Sailing meets science

Ocean observations during Sailing Races

Dr. Stefan Raimund

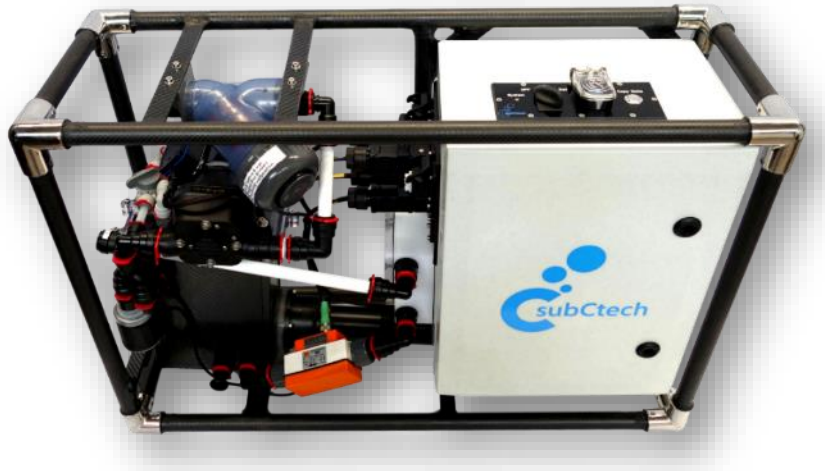
SubCtech – France / Germany

RVTEC Meeting, Fairbanks/Alaska, October 22nd 2019

Introduction SubCtech

SubCtech is a **SME** situated in Kiel (**Germany**) and has **30 years of experience** in the field of **ocean engineering**. Our core business activities comprises **monitoring systems, sensor integration, instrument development** (pCO_2) and **battery systems** for any kind of underwater application. Our typical clients are **research** institutes, universities, environmental agency and the offshore **industry (oil + gas)**.

Our Products: Underway Monitoring Systems (“Ferry Boxes”)



CLASSIC


Photo: Polar Research Institute of China

COMPACT

© awi.de

SPECIAL

© www.aims.gov.au

RACE


© Jean-Marie LIOT/ Boris Herrmann Racing

- **A**utonomous **U**nderway **M**easurement **S**ystems (**autonomy** for up to several month)
- Measuring of all typical parameters of the **ocean surface and the atmosphere**
- **Free choice** of sensors and devices: integration into a powerful sensor array
- Flexible solutions. Fits in a **wide range observation platforms**.

References:

Selected former projects

AWI:

RV Polarstern

- OceanPack™ Compact
- Water-CO_2
- Option: Air-CO_2
- TSG (SSS, SST)

pCO$_2$ Analyzer next generation

University of Cádiz :

RV UCadiz

- OceanPack™
- Water-CO_2
- TSG (SSS, SST)
- Fluorometer
- Optode (DO)
- Automatic cleaning
- Automatic calibration

IPEV / Ifremer:

RV Marion Dufrenese

- OceanPack™
- Option: Air-CO_2
- Option: Water-CO_2
- TSG (SSS, SST)
- Optode (DO)
- Automatic cleaning

CERC.OCEAN / Dalhousie University :

Here: @ RV Celtic Explorer

- OceanPack™ Compact
- Water-CO_2
- TSG (SSS, SST)
- Fluorimeter
- Optode (DO)
- Automatic calibration

Ongoing Projects:

Australia's next-generation Icebreaker (2019)

Parameter & Sensors

- OceanPack™
- Air-CO_2
- Water-CO_2
- SeaFET (pH)
- LISST 200x (particles)
- Fluorometer (div)
- PhytoFlash
- TSG (SSS, SST)
- Optode (DO)
- Water sampler
- Automatic cleaning
- Automatic calibration

Ongoing Projects:

China next-generation Icebreaker (2019)

Xuelong 2 (Snow Dragon 2)

Parameter & Sensors

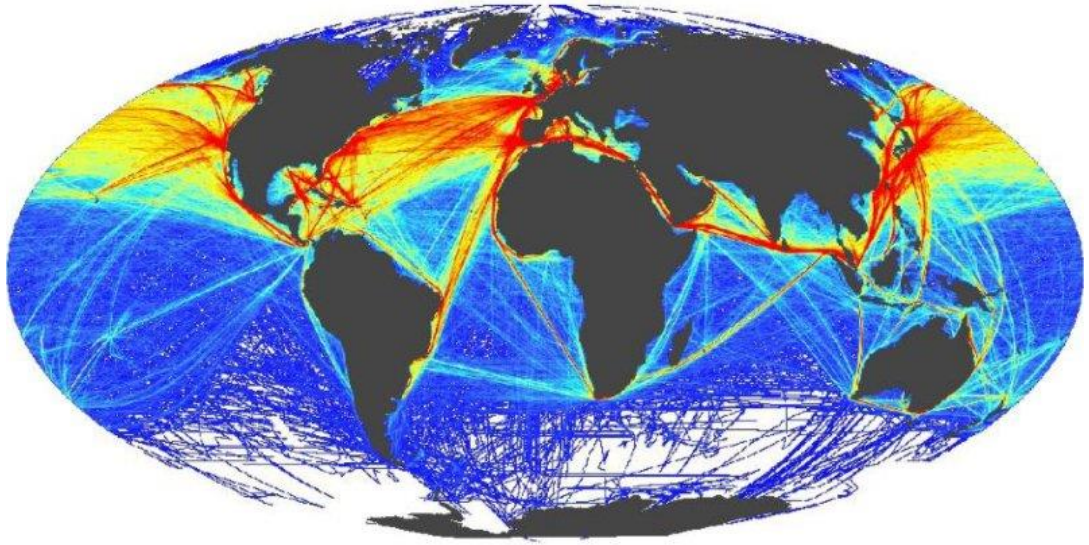
- OceanPack™
- Water-CO_2 CRDS
- SeaFET (pH)
- LISST 200x (particles)
- Fluorometer (div)
- TSG (SSS, SST)
- Optode (DO)
- Nutrient analyzer
- Automatic cleaning
- Automatic calibration

Polar Research Institute of China · 1989 ·

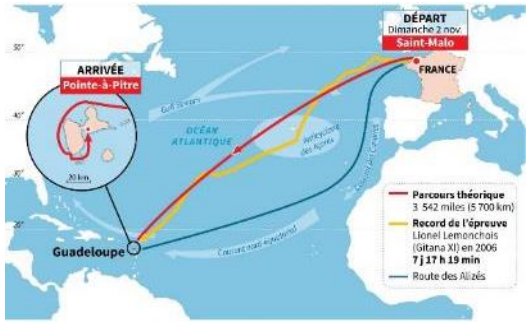
江南造船（集团）有限责任公司
Jiangnan Shipyard(Group) Co.,Ltd

Why to deploy scientific instruments on sailing yachts?

