

CLIVAR/CliC/SCAR Southern Ocean Region Panel SORP-12: 29-30 June 2017

National activities report

Country Canada

Contributor(s) (writer(s)) Polar Knowledge Canada

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Receipt of material prior to 15 June 2017 will ensure inclusion in meeting discussion. Receipt of material prior to 15 July 2017 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. All reports will be posted on the SORP website.

Purpose of material gathered for the SORP: To build an overview of
- observational, modeling, ocean reanalysis and 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.)

Please refer to SORP's terms of reference (also given at the end of this template) for guidance on scope: <http://www.clivar.org/clivar-panels/southern>

Note: Biological topics such as marine ecology and marine ecology research, for example, are not within the scope of SORP's terms of reference and are therefore not required in these reports. However, SOOS has an interest in such research, so National Representatives are welcome to include summaries of such research as separate sections.

Note: The Southern Ocean is not explicitly defined in SORP's terms of reference, so please note what the limit used for your national report is (e.g., research on regions only beyond an oceanographic boundary like "south of the Polar Front", or research contained within latitudinal limits like "south of 50°S").

A. Recent and ongoing activities

Does your country have a national committee tasked with oversight of Southern Ocean climate science (e.g., like US CLIVAR)? If yes, please give the name of the committee.

Polar Knowledge Canada (POLAR) is Canada's lead federal agency to strengthen Canadian leadership in science and technology in the polar regions. POLAR is Canada's member organization for the Scientific Committee on Antarctic Research (SCAR), an observer of the Council of Managers of National Antarctic Programs (COMNAP) and serves as a primary point of contact for the international community interested in doing research in Canada's Arctic or collaborating with Canadians on research in the Antarctic. For further

information, please visit POLAR's website at <https://www.canada.ca/en/polar-knowledge.html> or contact POLAR at info@polar.gc.ca.

Canada does not currently have a national committee specifically tasked with oversight of Southern Ocean climate science. However, POLAR's Canadian Committee on Antarctic Research (CCAR) provides advice and guidance to POLAR on Antarctic matters more broadly, and serves as Canada's National Committee under SCAR.

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 (e.g., Principal Investigators and Associate Investigators).

1. Observational?
2. Modeling?
3. Ocean reanalysis and state estimation?

Please give a full list of references at the end of section A.

POLAR is exploring opportunities to develop a Canadian Antarctic Research Program to provide a more comprehensive understanding of the Antarctic region, global systems, and polar linkages. In the absence of a national program, Canadian researchers pursue Antarctic research largely in partnership with the national Antarctic programs of other countries.

POLAR convened a Canadian Antarctic Research Workshop in October 2016 in Ottawa, which brought together more than 60 members of the Canadian polar research and policy community to explore opportunities to strengthen Canadian Antarctic research, including through the development of a program. This included Canadian Antarctic researchers with expertise in Southern Ocean observation and modeling. Workshop participants indicated broad support for a program with dedicated resources for Canadian Antarctic research to strengthen Canada's polar science leadership and capacity. A workshop report is available here: <https://www.canada.ca/en/polar-knowledge/reports/canadian-antarctic-research-workshop-report.html>

Some examples of recent and current Canadian work related to Southern Ocean observational, modeling, and state estimation are provided below.

Individuals from the Canadian Centre for Climate Modelling and Analysis (CCCMA) at Environment and Climate Change Canada (ECCC) (cccma_info@ec.gc.ca) are involved in a number of Southern Ocean related activities. This includes serving as:

- *Co-Chair of the Southern Ocean Regional Panel (John Fyfe)*
- *Co-author of the World Meteorological Organization/United National Environment Programme's Scientific Assessment of Ozone Depletion (2018) chapter on ozone influence on climate, with responsibility for the section on ozone depletion influence on Antarctic sea ice (Michael Sigmond)*
- *Co-chair of Climate and Cryosphere (CliC) from 2013-16 (Greg Flato)*

Recent CCCMA collaborators include: Sarah Gille (Scripps), Gareth Marshall (British Antarctic Survey), Andy Hogg (Australian National University), and Paul Spence (University of New South Wales). The following is a list of recent Southern Ocean related publications from CCCMA individuals:

