

# CLIVAR/CliC/SCAR Southern Ocean Region Panel SORP

## National activities report

Country: BRAZIL

Contributor(s) (writer(s)): Rodrigo Kerr (IO-FURG) and Luciano P. Pezzi (INPE)

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*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))*

One of the most actively Brazilian group executing scientific activities in the Southern Ocean (south of 50°S) is the Brazilian High Latitude Oceanography Group (GOAL; Mata et al. 2018). The GOAL was formed in 2002 within the scope of the Brazilian Antarctic Program (PROANTAR) aiming to contribute to the understanding of the relationship between the marine biota, from microorganisms to top predators of the Southern Ocean food web, and the physical-chemical environment. The understanding of those relationships is crucial to assess the effect of global climate change on the unique and sensitive Southern Ocean ecosystems. Despite the inherent difficulties to work in remote and harsh environments such as the Southern Ocean and the Antarctic margin, we conducted long-term, systematic and integrated studies of the marine ecosystem since the beginning of GOAL.

13 oceanographic cruises (spanning from 2003-2005; 2008-2011 and 2013-2018) were performed around the Northern Antarctic Peninsula (NAP), which includes the Bransfield and Gerlache Straits, the Powell Basin, and the Northwestern Weddell Sea continental shelf and slope. Even longer-term surveys have been continuously conducted with respect to marine mammals ecology and abundance (since the 1997/98 austral summer).

Please see below a map with the cruises performed (mostly during the summer – January or February) by the group in the last years (updated until 2018). New projects were recently approved by PROANTAR to start in 2019; thus additional cruises are expected to occur between 2020-2023 around the NAP.

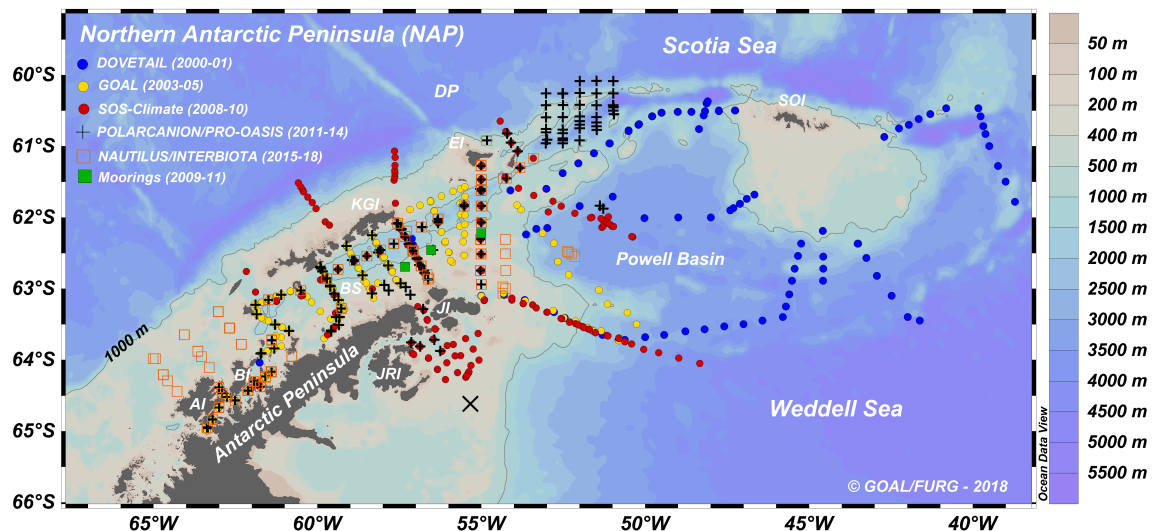


Figure 1. Oceanographic stations occupied by GOAL group around NAP since 2000. Figure from Mata et al. 2018. *Deep-Sea Research II*, vol 149.

