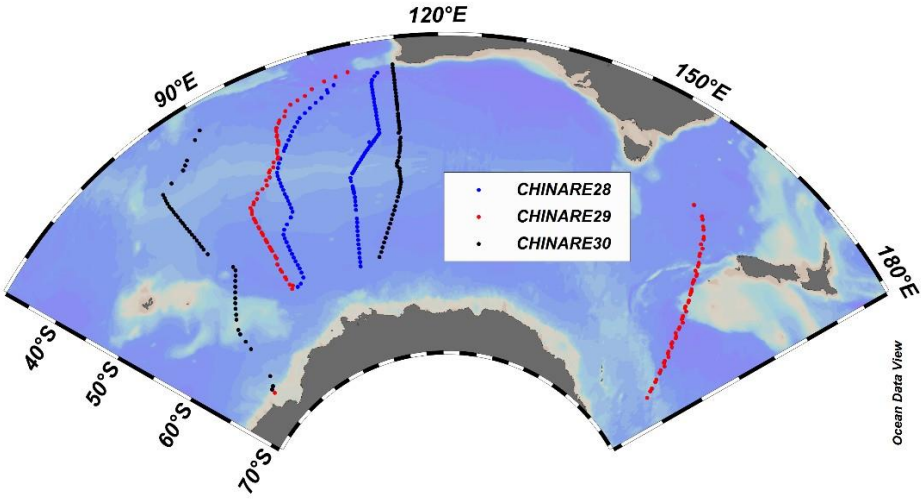


Fig. 4 XBT/XCTD sections between Australia and Antarctica

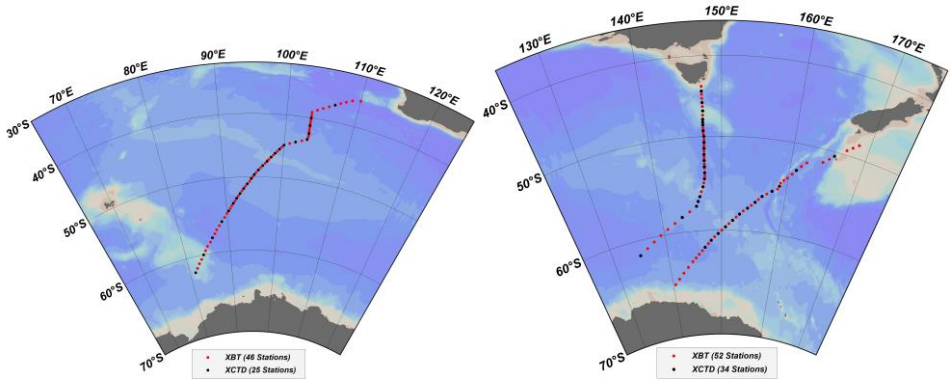


Fig. 5 XBT/XCTD sections between Australia (New Zealand) and Antarctica by CHINARE31 (2014/2015)

• Underway observation

Temperature, salinity and chemistry (CO_2, etc) of sea surface water, meteorology, sea ice (following ASPeCt sea-ice protocol) were measured along ship tracks

Type 1: Indian sector cruise: Fremantle - Prydz Bay - Ross Sea - Hobart/Christchurch, by CHINARE29 and CHINARE31;

Type 2: Circumpolar cruise, Fremantle - Prydz Bay - Ross Sea - South Shetland Islands – Drake Passage – South America – Drake Passage - Prydz Bay – Fremantle, by CHINARE28 and CHINARE30;

Currents in upper ocean were measured by 38kHz/300kHz ADCP in CHINARE31's cruise.

2. Modeling

Massachusetts Institute of Technology General Circulation Model (MITgcm, including sea ice model and ice shelf model) was applied in the region of Prydz Bay and Amery Ice Shelf to set up a high resolution (~1.5) regional numerical model. The products of the European Centre for Medium-Range Weather Forecast 40-yr Re-Analysis (ERA-40) are used as the atmospheric boundary condition. The open eastern, western and northern boundary conditions are given by a cube sphere global experiment similar to the Estimating the Circulation and Climate of the Ocean phase II: high resolution global- ocean and sea-ice data synthesis (ECCO2). The results of this model will give a preliminary comprehension of the seasonal variability of the features of circulation and water masses

3. State estimation

No.

B. Planned activities

What major activities are planned or likely to occur during the next several years? Contact information for the projects would be useful.

1. Observational

The Chinese Polar Environment Comprehensive Investigation and Assessment

Programme will be extended more 5 years (2016-2020) but the detailed field work plan is still pending. The likely observing activities include:

•Hydrographic observation at transects in regions around Prydz Bay (February, 2017, 2019), South Shetland Islands (February, 2016, 2018, 2020), and possibly Ross Sea.

