

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

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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 January 11 to March 8, 2021, aboard the Marion Dufresne II research vessel chartered by the French Oceanographic Fleet. Their goal is to better understand the sequestration of atmospheric CO<sub>2</sub> in the ocean, and especially how the chemical elements essential to this storage are supplied, transported and transformed by the ocean

The Southern Ocean, which surrounds the Antarctic continent, south of the Atlantic, Pacific and Indian Oceans, is a wild region that is difficult to explore. It plays a key, yet complex, role in the capture and storage of atmospheric CO<sub>2</sub>. 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 January 11 and involving 48 scientists, is part of the international GEOTRACES program, 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 sediments.

In addition to the SWINGS scientists, a team from OISO (Indian Ocean Observation Service), which is assessing the proportion of CO<sup>2</sup> from anthropogenic emissions and the resulting ocean acidification, will embark on the Marion Dufresne II during the cruise. Another temporal data monitoring program, 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 program 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)
- Laboratoire d'Océanographie et du Climat : Expérimentations et Approches Numériques (CNRS/IRD/MNHN/Sorbonne Université)
- 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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Provided by CNRS

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