

## CLIVAR/CliC/SCAR Southern Ocean Region Panel SORP-11: Sept. 17-18, 2016

### National activities report

Country: Belgium \_\_\_\_\_

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*Receipt of material prior to Sept. 5, 2016 will ensure inclusion in meeting discussion. Receipt of material prior to Oct. 10, 2016 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?

YES. This is the Belgian National Committee for Antarctic Research (BNCAR, <http://dev.ulb.ac.be/glaciol/BNCAR/index.htm>). The BNCAR is made of about 45 effective, associate or honorary members and is the direct link with the Scientific Committee on Antarctic Research (SCAR). The BNCAR is the national forum to share and discuss scientific results but also identify strategies for better coordination of resources.

The following acronyms are used to refer to universities or research institutes:

RMI : Royal Meteorological Institute  
UCL: Université catholique de Louvain  
VUB : Vrije Universiteit Brussel  
ULg : Université de Liège  
KUL : Katholieke Universiteit Leuven  
ULB : Université Libre de Bruxelles  
RMCA : Royal Museum of Central Africa  
UG : Universiteit Gent

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?

- a. RMI. Contact: [mangold@meteo.be](mailto:mangold@meteo.be).
  - i. Since February 2009 - continuous monitoring of total ozone, UV irradiation and ambient aerosol physical and optical properties at Princess Elisabeth Station, Dronning Maud Land, East Antarctic and weather balloon launches February 2014 and December 2014 to February 2015. Website: <http://ozone.meteo.be/meteo/view/en/1550481-AEROCLOUD.html>
- b. VUB
  - i. Participation to SIPEX-2 Sea Ice Physics and Ecosystem eXperiment (Sep-Oct 2012) was an Australian seven-week voyage into the sea-ice zone jointly coordinated by ACE-CRC and the Australian Antarctic Division. It was a continuation of the SIPEX 1 expedition that took place in 2007. The purpose of SIPEX2 was to investigate relationship between the physical & biogeochemical sea-ice system, and the structure of Southern Ocean ecosystems. Research was conducted at about 100-120°, east of Australia's Casey Station. BIGSOUTH participants are part of the Trace Metal & Biogeochemistry team. They especially worked on primary production and C, N, Si nutrient cycling via in-situ incubations experiments and natural nitrate isotopes signal study. Contact: [Arnout.Roukaerts@vub.ac.be](mailto:Arnout.Roukaerts@vub.ac.be)
  - ii. REVOLTA (Resources Ecologique et Valorization par un Observatoire à Long Terme en terre Adélie ; Nov-Dec 2014). As part of the Belspo BRAIN-be funded vERSO project VUB participants performed in-situ incubations experiments to assess carbon and nitrogen uptake by bottom ice and under ice algae. They also studied the natural isotopic composition of nitrate.
- c. UCL
  - i. Participation to the SIPEX-2 campaign (see below). Contact: [Olivier.lecomte@uclouvain.be](mailto:Olivier.lecomte@uclouvain.be)
- d. ULg
  - i. Impact of natural iron fertilization on the biogeochemical cycles in the Southern Ocean (KEOPS 2 project). Contact: [Bruno.delille@ulg.ac.be](mailto:Bruno.delille@ulg.ac.be)
- e. KUL. Contact: [henrik.christiansen@bio.kuleuven.be](mailto:henrik.christiansen@bio.kuleuven.be), [Filip.Volckaert@bio.kuleuven.be](mailto:Filip.Volckaert@bio.kuleuven.be), [antonarctica@gmail.com](mailto:antonarctica@gmail.com)
  - i. Collection of biological tissue samples of various Antarctic fish for molecular identification and population genetics.
  - ii. Development of genetic markers (microsatellites, and more recently SNPs using next generation sequencing)
  - iii. Fundamental research on connectivity, including reviews.
- f. ULB. Contact: [jean-louis.tison@ulb.ac.be](mailto:jean-louis.tison@ulb.ac.be)
  - i. YROSLAE (Year-Round Ocean-Sea-Ice-Atmosphere Exchanges) (add period Nov 2011- Dec 2012) is a Belgian project funded by the Fonds National de la Recherche Scientifique (FNRS) and the