Vendée Globe
(IMOCA60)



Barcelona Ocean Race
(IMOCA60)



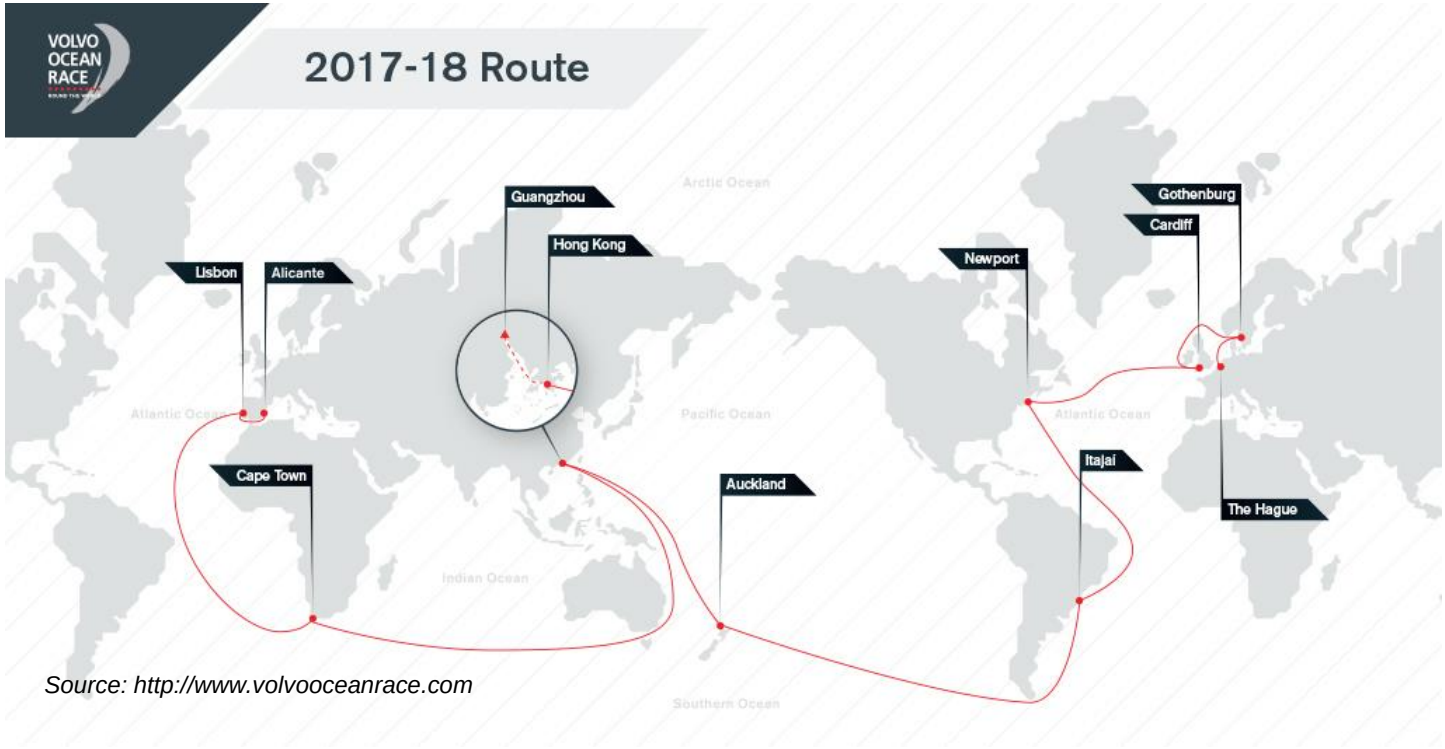
Route du Rhum
(IMOCA60)

Volvo Ocean Race
(VO.65)

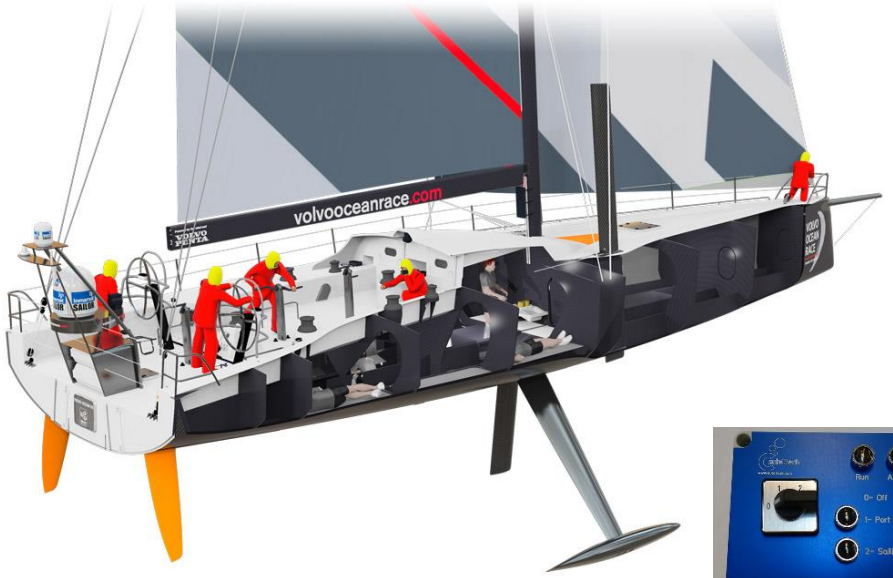
Transat Jacques Vabre
(IMOCA60)

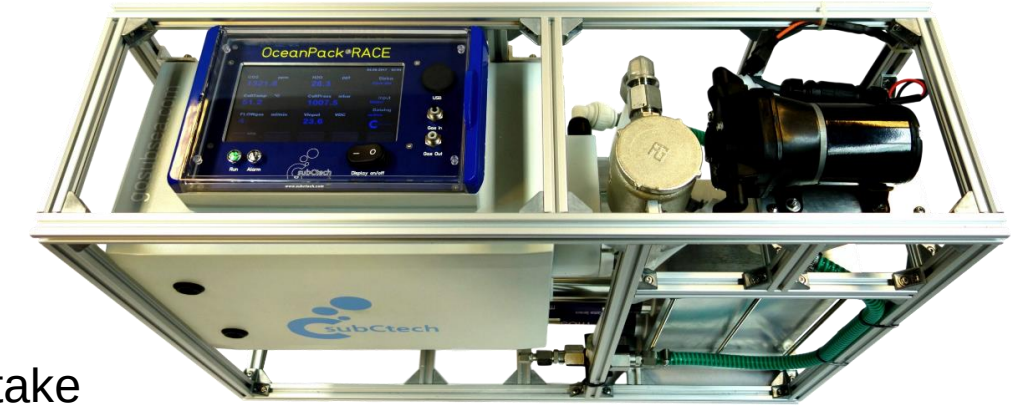
- Data from remote locations. Ship time is already paid.
- Combination Science/Sport: visible for public & political decision makers.

