CLIVAR/CliC/SCAR Southern Ocean Region Panel SORP

National activities report

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Date : 26th March 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

There are both observational and modelling research activities on the Southern Ocean in France. Observational activities encompass key species surveys as environmental and sea ice changes indicators, as well as sediment and ice core analysis to record past biological production changes. Ongoing modelling activities are focussed on ice shelves. The French community is also actively involved in several modeling intercomparison projects such as ISOMIP+ (ice shelves) and MISOMIP (marine ice sheet). Ocean reanalysis and state estimation activities are also progressing, for example producing global 1/12 ° coupled Ocean/Sea ice reanalysis. For the future, several projects are planned covering modelling and reanalysis activities.

Several attempts are currently underway to coordinate Antarctic/Southern Ocean research in France. CNFRA (Comité National Français des Recherches Arctiques et Antarctiques) has been gathering a part of the researchers that do field work in the Arctic and Antarctic (geophysics, ocean/atmosphere/cryosphere sciences, biology, ...) for many years. CNRS (French National Center for Scientific Research) is now aiming to develop a national working group to improve the synergy of polar and sub-polar research in France. In parallel, researchers are aiming to build a Research Group (GdR) to improve the visibility of Antarctic and Southern Ocean Research (ocean, atmosphere, cryosphere, marine biology). All these ongoing efforts should improve the national and international visibility of the French research that is dedicated to the Southern Ocean.

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:

See summary.

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

   - l'AMMER (Adélie penguins as bioplatformes of the marine environment) program (PI: yan.ropert-coudert@cebc.cnrs.fr) proceeds from the recent international efforts towards long-term monitoring of breeding and at-sea foraging performances of key species serving as eco-indicators of environmental changes. Here, foraging success of these species is linked to physical parameters of their environment and to resource availability. The data collected consist in identifying the preferred foraging zones of Adélie penguins in Dumont d'Urville, Adélie Land. Data are collected annually and are included in the databases of international programs of eco-regionalization (Census of Antarctic Marine Life, SCAR).

   - BIOCOD (BIOlogical Productivity changes and their leverage on the Carbon and Oxygen cycles during the last Deglaciations - INSU-LEFE-IMAGO) - The aim of this project is to estimate the leverage biological productivity has imposed on the C and O cycles over the last 800 kyrs, based on a model-data comparison approach. TOC, $CaCO_3$ and coccolith data are collected from sedimentary cores retrived within the Southern Ocean (to the north of the Polar Front) to document the Biological Pump Efficiency of this area. $\delta^{17}O$ of O_2 measurements are done on the air trapped in EDC ice core to infer productivity changes at a global scale. The use of the IPSL-CM model will help comparing regional vs global productivity data.

2. Modeling Activities

   - Towards a Regional Ocean / Ice Sheet / Atmosphere modelling System (TROIS AS, PI nicolas.jourdain@univ-grenoble-alpes.fr) : includes modelling of the ocean / ice shelves interactions in the Amundsen Sea (based on the NEMO ocean model) and aims to build coupled projections of the glaciers contribution to sea level rise over the 21st century.

3. Ocean reanalysis and state estimation Activities

- Production of a global 1/12 ° coupled Ocean/Sea ice reanalysis over the 1993-2018 period at Mercator Ocean International. The model component is the NEMO platform driven at the surface by ERA-Interim reanalysis. Observations are assimilated by means of a reduced-order Kalman filter. Along track altimeter data (Sea Level Anomaly), satellite Sea Surface Temperature, Sea Ice Concentration and in situ temperature and salinity vertical profiles are jointly assimilated. This reanalysis has been performed in the framework of the Copernicus Marine Service (http://marine.copernicus.eu/).

- Southern Hemisphere Sea Ice Extent monitoring indicator is currently produced within the framework of the Copernicus Marine Service at Mercator Ocean International (http://marine.copernicus.eu/science-learning/ocean-monitoring-indicators/catalogue/). This indicator is built in a multi-model approach with an ensemble of global ocean physical reanalysis.

4. National and International Projects/Initiatives

- 2nd Ice Shelf - Ocean Model Intercomparison Project (ISOMIP+) : MIP for idealized ocean simulations in static ice shelf cavities (French participation using the NEMO ocean model).

- Marine Ice Sheet - Ocean Model Intercomparison Project (MISOMIP) : MIP for idealized ice sheet - ocean coupled simulations (French participation using the Elmer/Ice-NEMO coupled model).

- SENSEI (Sentinels of the Sea Ice: https://sites.google.com/view/senseicebc) investigates the behavioural and demographic responses of seabirds and seals to changes in sea ice by combining analyses of foraging data acquired by bio-logging/bio-telemetry techniques and long-term demographic data both in the Arctic and in the Antarctic. The project will propose a suite of indicators of sea-ice ecosystem change using seabirds and seals as sentinels of the sea-ice.

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

   - Tipping Points in Antarctic Climate Components (TiPACCs, European H2020, 2019-2022, PI Svein.Osterhus@uib.no, French CI: olivier.gagliardini@univ-grenoble-alpes.fr). The overall aim of TiPACCs is to assess the likelihood of large and abrupt near-future changes in the contribution of the Antarctic Ice Sheet to global sea level, caused by tipping points in the Antarctic continental shelf seas and the Antarctic Ice Sheet.

3. Ocean reanalysis and state estimation

   - Production of a new global 1/12 ° coupled Ocean/Sea ice reanalysis in 2020 at Mercator Ocean International in the framework of the Copernicus Marine Service. Both models and assimilation scheme components will be upgraded and driven at the surface by ERA5 reanalysis.

4. National and International Projects/Initiatives

   - Continuous measurements of water vapor isotopic composition installed or to be installed on a transect in the southern ocean (Concordia, Dumont d'Urville and Amsterdam Island to come in complement with instrument installed in La Réunion operated by F. Vimeux). Contacts: A. Landais and E. Fourré (LSCE); projects ADELISE (IPEV & LEFE).

   - POLAR.POD (https://www.oceanpolaire.org/en/polar-pod) is a project, that is developing a new, state-of-the-art, oceanographic platform. The goal of POLAR.POD is to undertake a "world tour" through the Southern Ocean, following the Antarctic Circumpolar Current. POLAR.POD will be an additional tool dedicated to basic and applied research in the Southern Ocean. POLAR.POD will have the capacity to host a wide variety of oceanographic and atmospheric sensors, allowing it to make the detailed measurements normally

associated with intensive ship-based oceanography. Further, POLAR.POD's years-long residence time will mean that these measurements will be able to capture seasonal cycles and other long-term phenomena for the first time. Carried by the currents, the POLAR.POD is designed in such a way that it will be able to handle stormy conditions, it will be acoustically quiet, and it will minimize disruption of the surrounding ocean. These properties open opportunities for innovative and brand new research. The POLAR.POD will also have close to "zero emissions", which makes it a prototype that could be adapted for use in future oceanographic fleets.

5. Opportunities for future international collaborations

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.