Calling all stations:
using compact ocean monitoring systems
to turn (almost) any boat into a research vessel

Nuno Nunes, Jana Fahning, Stefan Marx
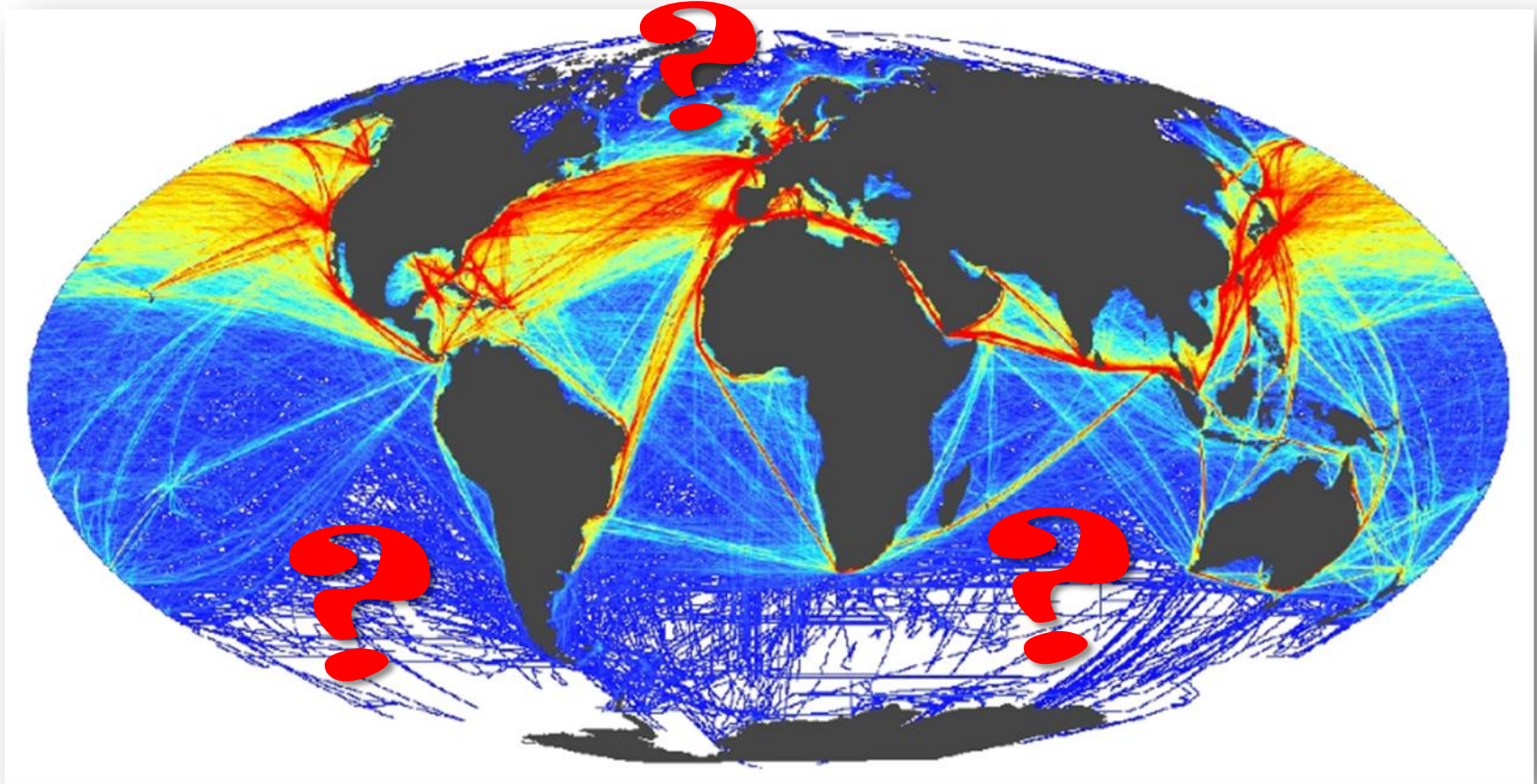
EOOS Technology Forum, 23 March 2022