Going fast: Technical Challenges



Source: http://www.volvooceanrace.com

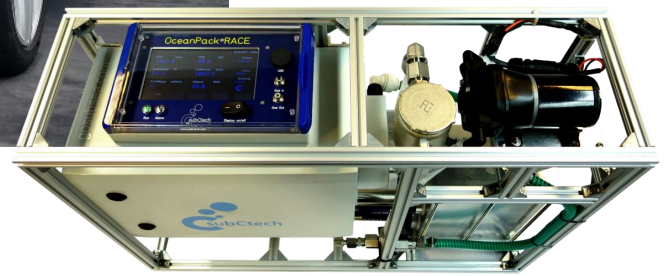




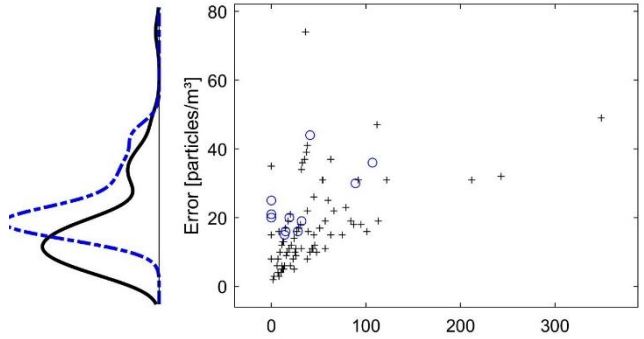
- High boat speed (up to 25 knots over 24h)
- Extreme conditions: sailing the Southern Ocean
- Easy operation. Untrained staff.
- No maintenance for several weeks
- Very unstable power supply

➢ Limitations: Weight, sizes, power demand, complicated water intake

Partners and Sponsors



€100 / V90 Cross Country Volvo Ocean Race by **Volvo Cars**



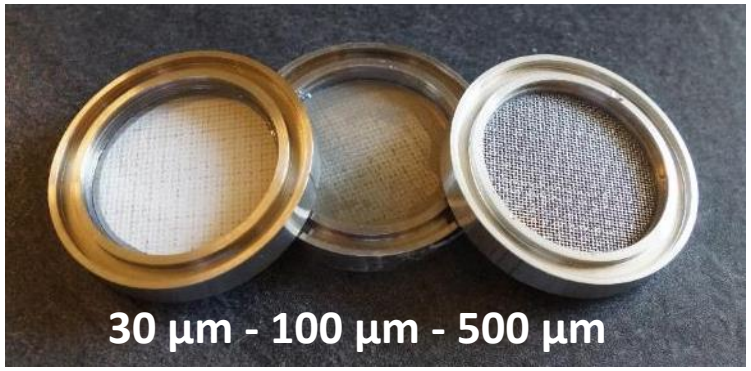
>100k€ for the project (mainly manpower) by **Futur Ocean**

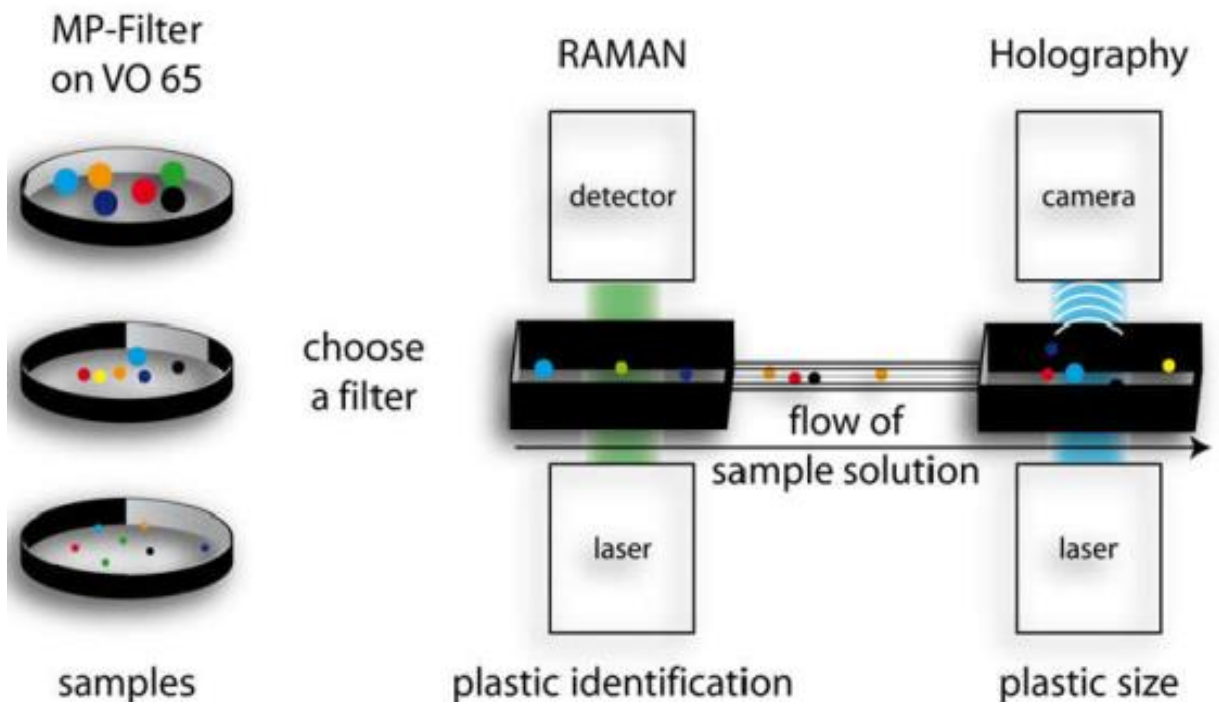
The Science Program on VOR

- Routing of **Meteorological Data**
- Deployment of **Surface Drifters**
- **Insitu measurements** of **pCO_2**, Sal, Temp and Chl *a*
- Sampling of **Marine Plastics**

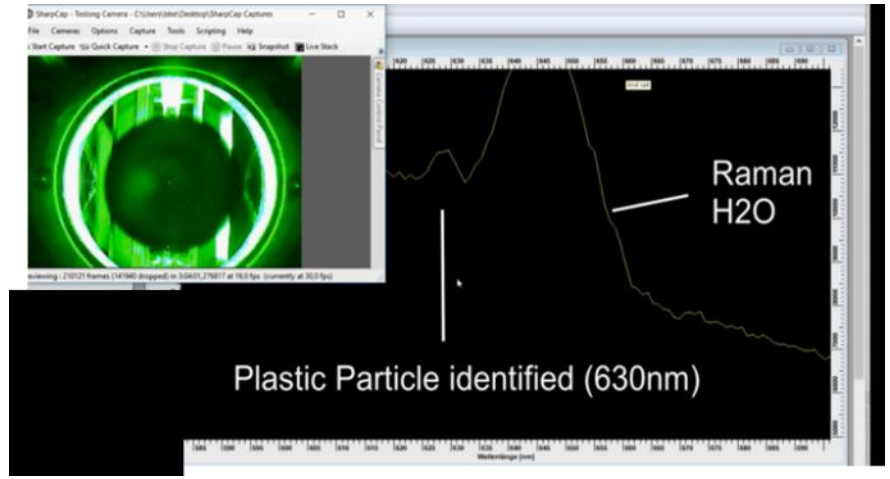
Microplastic:

