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## The data collected during the *OceanoScientific Expedition* were presented to scientists on Monday, 3 July at the Maison des Océans

After completing his single-handed round-the-world trip at the Yacht Club de Monaco on 2 June, and 152 days of sailing from Monaco to Monaco, on Monday, 3 July, in the library of the Maison des Océans -the Paris branch of the Institut océanographique, Fondation Albert I<sup>er</sup>, Prince de Monaco- Yvan Griboval handed over to scientists the oceanographic data and seawater samples collected during the sixty days of the first campaign ever conducted by sail at the Air-Sea interface in the Antarctic Circumpolar Current under the three Capes of Good Hope (South Africa), Leeuwin (Australia), and the Horn (Chile). The scientific expedition was carried out on board the *OceanoScientific Explorer "Boogaloo"*, a 16-meter (52.5 feet) monohull high-performance sailboat, without producing any CO<sub>2</sub> emissions or waste, flying the flag of the Yacht Club de Monaco.

**Robert Calcagno**, Director of the Institut océanographique, Fondation Albert I<sup>er</sup>, Prince de Monaco, chaired the ceremony celebrating the handover of the results of the *OceanoScientific Expedition*. *"As Director General of the Institut océanographique, I was honoured to have been able to follow and support the mission of the OceanoScientific Explorer carried out single-handed by Yvan Griboval. This project and the values it conveys are completely in line with the humanistic and scientific ideals of Prince Albert I of Monaco when he founded the Institut océanographique at the beginning of the 20<sup>th</sup> century, and which we are still pursuing today: to increase and extend the influence of scientific knowledge for the benefit of society at large.*

*This ceremony, in which the samples taken by Yvan Griboval in the Southern Ocean have been handed over at the Maison des Océans, under the portrait of Albert I, has made this moment particularly symbolic. I am convinced that Yvan's work will count for future generations, because improving our knowledge of the oceans by involving the younger generations will leave an indelible trace!*

*The Institut océanographique has chosen to support the OceanoScientific Programme in accordance with the will of HSH Prince Albert II of Monaco to federate and bring together initiatives that make the oceans better known, loved and protected: in the footsteps of the Prince, the Institut océanographique acts as a mediator to extend the influence of projects that are meaningful for humankind and knowledge about the oceans. Incontestably, the OceanoScientific Programme is one of those initiatives".*

**Mathieu Belbéoch**, Lead JCOMMOPS (Intergovernmental Oceanographic Commission of UNESCO, World Meteorological Organization / IOC-UNESCO - WMO), emphasized the importance of private initiatives in collecting data in regions of the seas that have seldom been explored if at all, and in deploying scientific floats (Argo), as Yvan Griboval successfully did by sail as far as 50° South in the Indian Ocean.

*"The implementation of a sustainable and balanced observation system in the Southern Ocean is a real challenge for the scientific community. Research campaigns and opportunities to deploy stand-alone instruments or to collect data from volunteer vessels are rare in the Southern Hemisphere.*



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*The commitment of the OceanoScientific Programme will allow us to fill in a number of gaps in areas of the utmost importance for climate research. The Intergovernmental Oceanographic Commission of UNESCO (IOC-UNESCO) is delighted to coordinate these operations, in particular through JCOMMOPS, its operational centre based in Brest.*

*This ambitious form of cooperation between oceanographers and skippers is another step towards optimizing and modernizing the components of the Global Ocean Observing System. A big thank you to Yvan Griboval who braved the Roaring Forties in the name of science!"*

Before submitting the data and samples to the representatives of Ifremer and the CNRS, **Yvan Griboval** insisted on the fact that *"This oceanographic campaign is dedicated to the memory of Fabienne Gaillard (Ifremer), who died on March 25 after a long illness the day before I rounded Cape Horn. Fabienne Gaillard had been the precious scientific guide of the OceanoScientific Programme since its inception in the autumn of 2006 and shall always be with us on our other expeditions"*.