Belgian Science Policy (BELSPO). The work has been focused on the study of landfast sea ice physics and biogeochemistry in order to better understand and budget exchanges of energy and matter across the atmosphere-sea ice-ocean interfaces during ice growth and decay, and to quantify their potential impact on fluxes of climate gases (CO<sub>2</sub>, DMS, CH<sub>4</sub>, N<sub>2</sub>O) to the atmosphere and carbon export to the deep ocean. Ice cores, sea water, brines and exported material had been collected in trace clean condition during field surveys at regular intervals to characterize the distribution of climate gases (CO<sub>2</sub>, DMS, CH<sub>4</sub>, N<sub>2</sub>O), physical (salinity, temperature, texture, 18O) and CO<sub>2</sub>-related (DIC, TA, CaCO<sub>3</sub>) biogeochemical parameters, macro-nutrients and particulate material (including δ<sup>13</sup>C, δ<sup>30</sup>Si and δ<sup>15</sup>N), micro-nutrient (Fe), biological parameters (chlorophyll a, primary production within sea ice derived from O<sub>2</sub>/Ar and O<sub>2</sub>/N ratios, transparent exopolymer particles (TEP). Incubations had been also carried (13C, 15N, and 30Si). Micro-meteorological tower for measurement of air-ice CO<sub>2</sub> flux by eddy-covariance and related parameters, sea ice mass balance buoy (ICE-T) and dust collectors were also deployed. A 1D halo-thermodynamic biogeochemical sea ice model will be used to better constrain the interplay between GCOS Essential and Ocean Climate Variables and as temperature salinity, partial pressure of CO<sub>2</sub>, ocean acidity, oxygen nutrients in the ice and the underlying layer.

- ii. The 2013 Antarctic Winter Ecosystem Climate Study is a German voyage into the sea-ice zone (R.V. Polarstern, ANTXXIX-6, Alfred Wegener Institute, Germany). This was an integrated multidisciplinary study of pack ice biogeochemistry in the Weddell Sea during the winter 2013 (June-August). A total of 12 stations were investigated by the sea ice biogeochemistry group, collecting a suite of variables in the fields of physics, inorganic chemistry, gas content and composition, microbiology, biogeochemistry, trace metals and the carbonate system in order to give the best possible description of the sea ice cover and its interactions at interfaces. Samples were therefore collected in the atmosphere above (gas fluxes), in the snow cover, in the bulk ice (ice cores), in the brines (sackholes) and in the sea water below (0m, 1m, 30 m).
- iii. Participation to the BIGSOUTH project (see above).
- g. RMCA: participation to the BIGSOUTH project (see above).
- h. UG. Contact: [elie.verleyen@ugent.be](mailto:elie.verleyen@ugent.be)
  - i. Reconstruction of past climate and environmental changes in Lützow Holm Bay (East Antarctica) and South Georgia.
  - ii. Development of relative sea level curves for Lützow Holm Bay and Prydz Bay (East Antarctica)
  - iii. Contribution to reviews regarding past changes in ice sheet and glacier dynamics in East Antarctica and the Sub-Antarctic Islands.

## 2. Modeling?

- a. ULg. Contact: [Bruno.delille@ulg.ac.be](mailto:Bruno.delille@ulg.ac.be)
  - i. Assessment of air-ice CO<sub>2</sub> fluxes over the Antarctic sea ice combining field observations and the NEMO-LIM3 large-scale sea ice-ocean. Participation to the BIGSOUTH project: BIGSOUTH is a research network funded through the SSD programme of Belspo (<http://bigsouth.be/>).
- b. UCL
  - i. Participation to the BIGSOUTH project (see above).
  - ii. Development of new processes in the sea ice model LIM, such as snow-on-sea ice representation, melt ponds, rheology, ice-ocean coupling. Contact: [Thierry.fichefet@uclouvain.be](mailto:Thierry.fichefet@uclouvain.be)
  - iii. Simulations with different types of model (ice-ocean models driven by reanalyses, analysis of the results of coupled climate models of different complexity). A focus is the impact of internal variability and in particular of ice-ocean interactions on the recent trends in sea ice extent in the Southern Ocean. Project PREDANTAR: <http://www.climate.be/PREDANTAR> Contact: [hugues.gosse@uclouvain.be](mailto:hugues.gosse@uclouvain.be)
  - iv. Study of past interglacials over the southern high latitudes including Southern Ocean through modelling approach (<http://www.nature.com/nature/journal/v494/n7436/full/nature11790.html>). Contact: [qiuzhen.yin@uclouvain.be](mailto:qiuzhen.yin@uclouvain.be)
  - v. Simulation of biogeochemical cycles in the Southern Ocean sea ice. Contact: [s.moreau@uclouvain.be](mailto:s.moreau@uclouvain.be), [hugues.gosse@uclouvain.be](mailto:hugues.gosse@uclouvain.be), [martin.vancoppenolle@locean-ipsl.upmc.fr](mailto:martin.vancoppenolle@locean-ipsl.upmc.fr)

