OceanoScientific Southern Expeditions 2019 - 2020
Two upcoming expeditions are scheduled on the same course from Monaco to Monaco via a virtual way-point on the line of the 40th South.

Scientific partners in POGO proposal:

POGO members: CNRS (LOCEAN), IFREMER, SIO, CSIRO, GEOMAR

With: OceanoScientific (Fr), Université de Perpignan (Fr), FURG (Porto Allegre, Brazil), UFPE (Recife, Brazil), NOAA (PMEL, USA)
**Rationale**

- Lack of in-situ observations at the air-sea interface in the southern ocean.
- Lack of visible or infrared satellite data.
- Autonomous observation systems (Argo floats, saildrones, wavegliders) need validation.

*Example:* In some regions recent BGC-Argo floats suggest air-sea \( \text{CO}_2 \) fluxes of opposite sign to the SOCAT winter estimate.

### Available cruise data (pCO\(_2\)) in austral winter south of 40°S (SOCAT)

2019-2020 *OceanoScientific Expeditions* will continuously measure from a sailboat:

- Meteorological variables (SLP, wind, air temperature, humidity...)
- SST/SSS, pH, \( \text{O}_2 \), \( \text{pCO}_2 \) (sensors Sunburst and/or Contros), fluorescence
- Water samples for validation and for DIC/ \( \text{A}_t \) analyses will be collected.
OceanoScientific Expeditions

In 2005-2006 Yvan Griboval had the idea of using ocean racing yachts that sail around the World in the Roaring Forties and Furious Fifties:

To collect oceanographic and meteorological data at the Air-Sea interface, to feed research on origins and impacts of climate change.

The result was the *OceanoScientific Programme* launched on 14 November 2006.
OceanoScientific has faced with a problem: no equipment existed in 2006 to equip ocean racing sailboats with oceanographic equipment.

The OSC System was then tested on the three-master BARK EUROPA in the waters of Antarctica.

OceanoScientific has called on the support of scientific advice and specialists to develop this equipment that did not exist for sailboats, in particular by financing and providing the fruit of his research free of charge to his German partner Stefan Marx, when the latter created the SubCtech corporation in Kiel (Germany).

The OSC-Software (intelligent part of the OSC System) is still a unique piece of equipment in the world today.
In 2016-2017, Yvan Griboval successfully led the first *OceanoScientific Expedition*. Yvan Griboval sailed single-handed for 152 days, 60 days under the 40th South, via the three main continental capes of Good Hope, Leeuwin, and the Cape Horn without creating any CO$_2$ emissions or waste, with an OSC system that he had to maintain while regularly collecting water samples and deployment of an Argo float at 50° South.
The entire energy of the *OceanoScientific Explorer* sailing vessels is provided by hydro generators without any gas-oil.
Data from the 2016-2017 OceanoScientific Expedition

Continuous meteorological and TSG (T/S) data transmitted in real time through the French Met Service, LOCEAN and the Coriolis consortium.

T/S data validated in DM and transmitted to GOSUD (IODE/UNESCO).

Fluorescence of ChlA and a few days of pCO2. At that time pCO2 data could not be validated because the sensor was not efficient.

Water isotopes (water cycle studies) Validated and transmitted to GISS (Goddard Institute data base)
Example of validation: T/S
Providing reliable data with known error bar.

**T**: Combining measurements from the *OSC system* with the keel temperature sensors allowed to correct *OSC System* values from thermal exchange with the boat interior reducing the error bar on the final SST values.

**S**: Water samples are used to estimate and correct instrumental salinity bias

*S*_{\text{final}} \rightarrow +/- 0.025 PSU

*SST*_{\text{final}} \rightarrow +/- 0.04°C
Two upcoming expeditions are scheduled on the same course from Monaco to Monaco via a virtual way-point on the 40th parallel.

The OceanoScientific Southern Summer 2019-2020 Expedition
December - February

The OceanoScientific Southern Winter 2020 Expedition
June - September
To carry out extreme *OceanoScientific Expeditions* you need a yacht capable of sailing fast enough not to be caught up in the really bad weather of the powerful southern depressions.

The new *OceanoScientific Explorer* 33.5m maxi-catamaran will become the most efficient scientific sailboat in the world, and the fastest too.

The entire energy of this *OceanoScientific Explorer* is provided by hydro generators without any gas-oil.
Implementation

**March to October 2019**
The scientific and technical team will work on the choice of instruments and sensors, the strategy of data validation and qualification and the collection of water samples.

**A crew of 7 or 8 members** will be formed, including one scientist, to log sensors data, maintain instrumentation and collect water samples during expeditions.

**December 2019 - February 2020**
*Southern Summer 2019-2020 Expedition* - Monaco to Monaco.

**June - September 2020**
*Southern Winter 2020 Expedition* - Monaco to Monaco.

During both expeditions, near-simultaneous measurements with other elements of the observing systems (research expeditions, instrumented moorings, wave gliders and sail drones, possibly SOCCOM BGC-Argo floats) will be favoured. Contributors to the proposal from various institutions will help for that.

**October 2020**
End of real time data transmission, start of water samples analyses.

**July 2021**
End of water samples analyses and of post expedition calibration of sensors.
Data management 1/2

Data transmission:

Data will be transmitted in near real time to:

- GOSUD (Global Ocean Surface Underway Data) an IODE / UNESCO Project for scientific use.
- Copernicus Marine Environment Service through its in-situ observations component for model validation and assimilation purposes
- Ocean data will be inserted on the GTS either by Ifremer or by Météo-France
- Meteorological data will be inserted on the GTS by Météo-France

After the expedition and / or on a regular basis, the full resolution dataset will be transmitted to the most relevant data centers for final archiving and for a wide distribution and a wide usage. This includes the final calibrated datasets and water samples analyses.
Data management 2/2

**Data qualification:**
Real time data will be quality controlled (automatic QC) and delayed mode datasets will be produced by Ifremer under LOCEAN scientific expertise.

**Data archival:**
The data will be long term safeguarded using the Ifremer facilities.

**Data dissemination:**
Through GOSUD, SOCAT, Copernicus CMEMS, Météo-France.

**Data publication:**
We propose Seanoe.org (Ifremer) as data publishing tool.
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