The OceanoScientific® Programme: Scientific Data Acquisition by Sailing Ships, results from the 2013 and 2014 campaigns
## Contents

- Review of the current platforms for offshore measurements 3
- Geographical coverage - Founding scientific assessment 4
- What about sailing boats? 6
- Creation of an innovative project: the OceanoScientific® Programme 7
- What do we actually measure and collect? 9
- OceanoScientific® Campaign / Bark EUROPA 10
- OceanoScientific® Campaign / NAVOSE® Boogaloo 12
- Upcoming OceanoScientific® Campaigns 21
- Sailing races and associated engineering challenges 23
Current platforms for sea exploration

**Surface Devices:** Moored and drifting buoys

**Sub-surface Devices:** Argo profilers, gliders and XBT’s

**Boats:** Research Vessels, Ships of Opportunity

**Remote sensing:** Oceanographic satellite observations
Geographical Coverage

Data Buoys positions - June 2014

Argo Drifters Float - July 2014

Voluntary Observing Ships Routes - April 2014

Aquarius Satellite SSS Data - June 2014
Scientists lack in situ quality data at the ocean - atmosphere interface on sea routes subject to little traffic, especially around the Antarctica.

This handicaps and slows down the understanding of causes and consequences of climate change / warming.
What about Sailing Boats?

- Enhanced manoeuvrability thanks to their small size
- Guaranteed safety despite high speeds (up to 25 knots)

This makes sailing vessels highly flexible platforms

- Cheaper than a research vessel expedition
- Complement the ocean observation performed by ships of opportunity
- Green platforms using renewable energy sources
Creation of an innovative project

Geographical data gap at high latitudes

Lack of scientific in-situ quality data

Expertise in the sailing field

OceanoScientific® Programme

- Collecting data at the ocean-atmosphere interface on sea routes subject to little or no exploration
- 15 or more-meter sailing yachts as innovative platforms
- Transmitting data free of charge to the scientific community
Innovative scientific programme initiated in 2006

Unprecedented approach studying climate change

Under the authority of UNESCO institutions (WMO and IOC)

With the support of international scientific research institutes

A unique scientific material: the OceanoScientific® System

Recognised results after seven years of R&D (2006 - 2014)
12 physical and chemical parameters logged every 6 seconds:

- $T_{\text{air}}$, $H_{\text{air}}$, $P_{\text{atm}}$, $(\text{Speed, Dir})_{\text{Wind}}$, PAR,
- SSS, SST, SS$CO_2$, Chl a, pH, Turbidity

- Transmission in near real-time, as per one file an hour
- Permanent scientific contact with the shore
- Plug and Play material: extra parameters can be added
Antarctic Campaign 2013 / Bark EUROPA

- Three-master Bark EUROPA
- Ushuaia - Antarctic Peninsula
- Ushuaia - South Shetland Islands
- Weddell Sea - South Georgia
- Tristan da Cunha - Cape Town

In use for 96 days
- Two 19-day sails
- One 52-day sail
Comparisons between in-situ measured data and Arpège Model - Comparison realised by Météo-France

- Sediments trapped in the system: the pump stopped, the water circuit is empty
- No model data to compare to (continental location)
Navire A Voile d’Observation Scientifique de l’Environnement - NAVOSE®

Sensors onboard the NAVOSE® Boogaloo
OSC System modules and sensors onboard the NAVOSE® Boogaloo
Atlantic Campaign 2013 - 2014
NAVOSE® - Boogaloo

North Atlantic and Mediterranean expedition November 2013 to April 2014
Chart LPO - IFREMER
Atlantic Campaign 2013 / NAVOSE®
Sea Surface Temperature & Salinity

Santa Cruz
47° 45'N 07° 01'W
29/11 - 06h13
SST = 13.233
SSS = 35.555

NAVOSE®
Boogaloo
47° 45'N 07° 00'W
30/11 - 07h50
SST = 13.225
SSS = 35.565

Santa Cruz and the NAVOSE® Boogaloo SSS and SST data comparisons at a single crossing point