Representing the Managing Director and Scientific Director of the Institut français de recherche pour l'exploitation de la mer (Ifremer) of which he is Deputy Director, **Patrick Farcy** recalled: *"The Southern Ocean in which the OceanoScientific Explorer "Boogaloo" sailed absorbs a large amount of man-made carbon in the form of CO<sub>2</sub>. It is important to know if the pump is working well or if it has breakdowns as it had in the 1990s.*

*In order to determine the state of health of the Southern Ocean, satellites are used which give surface information on temperature, salinity and CO<sub>2</sub>. Nevertheless, it is absolutely necessary to regularly combine satellite data with field (in situ) data in order to calibrate the instruments and validate the measurements made by them. In-situ measurements by vessels equipped with precise and reliable measurement systems, such as those on-board the OceanoScientific Explorer "Boogaloo", is therefore indispensable and must be carried out on a regular basis in order to provide a database for understanding and monitoring the characteristics of an ocean which is subject to climate change"*.

**Thierry Reynaud**, Ifremer Research engineer at the Laboratoire d'Océanographie Physique et Spatiale (LOPS), will now use the data collected by Yvan Griboval and the samples taken during the sixty days of navigation. He stated: *"This campaign allows us to obtain accurate measurements of the surface temperature and salinity in regions of the seas that are less frequented. The data transmitted hourly around Antarctica before any processing were already promising. These measurements will be useful to our community, particularly to our colleagues working on satellite measurements"*.

The presence of **Laurence Eymard** at the Maison des Océans linked up with the origins of the *OceanoScientific Programme*. Indeed, Laurence Eymard hosted the founding meeting of the initiative, on 14 November 2006 in the meeting room of the Laboratoire d'Océanographie et du Climat: Expérimentations et Approches Numériques (LOCEAN) that she then directed. The joint research unit, in partnership with the Université Pierre et Marie Curie (UPMC), the Centre National de la Recherche Scientifique (CNRS), the Institut de Recherche pour le Développement (IRD) and the Muséum National d'Histoire Naturelle (MNHN) guided the development of *OceanoScientific Programme* in close conjunction with Ifremer and also coordinates the scientific side of the expeditions.



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Today, as Director of Research at the CNRS, and director of the Observatoire des Sciences de l'Univers (OSU) Ecce Terra, a CNRS / INSU-UPMC unit in charge of the national observatories of the terrestrial environment and space, Laurence Eymard explains: *"Observing the natural environment (ocean and atmosphere) is imperative to understand its functioning and to foresee its evolution, both in the short term (weather, oceanography) and in the long term (climate).*

*This area of the southern ocean is poorly covered by in situ measurements, with only a few drifting floats for the ocean, and satellites for the atmosphere. The very low atmosphere is also a difficult – and even impossible – area to reach by satellite. But exchanges between the Ocean and the Atmosphere and the combined operation of the two environments govern the seasonal and inter-annual variations, and hence the climate of this southern region of the Southern Hemisphere.*

*In addition, there are many questions about climate change in these areas of the ocean, which also provide shelter for unusual fauna. Measurement campaigns have been organized in recent years, but have neither the repeatability nor the spatial coverage required to monitor the key variables of the Air-Sea interface. An observatory approach, with regularly renewed visits, would complement the work carried out in the campaigns while providing the necessary data for monitoring the Air-Sea interface around the Antarctic continent".*

**Gilles Reverdin**, CNRS Research Director at LOCEAN / Sorbonne Universités and Scientific Director of Coriolis, will analyse some of the samples collected by the navigator - explorer. He said: *"The Southern Ocean, as well as the Arctic Ocean, are among the regions we expect to have the strongest response to climate change in terms of physical properties (temperature and salinity T/S), ocean circulation (circumpolar current, ocean ventilation), as well as the ability to capture carbon dioxide or produce planktonic biomass.*

*It is also a region with very high oceanic variability, both at the timescales of ocean vortices and at large scales. Its sampling therefore requires regular and repeated monitoring. Expeditions such as the OceanoScientific Expedition thus provide a foundation on which to base that monitoring and improve our understanding of these issues. Their primary interest lies in the simultaneous measurement of several ocean surface parameters, under well-understood weather conditions".*

More generally, **Nicolas Metz**, CNRS Research Director at LOCEAN / Sorbonne Universités, insisted on the "mare incognito" aspect of the Southern Ocean Climate and its role as a sentinel: *"The ocean, by its capacity to absorb approximately 25 to 30% of man-made CO<sub>2</sub> emissions and more than 90% of the excess heat, plays a crucial role in regulating climate disturbance. Without that ocean carbon sink, the concentration of CO<sub>2</sub> in the atmosphere would be much higher than today, leading to a more pronounced climate change.*