## **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:*

*Brazilian Antarctic Program (PROANTAR).* The Brazilian Antarctic Plan 2013-2022 can be accessed at <http://www.ufrgs.br/inctcriosfera/arquivos/BrazilianActionPlanEnglish.pdf>. The plan is split in five main Programs, with the 3 first program's activities related to actions in the Southern Ocean: 1 - The role of cryosphere in the Earth system and its interactions with South America, 2 - Biocomplexity of Antarctic ecosystems, their connections with South America and climate change, 3 - Climate Change and the Southern Ocean, 4 - Geodynamics and geological history of Antarctica and its relations with South America, 5 - Dynamics of the Antarctic upper atmosphere, geospace interactions, and connections with South America.

Brazil has also a “National Institute for Science and Technology of the Cryosphere (INCT-CRIOSFERA)” with regular activities in the Southern Ocean. More info regarding this group can be accessible at: <http://www.ufrgs.br/inctcriosfera/>. INCT-CRIOSFERA PI is Dr. Jefferson C. Simões ([jefferson.simoed@ufrgs.br](mailto:jefferson.simoed@ufrgs.br)). The contacts of PIs of each INCT-CRIOSFERA subgroup can be seen at: <http://www.ufrgs.br/inctcriosfera/contato.html>.

*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.*

The GOAL group performed a summer cruise in February 2018 (focusing on investigating the oceanographic processes and ecosystem responses around NAP) and published a Special Issue at *Deep-Sea Research II (Vol. 149)* in March 2018. The projects in progress (ending March 2019) of the GOAL group were: NAUTILUS (PIs: Dr. Mauricio Mata – [mauricio.mata@furg.br](mailto:mauricio.mata@furg.br), responsible for Physical Oceanography, and Dr. Rodrigo Kerr – [rodrigokerr@furg.br](mailto:rodrigokerr@furg.br), responsible for Marine Biogeochemistry and Air-Sea Interactions), INTERBIOTA (PIs: Dr. Eduardo Secchi – [edu.secchi@furg.br](mailto:edu.secchi@furg.br), responsible for the area of Ecosystem Integration and Top Predators, and Dr. Carlos Rafael Mendes – [crbmendes@gmail.com](mailto:crbmendes@gmail.com), responsible for Plankton), and BALEIAS (PI: Dr. Luciano Dalla Rosa – [l.dalla@furg.br](mailto:l.dalla@furg.br), responsible for Marine Mammals).

In addition, two expressive scientific initiatives investigating air-sea interaction processes on Southwest Atlantic and Southern Ocean that live now under the INCT-CRIOSFERA umbrella, are named *Atlantic Carbon and Fluxes Experiment (ACEx)* and *Air-sea interaction at Brazil Malvinas Confluence (INTERCONF)*. Dr. Luciano Ponzi Pezzi ([luciano.pezzi@inpe.br](mailto:luciano.pezzi@inpe.br)) and Dr. Ronald Buss de Souza ([ronald.souza@inpe.br](mailto:ronald.souza@inpe.br)) from the National Institute for Space Research (INPE) lead those projects. These scientific initiatives have been executed through oceanographic campaigns performing simultaneously measurements of meteorological and oceanographic variables. From 2012, new techniques were added to directly measure the air-sea fluxes of heat,

momentum and CO<sub>2</sub> through the Eddy Covariance method. The intense sea surface temperature (SST) gradients present at frontal regions in the Southwest Atlantic Ocean are the major local forcing mechanisms for modulating the marine atmospheric boundary layer at the atmospheric synoptic scale. This modulation is suppressed when large scale, transient atmospheric system is crossing this region.

A Special Issue in the journal Deep-Sea Research II, entitled: “*Oceanographic processes and biological responses around Northern Antarctic Peninsula (NAP): a 15-year contribution of the Brazilian High Latitude Oceanographic Group*”, was published at Deep-Sea Research II (Vol. 149, March 2018) to celebrate the 15 years of GOAL since its formation.