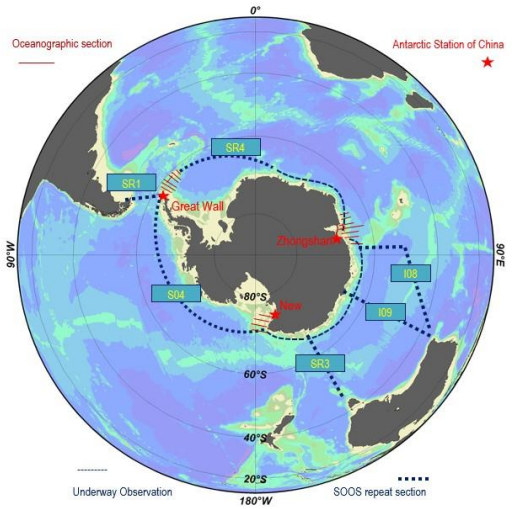
•Mooring deployment/recovery in Prydz Bay.

•Underway observations along ship track (Indian sector cruise: Fremantle - Prydz Bay - Ross Sea - Hobart/Christchurch, 2016/2017, 2018/2019; Circumpolar cruise: Fremantle - Prydz Bay - Ross Sea - South Shetland Islands – Drake Passage – South America – Drake Passage - Prydz Bay – Fremantle, 2015/2016, 2017/2018, 2019/2020): current in upper ocean (38kHz/300kHz ADCP), temperature, salinity and chemistry (CO2, etc) of sea surface water, meteorology, sea ice (ASPeCt).

•Expendable probes (XBT/XCTD, radiosonde) observation at transects: Fremantle - Prydz Bay , Ross Sea - Hobart/Christchurch , Drake Passage.

•Ice Mass Balance Buoy (IMB) on fast ice in Prydz Bay near Zhongshan Station in winter.

•Argo floats and surface drifting floats might be released in the ACC region and Prydz Bay respectively.



Observing sections might be completed by China in future 5 years (2016-2020).
The SOOS repeat sections can be finished only by XBT/XCTD.

Appendix D: National activities report - Japan

National activities report
Country Japan
Contributor(s) (writer(s)) K.Katsumata Date 11 Sep 2015

Receipt of material prior to Sept. 22, 2015 will ensure inclusion in meeting discussion. Receipt of material prior to Oct. 15, 2015 will ensure inclusion in meeting report and contribute to future SORP discussions, as well as input to the SOOS and other CLIVAR/CliC/SCAR activities.

Purpose of material gathered for the SORP: To build an overview of
- observational, modeling, state estimation initiatives relevant to the SORP

(This can include a list of activities, maps showing where work has been done, major international project involvement, etc.)

A. Recent and ongoing activities

Does your country have a national committee tasked with oversight of Southern Ocean climate science?

No

What major activities have been carried out in the last several years or are in progress now? Contact information for the projects would be useful.

Japanese physical oceanographers with main research interest in the Southern Ocean observation are found in four groups; Hokkaido University (K. I. Ohshima, Y. Fukamachi, S. Aoki), National Institute of Polar Research (NIPR, T. Tamura), Tokyo University of Marine Science and Technology (TUMSAT, Y. Kitade) and JAMSTEC (K.Katsumata). For modelling, two groups exist; one in paleo-simulation (A. Abe-Ouchi), another in climate modelling (H. Hasumi).

Cape Darnley projects (Hokkaido University, NIPR. PI: K. I. Ohshima)
Mooring observation off the coast of Cape Darnley, a recently discovered dense shelf water source near 70E. (Ohshima et al., 2013, doi:10.1038ngeo1738)

Vincennes Polynya project (TUMSAT. PI: Y. Kitade)
Mooring observation and ship hydrography including turbulence measurements. (Kitade et al., 2013, doi:10.1002/2014GL059971)

WOCE/CLIVAR repeat hydrography (JAMSTEC, PI: K. Katsumata)
Reoccupation of WOCE P14S and S4I hydrography sections. (Katsumata et al., 2014, doi:10.1016/j.dsr2.2014.05.016)

