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2 months at sea to explore the Southern Ocean's contribution to climate regulation

To better understand the sequestration of atmospheric CO₂ in the ocean, and especially how the chemical elements essential to this storage are supplied, transported and transformed by the oceans, is the goal of the SWINGS oceanographic cruise. To this end, a team coordinated by two CNRS researchers and involving colleagues from Sorbonne University, Toulouse III - Paul Sabatier University, the University of Western Brittany and Aix-Marseille University, will traverse the Southern Ocean from 11 January to 8 March 2021, aboard the *Marion Dufresne II* research vessel chartered by the French Oceanographic Fleet.

The Southern Ocean, which surrounds the Antarctic continent, south of the Atlantic, Pacific and Indian Oceans, wild region that is difficult to explore. It plays a key, yet complex, role in the capture and storage of atmospheric CO₂. A wide range of factors need to be taken into account, including biological activity (surface photosynthesis, carbon export to the deep ocean and its sequestration in sediments) and ocean circulation.

To understand these processes it is necessary to quantify them, which can be done by measuring what are known as geochemical elements (silica, nitrate, iron, zinc, as well as elements such as thorium, radium and rare earths). The vast majority of these tracers are present in minute concentrations in seawater.

The SWINGS¹ oceanographic cruise, starting on 11 January and involving 48 scientists, is part of the international GEOTRACES programme, which since 2010 has been constructing a chemical atlas of the oceans, compiling data describing the biogeochemical cycles of these trace elements and their isotopes in the world's oceans. The data is acquired using very strict protocols, compared and validated among the different countries, and made available in an open database. This is the first time that such a comprehensive marine survey has been carried out in the Southern Ocean. Its goal is to determine the sources (atmospheric, sedimentary, hydrothermal, etc) of these elements, some of which (iron and zinc for example) play a crucial role in the photosynthetic activity of phytoplankton. The scientists will be studying their physical, chemical and biological transformations at all depths of the Southern Ocean, as well as their ultimate fate, when they sink into the deep ocean and are stored in sediments².

In addition to the SWINGS scientists, a team from OISO (Indian Ocean Observation Service), which is assessing the proportion of CO₂ from anthropogenic emissions and the resulting ocean acidification, will embark on the *Marion Dufresne II* during the cruise. Another temporal data monitoring programme, THEMISTO, will be studying open-ocean ecosystems. Finally, a third project (MAP-IO) will use the *Marion Dufresne II* to carry out, among other things, physical measurements of the distribution of aerosols and trace gases. With these three projects complementing the SWINGS goals, scientific cooperation lies at the heart of the new cruise.



The laboratories involved in the SWINGS programme are:

- Laboratoire des Sciences de l'Environnement Marin (CNRS/IFREMER/IRD/Université de Bretagne occidentale)
- Laboratoire d'Etudes en Géophysique et Océanographie Spatiales (CNRS/CNES/IRD/Université Toulouse III - Paul Sabatier)
- Laboratoire de Météorologie Dynamique (CNRS/ENS- PSL/ École polytechnique-Institut Polytechnique de Paris/Sorbonne Université)³
- Laboratoire d'Océanographie et du Climat : Expérimentations et Approches Numériques (CNRS/IRD/MNHN/Sorbonne Université)³
- Centre Européen de Recherche et d'Enseignement de Géosciences de l'Environnement (CNRS/INRAE/IRD/Aix-Marseille Université)
- Laboratoire d'Océanographie Microbienne (CNRS/Sorbonne Université)
- Institut Méditerranéen d'Océanologie (CNRS/IRD/Université de Toulon/Aix-Marseille Université)
- Laboratoire Climat, Environnement, Couplages et Incertitudes (CNRS/CERFACS)
- Technical Division of CNRS-INSU

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The *Marion Dufresne II* sailing in the Southern Ocean.

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The Marion Dufresne II off the Crozet archipelago. King penguins can be seen in the foreground.
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Note

¹ *South West Indian Geotraces Section.*

² In particular, the team will carry out coring along the South African coast, as well as around the islands of Marion, Crozet and Kerguelen, and in deeper waters. The very low concentrations of chemical elements found in the ocean makes them hard to analyse, as the samples collected must be protected from contamination caused by rust and the ship's funnels, and even by the scientists themselves.

³The laboratory belongs to the Institut Pierre Simon Laplace.

Contacts

Available from January 4 to 7 (arrivals in Reunion Island on January 8, departure at sea on January 11) :

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