Filtration -> Transport -> Extraction -> Analysis

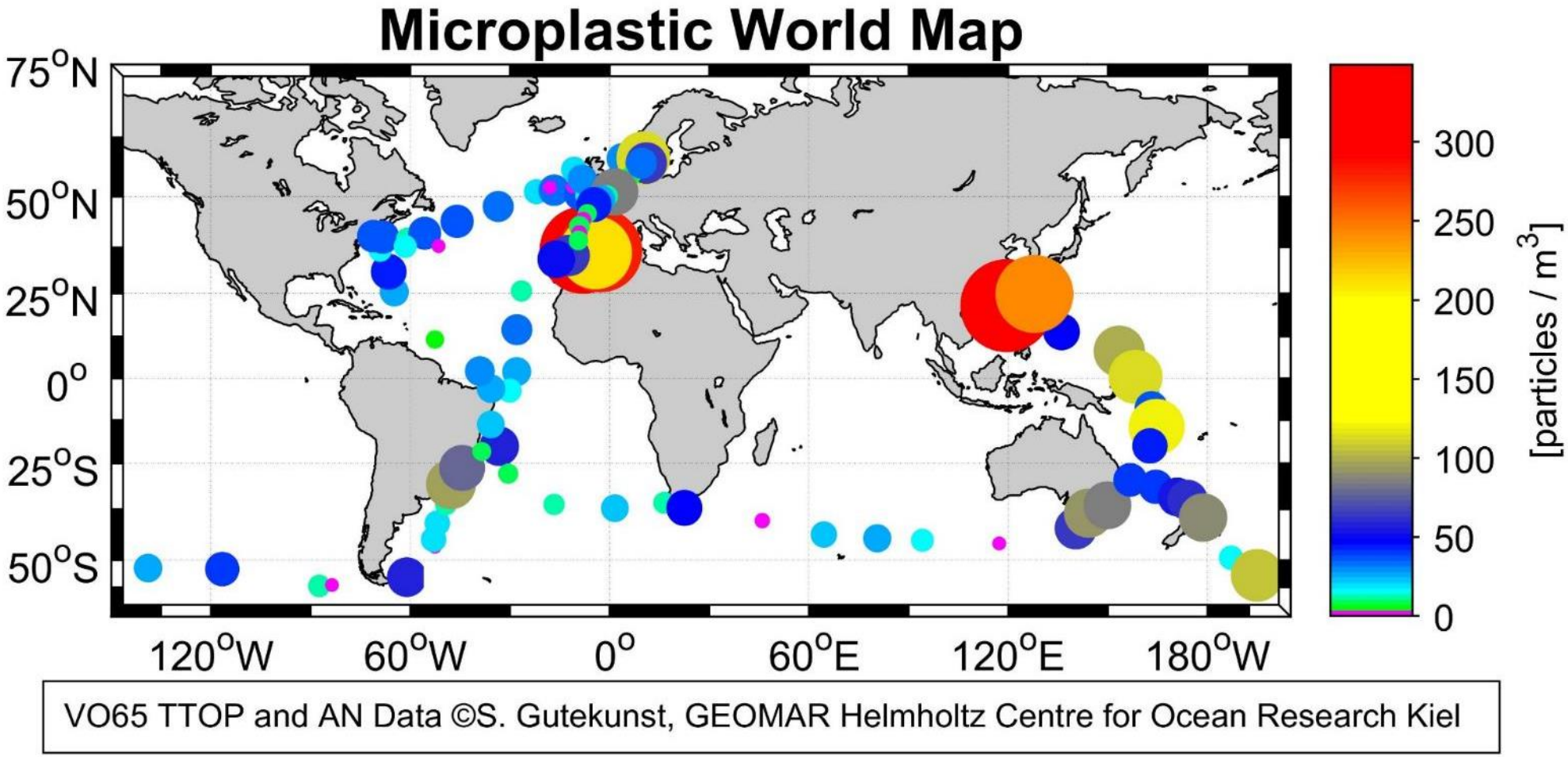




- State-of-the-art instrument
- Every 2nd day filter change
- Recording: flow, volume, sampling time
- Particles <5mm
- Lab analysis conducted by GEOMAR, Kiel