## 3. State estimation?

- a. UCL
  - i. Implementation of ensemble data assimilation for reanalyses of Arctic and Antarctic sea ice. Contact: [francois.massonnet@uclouvain.be](mailto:francois.massonnet@uclouvain.be)

## 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?

- a. RMI. Contact: [mangold@meteo.be](mailto:mangold@meteo.be)
  - i. Existing activities (see above) will continue for at least 4 years. Focus will shift from purely monitoring to investigation of cloud-precipitation-aerosol interactions (collaboration with KUL).
- b. KUL. Contact: [henrik.christiansen@bio.kuleuven.be](mailto:henrik.christiansen@bio.kuleuven.be), [Filip.Volckaert@bio.kuleuven.be](mailto:Filip.Volckaert@bio.kuleuven.be), [antonarctica@gmail.com](mailto:antonarctica@gmail.com)

- i. Integrative approach of modeling and genetics ("seascape genetics")
    - ii. Trophic ecology studies
  - c. VUB: As part of the Belspo BRAIN-be funded vERSO project, the VUB team will contribute to Project 4291 of the Australian Antarctic Science program: Impact of changes in sea ice extent on primary productivity in the Southern Ocean: links between the iron and carbon cycles in fast ice and the marginal ice zone. (Nov. – Dec. 2015). The VUB will study primary production and the N-cycle in sea ice using stable isotope techniques. Contact: [fdehairs@vub.ac.be](mailto:fdehairs@vub.ac.be)
  - d. ULB and ULg are planning to participate to the PIPERS (Polynyas, ice production and seasonal evolution in the Ross Sea) cruise funded by the NSF and led by Steve Ackley (UTSA). The cruise will investigate the Ross Polynya in April-Jun 2017. PIPERS is a larger multi-platform project designed to carry out In situ observations of air-sea-ice interactions in order to improve estimates of sea ice production and water mass transformation in the Ross Sea.
  - e. UG. Contact: [elie.verleyen@ugent.be](mailto:elie.verleyen@ugent.be)
    - i. Planned field campaigns to Southern South America (2015-2016) and the Larsemann Hills (2016-2017).
- 2. Modeling?
  - a. UCL:
    - i. Identification of sources of model biases and improvement of physical processes in climate models in the Southern Ocean. Contact: [hugues.goose@uclouvain.be](mailto:hugues.goose@uclouvain.be)
    - ii. Analysis of CMIP6 simulations in the polar regions. Contact: [thierry.fichefet@uclouvain.be](mailto:thierry.fichefet@uclouvain.be)
    - iii. Study of small-scale processes using high-resolution (2 km) a coupled atmosphere-ocean-sea ice regional climate model. Contact: [Thierry.fichefet@uclouvain.be](mailto:Thierry.fichefet@uclouvain.be) (partnership with ULg)
    - iv. Study of predictability of sea ice in the Southern Ocean. Contact: [sylvain.marchi@uclouvain.be](mailto:sylvain.marchi@uclouvain.be)
    - v. Exercise of inter-comparison of seasonal forecasts of sea ice in the Southern Ocean (in the framework of the Year of Polar Prediction, YOPP). [francois.massonnet@uclouvain.be](mailto:francois.massonnet@uclouvain.be)
    - vi. Contribution of Southern Ocean to the interglacial carbon cycle. Contact: [qiuzhen.yin@uclouvain.be](mailto:qiuzhen.yin@uclouvain.be)
  - b. ULg:
    - i. Study of small-scale processes using high-resolution (2 km) a coupled atmosphere-ocean-sea ice regional climate model. Contact: [Xavier.fettweis@ulg.ac.be](mailto:Xavier.fettweis@ulg.ac.be)
    - ii.
- 3. State estimation?
  - a. UCL:
    - i. Ensemble, coupled reanalyses in the Southern Ocean. Contact: [francois.massonnet@uclouvain.be](mailto:francois.massonnet@uclouvain.be), [hugues.goose@uclouvain.be](mailto:hugues.goose@uclouvain.be)

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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.

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