Colibri
9° 04' N 49° 36'W
13/12 – 00h22
SST = 28.22
SSS = 34.914

NAVOSE®
Boogaloo
9° 04' N 49° 31'W
14/12 – 21h22
SST = 27.97
SSS = 35.101

Colibri and the NAVOSE® Boogaloo SSS and SST data comparisons at a single crossing point

The NAVOSE® Boogaloo, Colibri and Santa Cruz trajectories across the Atlantic
SST and SSS compared to ISAS-13 monthly climatology and annual variance
Atlantic Campaign 2013 / NAVOSE®
Atmospheric data comparisons

### 29/11/2013

<table>
<thead>
<tr>
<th></th>
<th>NAVOSE® Boogaloo</th>
<th>Brittany</th>
<th>Mercator</th>
<th>NAVOSE® Boogaloo</th>
<th>Brittany</th>
<th>Mercator</th>
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<tr>
<td>Pressure (hPa)</td>
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<td>1037,5</td>
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<td>1036,7</td>
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<tr>
<td>SST (° C)</td>
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<td>SSS (PSS)</td>
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<td>Wind Direction (°)</td>
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<td>15</td>
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<tr>
<td>Wind Speed (m.s⁻¹)</td>
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The NAVOSE® Boogaloo data comparisons with the Brittany moored buoy (47°29'N - 8°25'W) and Mercator model output.

### 12/12/2013

<table>
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<tr>
<th></th>
<th>NAVOSE® Boogaloo (Average 14-16h)</th>
<th>Buoy 41734</th>
<th>Mercator</th>
<th>ECMWF Buoy 13009</th>
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<td>Humidity (%)</td>
<td>81%</td>
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<td>82%</td>
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<td>Dew Point (° C)</td>
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<td>SST (° C)</td>
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<td>SST Seabird (° C)</td>
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The NAVOSE® Boogaloo data comparisons with a drifting and a moored buoys and Mercator and ECMWF models output.
Atlantic Campaign 2013 / NAVOSE®
Atmospheric data comparisons

The NAVOSE® Boogaloo - Leg Grenada / Horta
Wind Direction and Speed, Comparisons with ECMWF analysis
Atlantic Campaign 2013 / NAVOSE®
Atmospheric data comparisons

Atmospheric pressure measured onboard the NAVOSE® Boogaloo and compared to the ECMWF values
Atlantic Campaign 2013 / NAVOSE®
Atmospheric data comparisons

Air temperature and humidity measured onboard the NAVOSE® Boogaloo and compared to the ECMWF values
Around the Atlantic / Around the Antarctic

Navigation around the Atlantic during Northern Hemisphere Summer
Around the Antarctic Campaign during Southern Hemisphere Summer

Shore team in liaison with the scientific partners will provide routings based on weather and scientific phenomenon of interest as they arise.

OceanoScientific® Campaigns will sail into these hostile areas every year.
Antarctic Campaigns / NAVOSE® Boogaloo

- OceanoScientific® 2013 - 2014
  A single NAVOSE®: Boogaloo

- OceanoScientific® 2014 - 2015
- Then 2015-16, 2017-18, etc...
  Two NAVOSE®:
  - Scientific data redundancy
  - Enhanced security
The OceanoScientific® Programme targets all the sailing boats entering the next offshore races through the Southern seas: Barcelona, Volvo, Vendée Globe...

Down the Atlantic - through Indian and Pacific Oceans - Up the Atlantic
Current engineering challenges to meet demanding racing requirements

- **Volume and weight reduction** to fit onboard in small compartments
- **Power consumption limitation** to keep fuel volume required down
- **Improved resistance** to shocks and vibrations
- **Enhanced water tightness**
- **More hydrodynamic water intake pipes** not to impact performances
- **More efficient electro-mechanical parts** for a 100% unattended system
Any question?

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