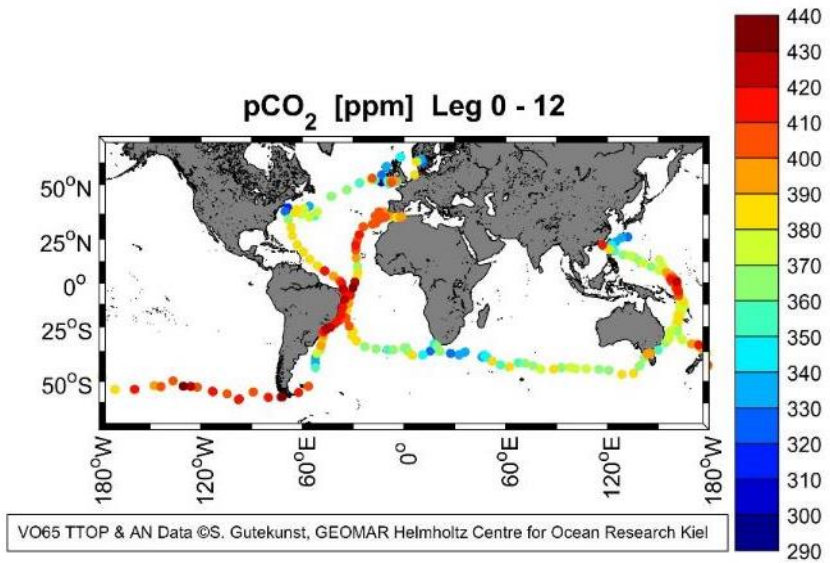


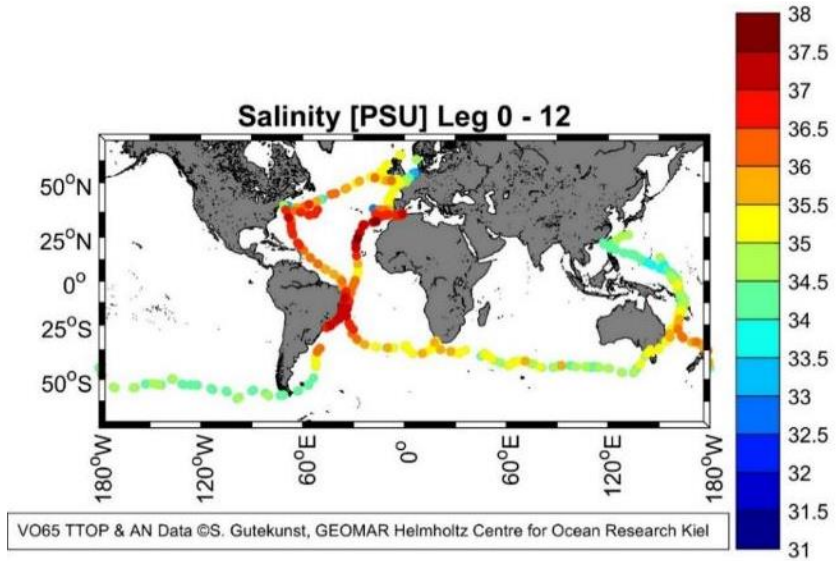
Microplastic World map: It is everywhere!

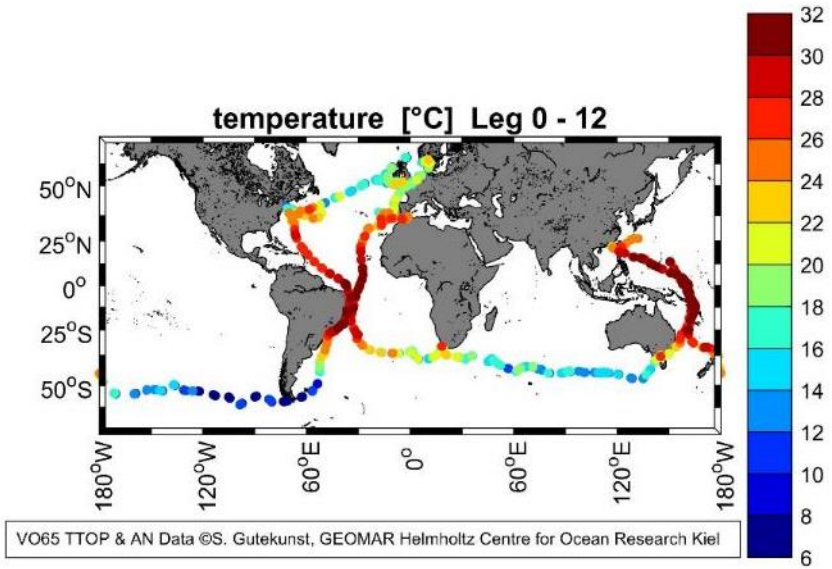


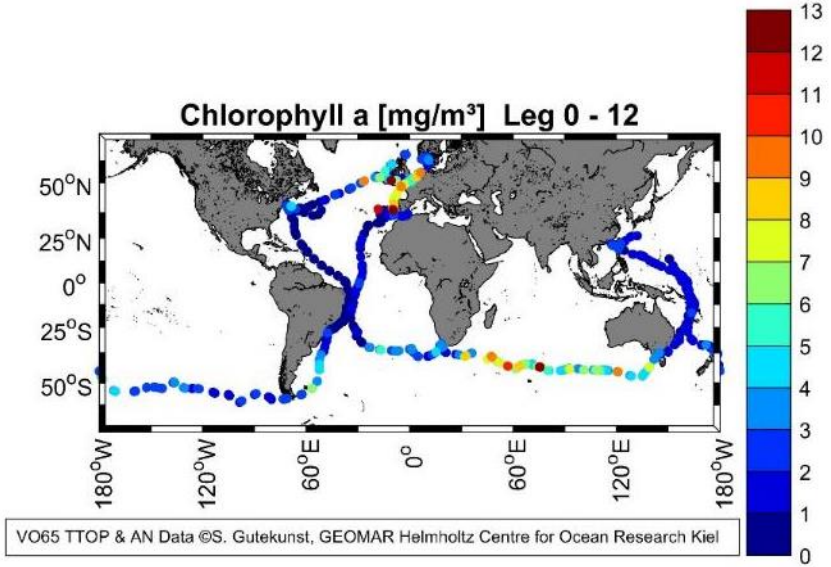
- VOR sampling: subsurface
- >230 samples @ >90 locations
- size and colour of these dots refers to the particles per cubic meter

In situ measurements: pCO_2 , SSS, SST, Chl *a*









- “Turn the tide on Plastic”: since leg 0
- “AkzoNobel”: since leg 7
- Measurements 2x per day for 1h
- TSG: Idronaut Ocean Seven (Sea Surface Temperature, Sea Surface Salinity)
- Fluorimeter: TriOS nanoFlu (Optical proxy for phytoplankton biomass)
- Database NOAA NCEI: gov.noaa.nodc:0170967
- SOCAT database for pCO2