- *Purich, A. Fyfe, J.C. et al. Tropical Pacific SST drivers of recent Antarctic sea ice trends, J. Climate 29, 8931-8948 (2016).*
- *Swart, N.C., J.C. Fyfe, N.P. Gillett and G.J. Marshall (2015) Comparing Trends in the Southern Annular Mode and Surface Westerly Jet, J. Clim, 28, doi: 10.1175/JCLI-D-15-0334.1.*
- *Swart, N.C., J.C. Fyfe, O.A. Saenko and M. Eby (2014) Wind driven changes in the ocean carbon sink, Biogeosciences Discuss., 11, 8023-8048, doi:10.5194/bgd-11-8023-2014.*
- *Swart, N.C. and J.C. Fyfe (2013) The influence of recent Antarctic Ice Sheet retreat on simulated sea-ice trends, Geophysical Research Letters. 40:4328-4332. doi:10.1002/grl.50820.*
- *Swart, N.C. and J.C. Fyfe (2012) Observed and simulated changes in the Southern Hemisphere surface westerly wind-stress. Geophysical Research Letters. 39 (L16711). doi:10.1029/2012GL052810.*
- *J. C. Fyfe, N. P. Gillett, G. J. Marshall, Human influence on extratropical Southern Hemisphere summer precipitation, Geophys. Res. Lett., 39(23), L23711, 2012.*
- *N. P. Gillett, J. C. Fyfe, D. E. Parker, Attribution of observed sea level pressure trends to greenhouse gas, aerosol and ozone changes, Geophys. Res. Lett., 40(10), 2302-2306, 2013.*
- *N. P. Gillett, J. C. Fyfe, Annular mode changes in the CMIP5 simulations, Geophys. Res. Lett., 40(6): 1189-1193, 2013.*
- *M.-È. Gagné, N. P. Gillett, J. C. Fyfe, Observed and simulated changes in Antarctic sea ice extent over the past 50 years, Geophys. Res. Letters, 42, 90-95, 2015.*
- *Sigmond, M. and J.C. Fyfe, 2014: The Antarctic sea ice response to the ozone hole in climate models, J. Clim, 27, 1336-42, doi 10.1175/JCLI-D-13-00590.1*
- *Hogg, A. McC., P. Spence, O. A. Saenko and S. M. Downes, 2016: The energetics of Southern Ocean upwelling, Journal of Physical Oceanography, Submitted.*

- Morrison, A. K., O. A. Saenko, A. McC. Hogg, and P. Spence (2013), *The role of vertical eddy flux in Southern Ocean heat uptake*, *Geophys. Res. Lett.*, 40, 5445–5450, doi:10.1002/2013GL057706.
- Van Sebille, E., P. Spence, M. R. Mazloff, M. H. England, S. R. Rintoul, and O. A. Saenko (2013), *Abyssal connections of Antarctic Bottom Water in a Southern Ocean State Estimate*, *Geophys. Res. Lett.*, 40, 2177–2182, doi:10.1002/grl.50483.
- Spence, P., S. M. Griffies, M. H. England, A. M. C. Hogg, O. A. Saenko, and N. C. Jourdain (2014), *Rapid subsurface warming and circulation changes of Antarctic coastal waters by poleward shifting winds*, *Geophys. Res. Lett.*, 41, 4601–4610, doi:10.1002/2014GL060613.

Karen Kohfeld, Associate Professor and Canada Research Chair (II) in Climate, Resource and Global Change, Simon Fraser University (SFU) (kohfeld@sfu.ca) is also involved in the following current initiatives:

- *Understanding iron and nutrient (silica) cycling of the Southern Ocean using modern and ice model simulations, and compiling modern and past observations of nutrient and silica distributions with researchers from Australia, the US and Sweden. This has also involved the use of modern measurements of physical oceanographic characteristics and satellite measurements of chlorophyll activity and net primary productivity to determine physical and chemical (iron) controls on Southern Ocean nutrient cycling (2010 – ongoing)*
- *Understanding physical oceanographic conditions during the initiation of glaciations through the compilation of past observations of sea surface temperature and sea ice patterns in the Southern Ocean, working in collaboration with an Australian researcher (2015 – ongoing)*

Karen Kohfeld and Kirsten Zickfeld, Associate Professor, SFU have also been working with researchers from the UK and Sweden to assess the importance of vertical mixing parameters in model simulations of modern and ice age climates, to understand the influence of these mixing parameters on circulation, nutrient, and carbon distributions in the ocean (2015 – ongoing).

Diana Varela, Associate Professor, University of Victoria (dvarela@uvic.ca), recently studied the effect of warming oceans and glacier melting on Antarctic plankton from December 2013 to February 2014, and from December 2015 to February 2016. This was part of a research team of collaborators from Argentina, Spain, Germany, Belgium, The Netherlands and Sweden. The team studied the effect of lower salinities due to glacier melting and increasing temperature due to ocean warming on plankton physiology and ecology at the Argentinean Carlini Station in the vicinities of Potter Cove, King George (25 de Mayo) Island, South Shetlands, Antarctica. The objective of this

work was to understand how phyto- and zoo-plankton respond to these stressors, by quantifying damage from the cellular to the community level. An automatically controlled setup of 12 microcosms, each containing 100 L of seawater, was used to simulate the combined effects of salinity and temperature on coastal plankton, and the evolution of the community was then followed during about 10 days during the two field seasons. The experiments were conducted at different successional stages of the summer phytoplankton assemblage. In addition, plankton dynamics were also simultaneously studied in the natural environment together with the physical and chemical characteristics of the water column in Potter Cove.

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 (e.g., Principal Investigators and Associate Investigators).

1. Observational?
2. Modeling?
3. Ocean reanalysis and state estimation?

Findings from the Canadian Antarctic research workshop that POLAR convened in October 2016 will be used to inform future plans and activities under POLAR's mandate. POLAR is currently exploring opportunities to develop a Canadian Antarctic Research Program, and is interested in opportunities for Canadian researchers to collaborate with the international community to participate in current or planned Southern Ocean related initiatives. For further information, please contact POLAR at: info@polar.gc.ca.

SORP terms of reference <http://www.clivar.org/clivar-panels/southern>

"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.