Recent relevant publications can be viewed at the DSR-II Special Issue NAP Oceanography (Vol. 149): <https://www.sciencedirect.com/journal/deep-sea-research-part-ii-topical-studies-in-oceanography/vol/149/suppl/C>

### 1. Observational Activities

GOAL normally executed and measure in its cruises around NAP (Figure 1): Hydrography – T, S, Oxygen, Fluorescence, Beam Attenuation, Phytoplankton pigments, Nutrients. Since 2015, has started to measure the carbon parameters: AT/CT, pH, continuous pCO<sub>2</sub>, POC/DOC/TOC, Microbiology, and continuous CPR lines. Some of the physical dataset produced by the GOAL group since the 2000s can be accessed by PANGAEA website.

Additionally, the Brazilian Antarctic Operation (OPERANTAR) XXXVII, which began in 2018, counted on INPE participation in atmospheric and oceanic data collection in the Southwest Atlantic Ocean, Drake Passage and in the vicinity of the South Antarctic Islands archipelago, conducting this observational experiment (Figure 2). It was held between October 8 and November 26 with teams from the Laboratory of Ocean and Atmospheric Studies (LOA / DSR / OBT / INPE) led by Dr. Luciano P. Pezzi and the Laboratory of Meteorology and Oceanography by Satellite (LAMOS / CRS / INPE) led by Dr. Ronald B. de Souza. This data will also be used in cooperation with the European Center for Medium-Range Weather Forecasts (ECMWF) where they will be used for coupled numerical studies to better represent atmospheric and oceanic variability in the CBM region.

INPE also participated actively in an international initiative called *The Year of Polar Prediction* (YOPP, 2017-2019) which is an initiative supported by the World Meteorological Organization (WMO) whose objective is to seek improvements in the quality of environmental forecasting for the polar regions and their surroundings through intensive campaigns of observations, numerical modeling, forecasting and validation. The atmospheric radiosondages data collected at standard synoptic times were transmitted in real time to the UK Meteorology Center (UKMet Office) to be assimilated by numerical weather forecasting models. These radiosondages were performed on waters of the

Southern Ocean between November 16 and 21, 2018 during the 2nd phase of OPERANTAR XXXVII in the locations indicated by the red circles in Figure 3.

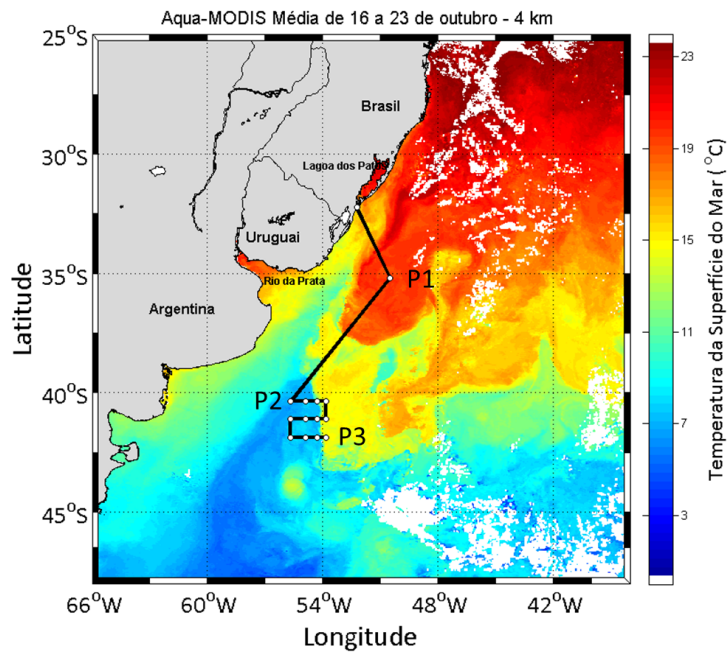


Figure 2. Average sea surface temperature map from October 16 to 23, 2018 used for the determination and planning of data collections using radiosondes, XBT probes and CTD profiles (Conductivity, Temperature and Depth). Between the points P1 and P2, vertical and atmospheric profiles were obtained with 8 radiosondes and 10 XBT type probes. Between the points P2 and P3, 12 CTD profiles were performed, and data of dissolved oxygen concentration and fluorescence were also collected.