The OceanPack System: Proven in harsh conditions

2009

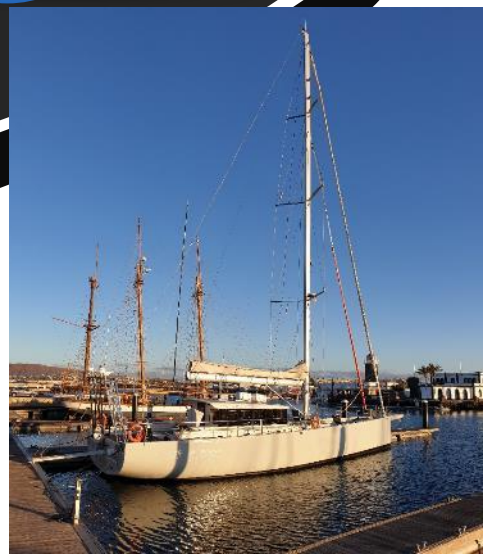
Start Product Development

2017-2018

Volvo Ocean Race

2018 …

RSY Eugen Seibold



2018-2021

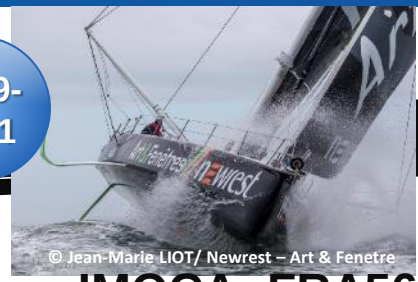
IMOCA: Malizia

2019-2020

Iodysséus

2019-2021

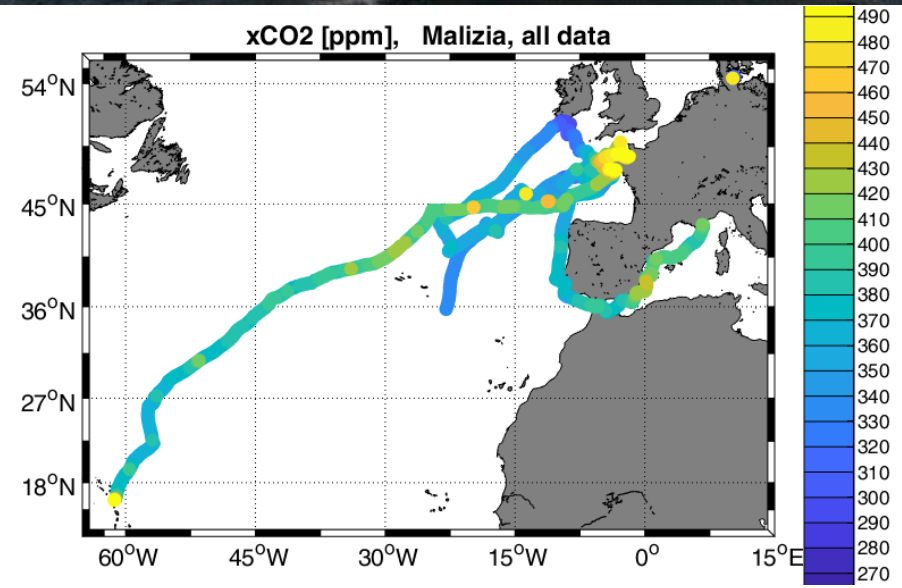
IMOCA: FRA56



Current projects: IMOCA 60, Team Malizia / Boris Herrmann Racing

pCO2: Peter Landschützer, MPI-M Hamburg

Source: Boris Herrmann Racing



Thunberg to sail to climate talks

Swedish activist *Greta Thunberg*, 16, who refuses to fly because of the environmental impact of air travel, will cross the Atlantic in a zero-carbon vessel to attend two key summits on global warming

Thunberg accepted offer from *Team Malizia* to sail from UK to New York aboard racing yacht. Crew could face hurricanes en route

Sep 23: New York UN Climate Action summit

Dec 2: Santiago Climate Change Conference, Chile

Thunberg, taking year off school to campaign against climate change, will tour U.S., Canada and Mexico before taking low-carbon transport to Santiago

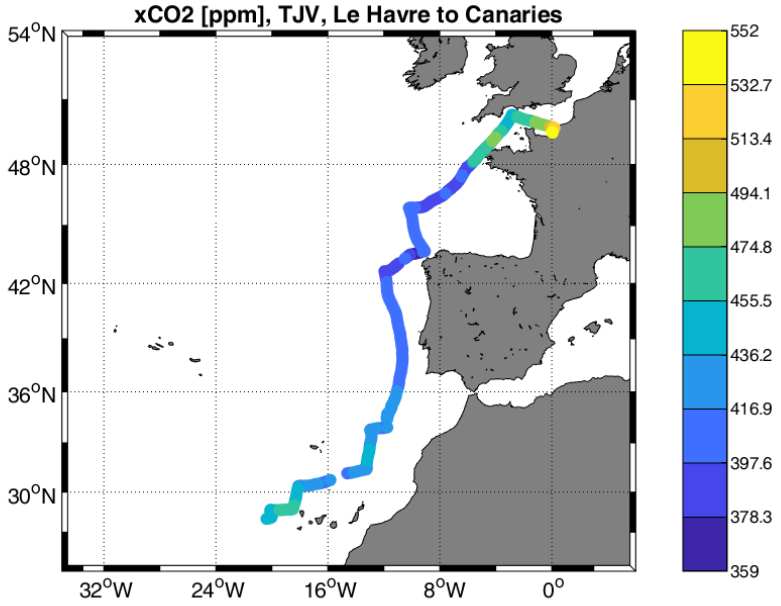
Malizia II: *18m yacht generates electricity through solar panels and underwater turbines*

*Thunberg accompanied by captain **Boris Herrmann**, Team Malizia co-founder **Pierre Casiraghi**, her father **Svante**, and Swedish documentary maker*

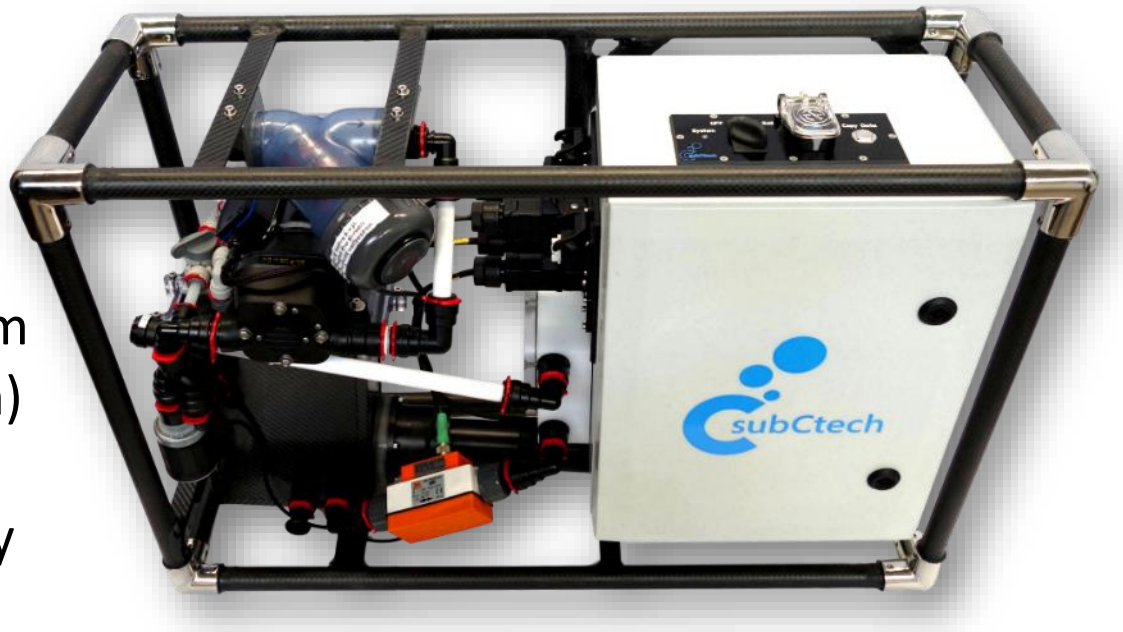
Pictures: Andreas Lindahr, Getty Images

Current projects: IMOCA 60, Team Newrest / Fabrice Amedeo

pCO2, SST, SSS, bio-optics, micro plastics



- Carbon frame
- Self priming pump
- Auto-calibration
- 16.2 kg (35.6 lbs)
- 733 x 500 x 250 mm (28.9 x 19.7 x 9.5in)
- <30W (24VDC)
- Optional telemetry