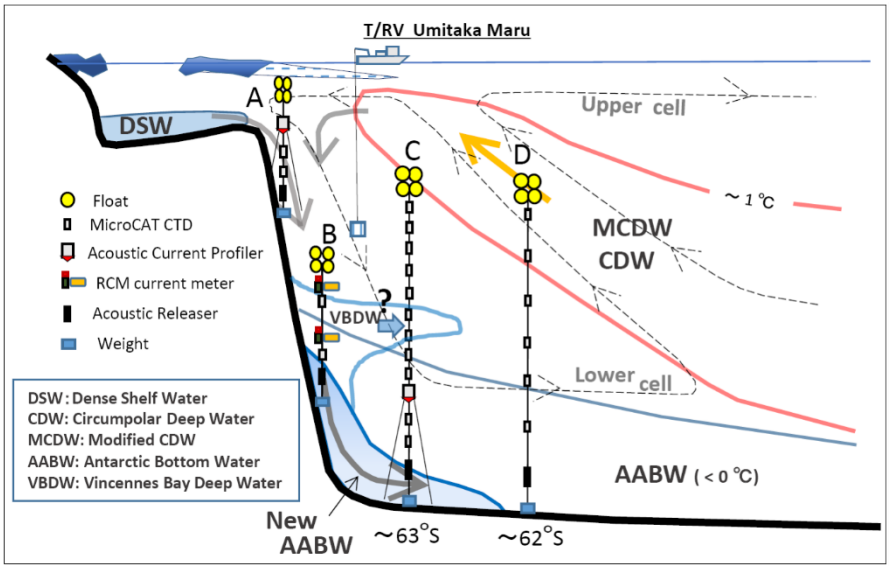
B. Planned activities

What major activities are planned or likely to occur during the next several years? Contact information for the projects would be useful.

1. More moorings are planned in the region. Plans include collaboration with biogeochemists (sediment traps, remote access sampler, etc.). Several revisits by *R/V Hakuho* are planned (2015/16 (funded), 2018/19 (funded), 2020/21 (to apply)).

2. Vincennes Polynya project (TUMSAT. PI: Y. Kitade)

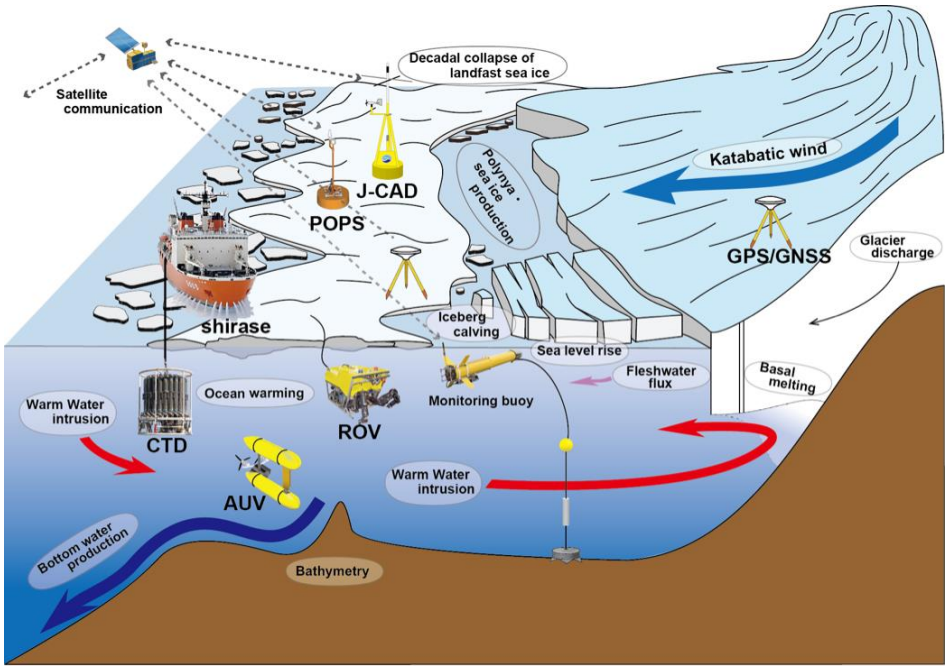
Moorings are planned off the coast of the Polynya (about 62°S and 63°S) with closely---spaced CT sensors. Targets include near---bottom turbulence, intrusion of DSW, and upwelling of CDW. Annual revisit by *R/V Umitaka* are planned and funded until 2018/19.



3. WOCE/CLIVAR repeat hydrography (JAMSTEC. PI: K. Katsumata)

Revisit to P17E (125° W, South Pacific) is planned in 2016/17 (funding pended with decision in March 2016). First occupation of a new South Indian line (I7S, 56°E) is planned, but not funded yet.

4. ROBOTICA — Research of Ocean-Ice Boundary Interaction and Changes around Antarctica (Hokkaido University, NIPR. PI: S. Aoki)



Field observations focusing on interactions and long-term variabilities of climate subsystems of East Antarctica coast. The project includes use and development of unmanned/automated vehicles as part of Prioritized Studies of the 9th six-year plan of Japanese Antarctic Research Expedition (2016 - 2023).