- We need data to understand ocean and climate processes, but...
  all oceanographic data ever recorded (excluding satellite data)
  Source: Boris Kelly-Gerreyn; NOC, EuroGOOS FerryBox Meeting, Goteborg 16-17 March 2010
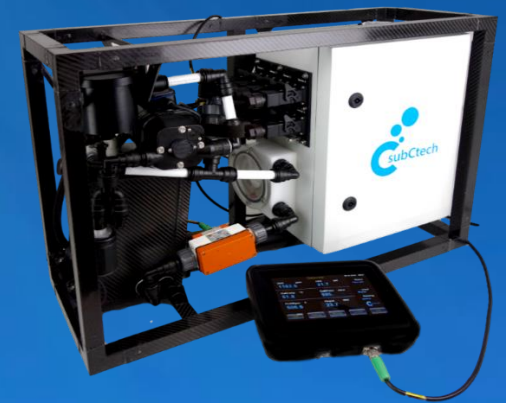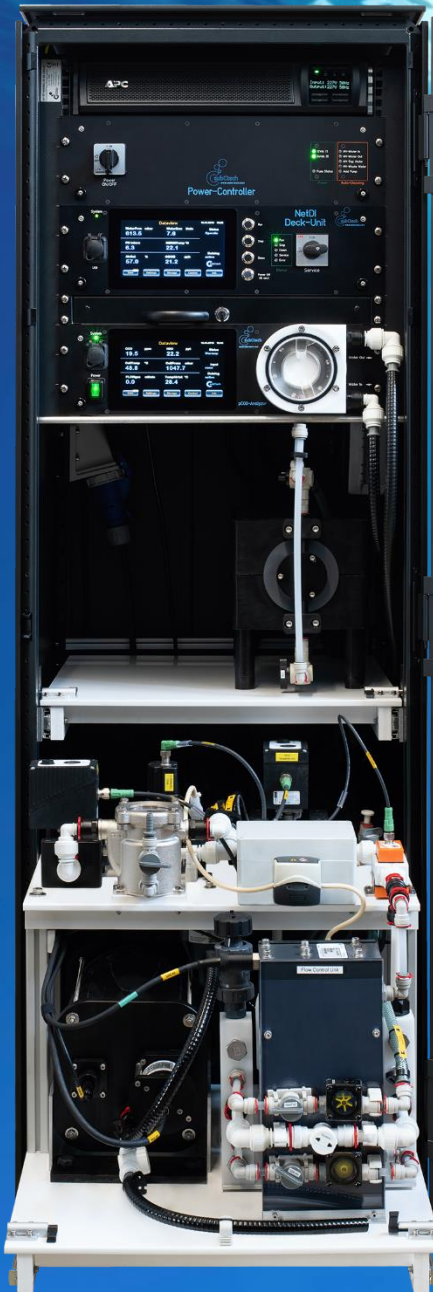

- Data coverage is good in some regions, but large areas are still unknown.
  ⇨ effects on energy transport/climate models & predictions, etc.

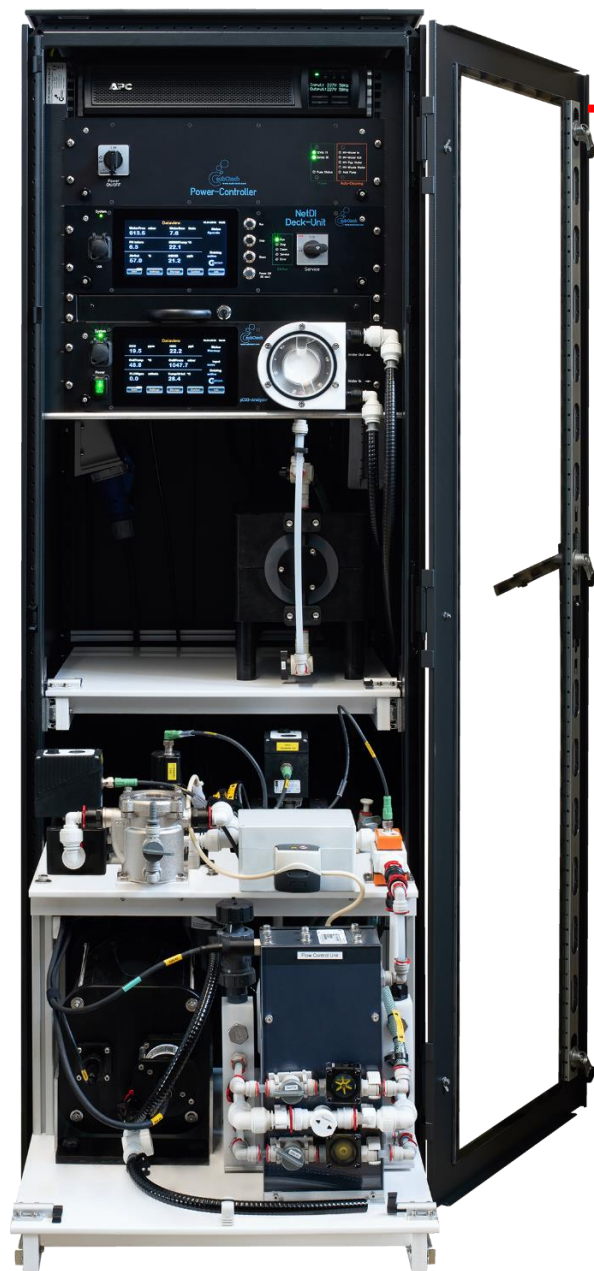# OceanPack™

Ocean Monitoring Systems

Autonomous

Industrial

RSV Nuyina, © AAD/Flying Focus

Simplified

Standardized

Main Rack

- Power controller / UPS
- NetDI Deck Unit:
  controller, data logger and data interface
- *p*CO$_2$ Analyzer
  with auto-calibration
- Sensor integration: debubbler / bypass
- Automatic cleaning

Nutrients Rack

- RO water tank
- Systea Nutrient Analyzer
- Cool storage for reagents
- Automatic cleaning
- Water supply and data: integrated with main rack or stand-alone