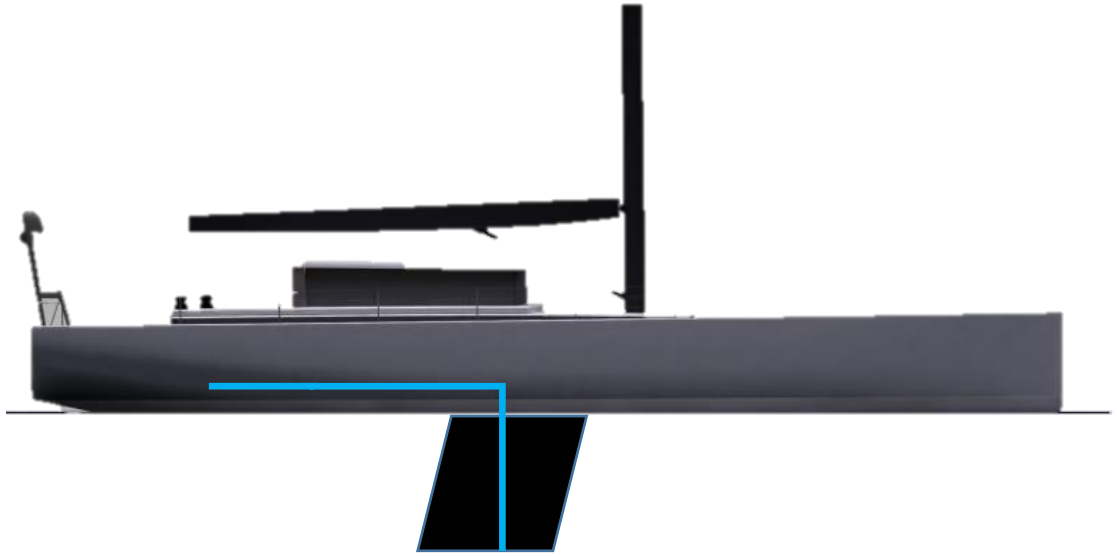
Source: newrest.eu

Source: transatjacquesvabre.org

Source: vendeeglobe.org

Current projects: Max Planck Institute for Chemistry, RSY Eugen Seibold

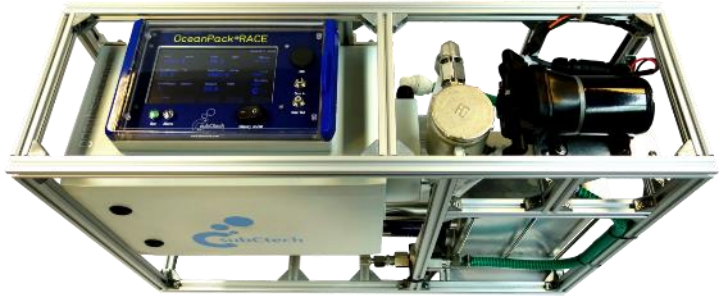
Microfossil proxy calibration in paleoceanography and paleoclimate



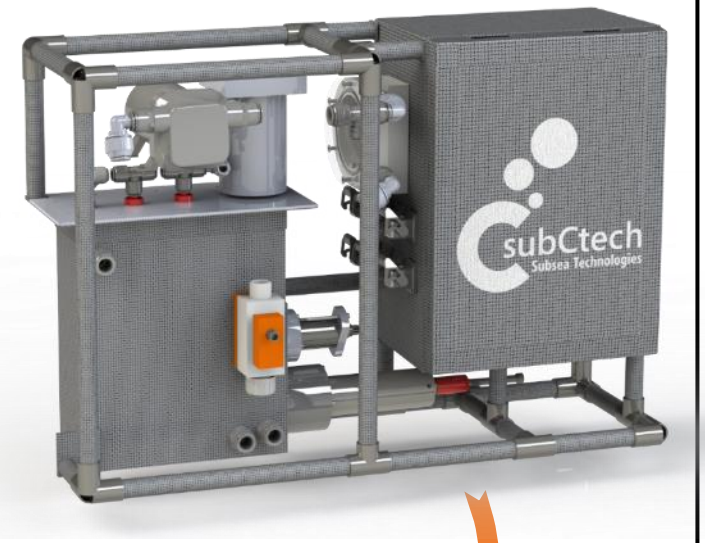
- Sailing the North Atlantic
- Integration of a complex sensor array: MK2 pCO2 analyzer, SBE45, Seabird EcoTriplet, Aanderaa 4835, LISST 200, TriOS OPUS, Seapoint Turbidity, Trios EnviroFlu
- External sensors: SoundNine SST, LICOR PAR, GPS
- Water supply for external sensors: Chelsea FRRF, CytoSense FCM, Deltaray IRIS, miniRUEDI mass spectrometer

Technology transfer: Continuous development for “Sailing meets Science” (from standard products and back to standard)

3th generation mobile underway system



5th generation mobile underway system for the Volvo Ocean Race

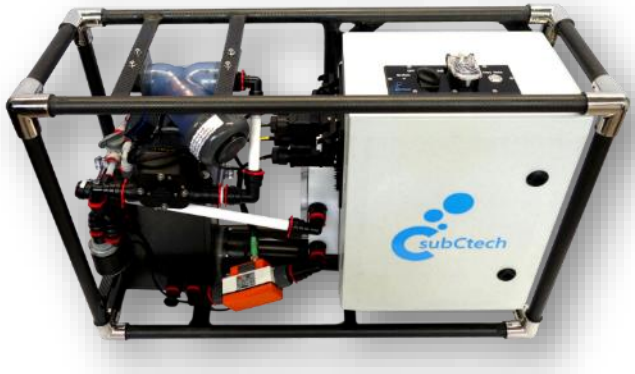


Compact system (developed 2011)

The “Cube” (developed 2018)

Conclusion

- **User-friendly technology:** the system can be controlled by few physical switches and an **intuitive touch control**. Our devises can be operated also by untrained personal.
- **Reliable technology:** 30 years of experience in ocean engineering. 10 years of experience in multiple "**Sailing meets science**" projects. The industrial ARM processor guarantees a stable computer environment and highest performance at the same time.
- **Flexible solutions:** we integrate nearly all kind of devices and sensors into a powerful array. We offer different (and flexible) form factors.
- **Portability**: Our **size and weight optimized** "CUBE" and "RACE" lines guaranty highest degree of portability.
- **On site service**: we can offer flexible and comprehensive service solution world wide.



subCtech

Thank you!

www.geomar.de/en/research/fb2

www.borisherrmannracing.com

www.reportersdularge.com/

www.volvooceanrace.com

www.theoceanrace.com

www.mpimet.mpg.de

www.iodysseus.org

www.subctech.com

Sailing Meets Science – Malizia Project

SubCtech
Subsea Technologies

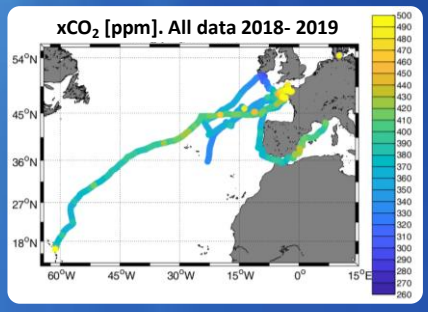
OceanPack RACE©

SubCtech has an unbeaten track record with its “Sailing meets science” concept: ultra-compact and robust scientific instruments, developed to deploy on racing yachts for a deeper investigation of ocean health.