*The Southern Ocean, south of the Roaring Forties where Yvan Griboval sailed, is known to absorb much of man-made CO<sub>2</sub>. This is due to both physical and hydrodynamic mechanisms (more soluble cold water, formations from the surface of circumpolar deep and bottom waters) and biological mechanisms (phytoplankton production, sedimentary export). We refer in these cases to physical and biological carbon "pumps".*



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*On the basis of observations made since the 1990s, it is estimated that the Southern Ocean alone accounts for 40% of the global oceanic carbon pump, accompanied by inter-annual to decadal variability that we have only just begun to identify and explain (the change in wind conditions for example). In particular, it has recently been demonstrated that since the start of the millennium, the carbon sink has intensified in the Southern Ocean.*

*Furthermore, in the future, by the end of the 21<sup>st</sup> century and despite the uncertainties simulation of numerical simulations, climate models suggest that the Southern Ocean is the only one capable, in the long term of maintaining an effective carbon pump to reduce the accumulation of CO<sub>2</sub> in the air.*

*If this is confirmed by the observations -which must be continued and increased!- this is good news for the Climate. But there is another CO<sub>2</sub> problem. The accumulation of man-made CO<sub>2</sub> in the ocean leads to so-called "ocean acidification", which is noticeably faster in cold waters, with consequences still unclear on marine ecosystems and the food chain, all of which perhaps more vulnerable in Antarctic waters.*

*For these reasons and in order to monitor from year to year the oceanic carbon pump and the associated acidification, it is urgent to regularly observe, if possible every season, summer and winter, the physicochemical properties (CO<sub>2</sub>, pH) and biological properties of the Southern Ocean to better understand climate change and its consequences on vulnerable marine ecosystems.*

*New in-situ observations, which are still rare in this ocean remote from sources of local pollution and which can be described as a "Climate Sentinel", will also make it possible, once synthesized -for example through the international database SOCAT- to better qualify climate models and thereby reduce uncertainties about future projections. An increase in the number of OceanoScientific expeditions in summer (December-February), but also in winter (June-August) would be a valuable factor in increasing our knowledge in this respect..."*

**Pierre-Yves Le Traon**, Scientific Director of Mercator Océan (Centre for analysis and forecasting of the global ocean) recalled that *"Despite the advances of the last decades, the ocean and, in particular, the South Seas remain insufficiently observed. New regular and repeated observations as proposed by the OceanoScientific Programme are and will be of great use to validate the analysis and ocean forecasting models produced and disseminated to thousands of users worldwide by Mercator Océan and the EU Copernicus Marine Service and thus provide a better response to the major challenges involved in the sustainable management of the oceans"*.

**Finally, Olivier Piquet**, Managing Director of the Lise Charmel company, one of the main sponsors who allowed this unique expedition to take place, recalled: *"It is important for the private sector to effectively support initiatives such as the OceanoScientific association to accelerate research on climate change. In these times of stagnation or a decline in the resources of state institutes, we need to help scientists increase their knowledge about climate change so that our governments can make the strategic decisions that will ensure the future of our children. The tax incentives for individuals and businesses to do so are a real asset that must be properly exploited for such a just cause"*.

Finally, **Cécile d'Estais**, General Delegate of the OceanoScientific philanthropic association, said: *"Over and above the scientific issues, this unprecedented expedition has provided an opportunity to raise the awareness of the public and especially that of children aged 7-10 years old about the need to preserve the Ocean thanks to the publication of weekly newsletters written by Yvan Griboval on board the OceanoScientific Explorer "Boogaloo"*.



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*That constant exchange with children, to explain life in the Far South and raise their awareness about the effects of climate change on the Ocean, is a priority for the OceanoScientific association. Let us hope that this expedition will in turn inspire such a particularly attentive young audience to become defenders of the ocean!"*

The expedition, organized by the OceanoScientific philanthropic association and registered charity, has been supported and supervised by Ifremer, Météo-France, and the CNRS. It is sponsored by the Intergovernmental Oceanographic Commission of UNESCO (IOC-UNESCO) with the support of JCOMMOPS and Mercator Océan. It is supported by the Yacht Club de Monaco, whose flag is flown by Yvan Griboval and *Boogaloo*, by the Institut océanographique, Fondation Albert I<sup>er</sup>, Prince de Monaco; by the Fondation Prince Albert II de Monaco, and by the Centre Scientifique de Monaco.

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