

CLIVAR/CliC/SCAR Southern Ocean Region Panel SORP

National activities report

Country **Canada**
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Date **January 15, 2019**

Receipt of material prior to 1 February 2019 will ensure inclusion discussions at the first SORP video conference for 2019. The reports 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, national projects and initiatives, ocean reanalysis and state estimation initiatives relevant to the SORP

(This can be detailed as a list of activities; maps showing where instruments have been or will be deployed; examples of modeling developments, experiments and set-ups; major national and 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 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 encouraged 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").

Summary of National Activities

(Half page max. This section should include a succinct list of the main annual activities and breakthroughs as well as future plans (including any possible future opportunities for international collaboration))

A. Recent and ongoing activities

If your country has a national committee tasked with oversight of Southern Ocean climate science (e.g., like US CLIVAR), please give the name of the committee here:

Polar Knowledge Canada (POLAR) is Canada's lead federal agency to strengthen Canadian leadership in polar science and technology. 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 international interest in doing research in Canada's North 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.

Describe which major activities have been carried out in the last year or are in progress now. For each activity/project, provide a contact information (e.g., Principal Investigators and Associate Investigators), a website if available and a list of relevant publications.

1. Observational Activities
2. Modeling Activities and Ocean reanalysis and state estimation Activities:

Some examples of recent and current Canadian work related to Southern Ocean observational, modelling 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-author of the World Meteorological Organization/United Nations 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 the Southern Ocean Regional Panel from 2015-2018 (John Fyfe)
- 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:

- Swart, N.C., Gille, S.T., Fyfe, J.C. and Gillett, N.P. (2018) Recent Southern Ocean warming and freshening driven by greenhouse gas emissions and ozone depletion, *Nat. Geosci*, 11, 836-841.
- Hogg, A. McC., Spence, P., Saenko, O.A. and Downes, S.M. (2017) The energetics of Southern Ocean upwelling, *J. of Phys. Ocea.*, 47, 135-153, doi: 10.1175/JPO-D-16-0176.1.
- 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., Fyfe, J.C., Gillett, N.P. and Marshall, G.J. (2015) Comparing Trends in the Southern Annular Mode and Surface Westerly Jet, *J. Clim*, 28, doi: 10.1175/JCLI-D-15-0334.1.
- Gagné, M.-È., Gillett, N. P., Fyfe, J. C. (2015) Observed and simulated changes in Antarctic sea ice extent over the past 50 years, *Geophys. Res. Letters*, 42, 90-95.
- Swart, N.C., Fyfe, J.C., Saenko, O.A. and Eby, M. (2014) Wind driven changes in the ocean carbon sink, *Biogeosciences Discuss.*, 11, 8023-8048, doi:10.5194/bgd-11-8023-2014.
- Spence, P., Griffies, S. M., England, M. H., Hogg, A.McC., Saenko, O.A. and Jourdain, N. C. (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 involved in biogeochemical modelling in the Southern Ocean:

- Chase, Z, KE Kohfeld, K. Matsumoto, Controls on rates of opal burial in the Southern Ocean, *Global Biogeochemical Cycles* 29 (10): 1599-1616, 2015.
- Graham, R, A De Boer, E. van Sabelle, KE Kohfeld, C. Schlosser, Inferring source regions and supply mechanisms of iron in the Southern Ocean from satellite chlorophyll data, *Deep-Sea Research Part I*, 104 (2015) 9–25, **2015**.

Kohfeld is also engaged in international collaborations:

- 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 with an Australian research (2015 – ongoing).
- Assessing 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 with SFU Associate Professor Kirsten Zickfeld and researchers from the UK and Sweden (2015-ongoing).

3. National and International Projects/Initiatives

Based on guidance from Canadian researchers and policy experts during the Canadian Antarctic Research Workshop in 2016, POLAR is exploring opportunities to develop a Canadian Antarctic Research Program. As an Arctic state, such a program would enable Canada to foster polar linkages and contribute to a more comprehensive understanding of the Antarctic region and its influence on global systems. In the absence of a national program, Canadian researchers currently engage in Antarctic research through partnership with the national Antarctic programs of other countries. As Canada pursues its own national Antarctic program, it will strive to keep collaboration and partnership at the center of its approach.

A report from the 2016 Canadian Antarctic Research Workshop is available here:
https://www.canada.ca/content/dam/polar-polaire/documents/pdf/antarctic_report_en.pdf

B. Planned activities

List which major activities are planned or likely to occur during the next several years, together with a contact information (e.g., Principal Investigators and Associate Investigators).

1. Observational
2. Modeling
3. Ocean reanalysis and state estimation
4. National and International Projects/Initiatives

POLAR will continue to pursue opportunities to develop a Canadian Antarctic Research Program to support and strengthen Canadian contributions to the international Antarctic scientific community.

5. Opportunities for future international collaborations

Partnership will remain central to Canada's activities in Antarctica and POLAR 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.

CLIVAR/CliC/SCAR 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.