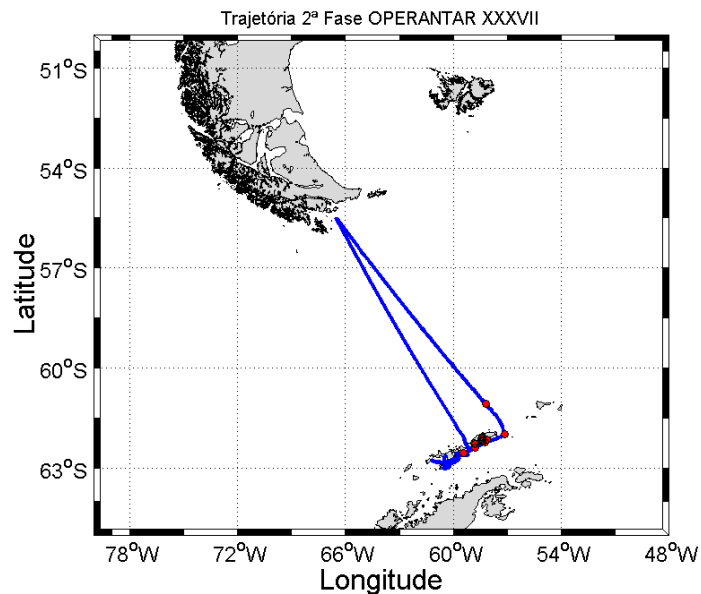


Figure 3 - Trajectory taken by the H41 in the passage of Drake and region of the South Shetland Islands between November 7 and 23, 2018 where micrometeorological data necessary to calculate the turbulent fluxes between the ocean and the atmosphere were collected. The red dots indicate radiosondes launching positions performed in collaboration with the YOPP between November 16 and 21, south of 60° latitude.

## 2. Modeling Activities

Contact for specific information about Southern Ocean modeling is Dr. Ilana Wainer – [wainer@usp.br](mailto:wainer@usp.br).

## 3. Ocean reanalysis and state estimation Activities

None being done and none planned.

## 4. National and International Projects/Initiatives

NAUTILUS project – cooperation with UPVD (France), UEA (UK), and AWI (Germany).

INTERBIOTA project – cooperation with UL (Portugal), Univ. of Nantes (France), WHOI (USA), and IAA (Argentina).

ATMOS - Antarctic Modeling Observation System – This is an international project recently funded by Brazilian government under PROANTAR, Brazilian Antarctic Program. PI Dr. Luciano Ponzi Pezzi ([Luciano.pezzi@inpe.br](mailto:Luciano.pezzi@inpe.br))

## 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

The last cruise of the projects NAUTILUS and INTERBIOTA will occur in January 2019. Together with the classical oceanography normally performed by the group around NAP, it is planned to launch and recovery a seaglider in the area (in collaboration with UK researchers from University of East Anglia).

The GOAL projects NAUTILUS and INTERBIOTA will be replaced by the following projects: PROVOCCAR (PIs: Dr. Mauricio Mata and Rodrigo Kerr) and ECOPELAGOS (PIs: Dr. Eduardo Secchi and Dr. Carlos Rafael Mendes), during the period of 2019-2023. Three cruises are expected to occur during the summer seasons of 2020, 2021 and 2022. The Figure 4 shows the expected oceanographic stations planned to be occupied around NAP. Sediments traps are expected to be moored.