At the beginning of August 2018 one of these very unique scientific instruments started operating on the sailing yacht “Malizia II” with the aim to measure the partial pressure of carbon dioxide (pCO_2) around the globe over the next 4 years - a scientific project which has partnered with Dr Peter Landschützer, a leading scientist from „The Ocean in the Earth System“ department at the Max Planck Institute for Meteorology, Germany. Together, with colleagues from GEOMAR Helmholtz Centre for Ocean Research in Kiel, the “Malizia campaign” is aimed at providing highly relevant scientific data over 4 years whilst racing 70.000 nautical miles offshore, this includes transatlantic as well as round-the-world races, the most prominent being the Vendée Globe 2020/2021 and the Ocean Race 2021. “This data will be made available to the scientific community, but it will also be a valuable asset for my own data-based research”, Peter Landschützer adds. He hopes for new insights regarding the exchange of CO_2 between the ocean and the atmosphere and the processes driving the exchange.

© Jean-Marie LIOT/ Boris Herrmann Racing

“Measurements of the ocean CO_2 content are essential to understanding the ocean carbon cycle” says Peter Landschützer. Estimates based on data from shipboard measurements suggest that the world's oceans absorb roughly 25% of the annually emitted human carbon dioxide (CO_2) and thereby help to mitigate the effect of global warming. In the process of absorbing CO_2, the ocean is becoming acidified with significant effects for marine life. Due to the vastness of the ocean and the high cost of sampling, most ocean regions, despite their crucial roles in the Earth’s climate system, are still under-sampled.



The United Nations 21st conference of parties (COP21) in Paris has set out the goal to reduce greenhouse gas emissions in order to limit global warming to 2°C, and the UN Sustainable Development goals call for limiting ocean acidification. Both mandates call for increased knowledge about the ocean carbon cycle. There is a need for novel observing systems that overcome the limitations of the currently existing observing networks. One very promising way is to combine sail racing events with scientific data collection. This is what the Malizia campaign, initiated by Boris Herrmann and Pierre Casiraghi, is set out to achieve. „The vast majority of the Earth is covered by oceans, but we still lack observations in essential regions such as the Southern Ocean”, Peter Landschützer adds. With the high-tech racing yacht „Malizia II“ it will be possible to receive data from these far reaches.

OceanPack™ CUBE

“We are happy to be part of this exiting adventure and will support this ambitious project with our know-how and passion for our blue planet” says Stefan Marx, CEO of SubCtech.

Source: www.mpimet.mpg.de

* This project is also supported by The Yacht Club de Monaco and The Prince Albert II of Monaco Foundation

Malizia
OCEAN CHALLENGE

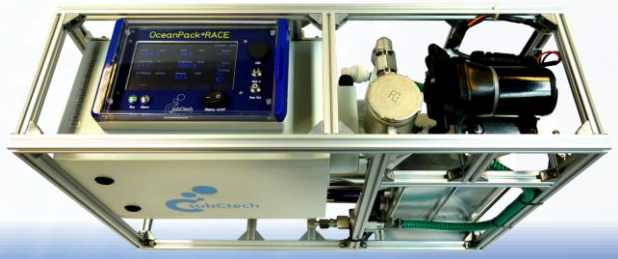
www.subctech.com

www.borisherrmannracing.com

What can you do for the ocean?

Sailing Meets Science – Malizia Project

SubCtech
Subsea Technologies

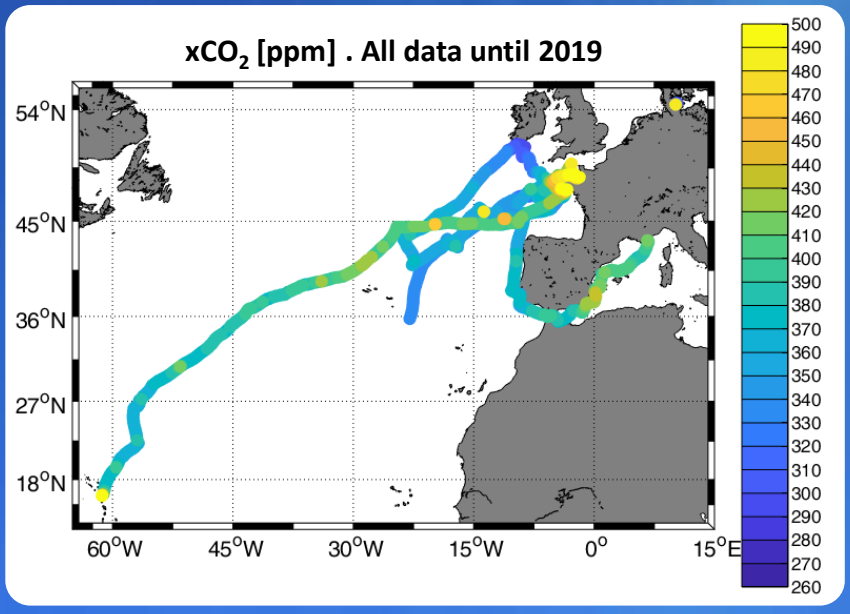


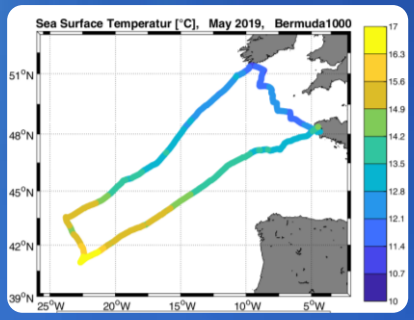
OceanPack RACE©

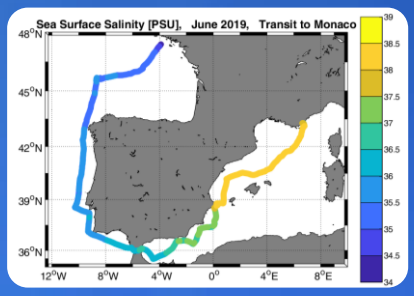
© Jean-Marie LIOT/ Boris Herrmann Racing

Facts at a glance:

- ❑ 60 ft racing boat (IMOCA)
- ❑ 70,000 nautical miles
- ❑ Offshore and inshore races
- ❑ 2018-21: autonomous data acquisition with high precision scientific sensors
- ❑ Cooperation with 3 leading research institutes
- ❑ Open access data storage







Malizia
OCEAN CHALLENGE

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What can you do for the ocean?