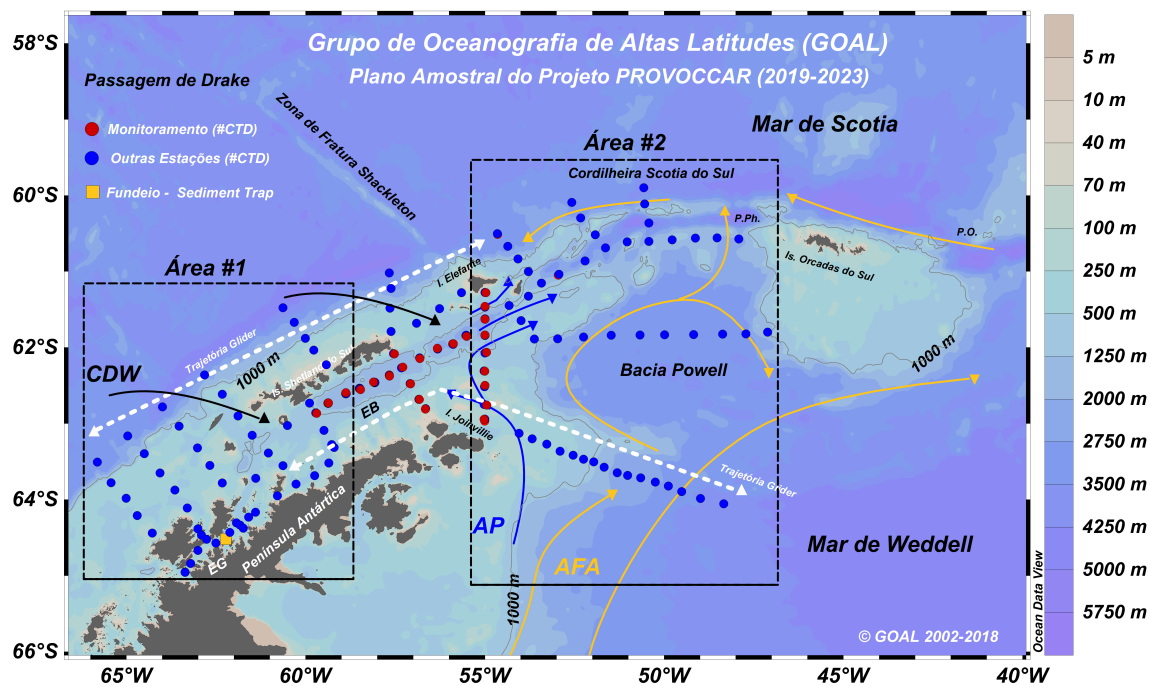


Figure 4 - Proposed oceanographic stations for the PROVOCCAR/ECOPELAGOS cruises.

In addition, a total of 16 projects were recently approved by the Brazilian PROANTAR/CNPq call for proposals to work on the Southern Ocean and Antarctic continent. The topics of investigation to be covered by the projects are in accordance with the Brazilian Action Plan for Antarctic (2013-2022), available at <http://www.ufrgs.br/inctcriosfera/arquivos/BrazilianActionPlanEnglish.pdf>

## 2. Modeling

Contact for specific information about Southern Ocean modeling is Dr. Ilana Wainer – [wainer@usp.br](mailto:wainer@usp.br).

## 3. Ocean reanalysis and state estimation

None being done and none planned.

## 4. National and International Projects/Initiatives

Both PROVOCCAR and ECOPELAGOS projects focus on strength the scientific cooperation between Brazil and other countries.

Briefly, PROVOCCAR researchers will be working close together with scientists from UPVD (France), British Antarctic Survey & UEA (UK), CSIR (South Africa), AWI (Germany), SHN & UBA (Argentina), on the areas of marine CO<sub>2</sub>-carbonate system & anthropogenic carbon, physical oceanography, and biogeochemical modelling.

ECOPELAGOS researchers will be working close together with scientists from IAA (Argentina), UL (Portugal), WHOI (USA), Univ. of Nantes (France), NIOZ (Netherlands), PML (UK), and others, on the areas of remote sensing, phytoplankton groups, microbiology, ecophysiology, and ecosystem modelling.

## 5. Opportunities for future international collaborations

Please contact the PIs of the PROVOCCAR and ECOPELAGOS projects.

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## 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.