Parameter & Sensors

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

DAMEN

EMS

Australian Government
Department of the Environment and Energy
Australian Antarctic Division

© CGTN

Parameter & Sensors

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

OceanPack Rack

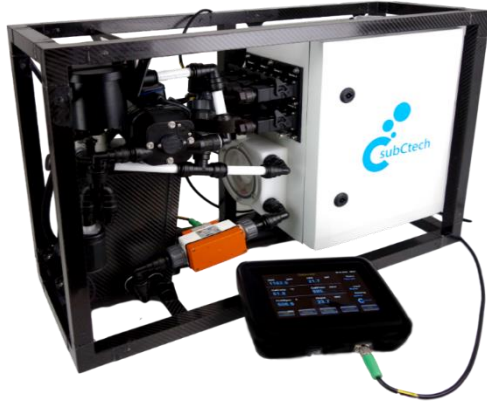Ship Water Sampler

Laser Spectrometer

Display

Polar Research Institute of China · 1989 ·

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

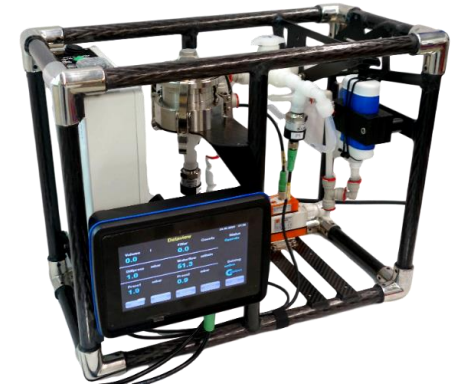© BorisHerrmannRacing, Photo Jean-Marie Liot/Malizia 2020

OceanPack™ RACE® 6th generation
autonomous monitoring system for greenhouse gases (CO$_2$), temperature, salinity, algae etc.

© BorisHerrmannRacing, Photo Jean-Marie Liot/Malizia 2020

© Fabrice Amédéo, Kapitän der Newrest - Art & Fenêtres, Photo Pierre Bouras #VG2020

"An unprecedented circumnavigation of high quality CO$_2$ data in 80 days. I think this has never been done before. That is a great testimony to the instrument that it survived a very bumpy ride!"
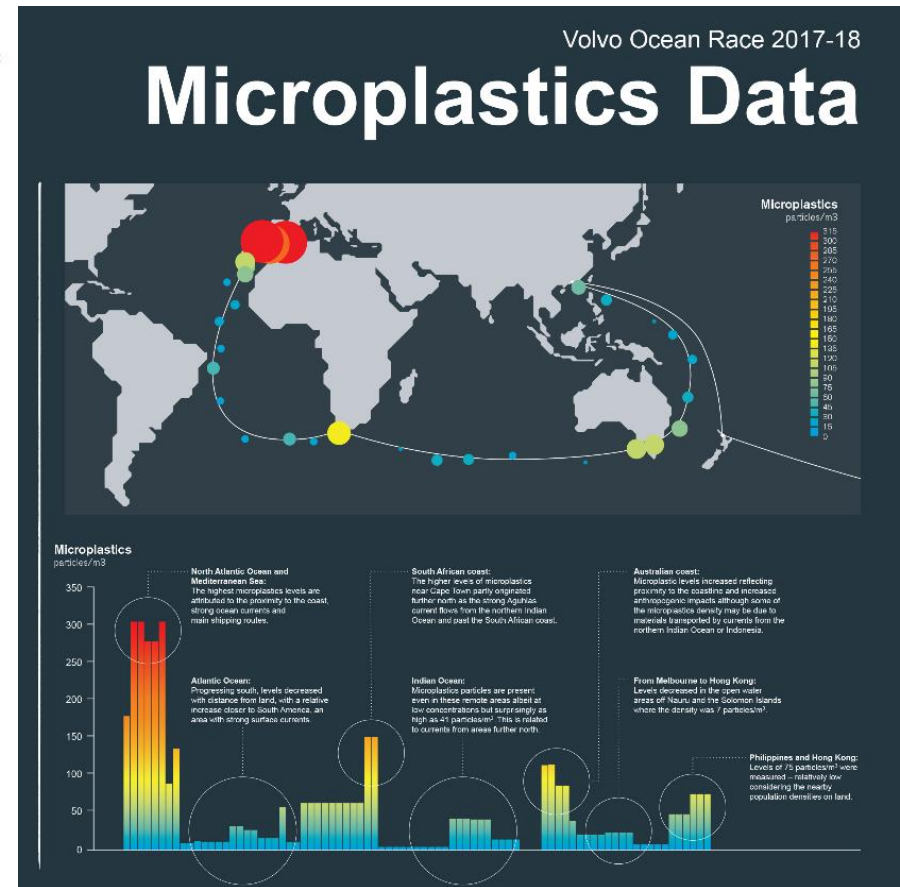Toste Tanhua, GEOMAR
Feb. 2021

RACE® Microplastics Sampler
flow-through

RACE® Microplastics Sampler
for autonomous operation
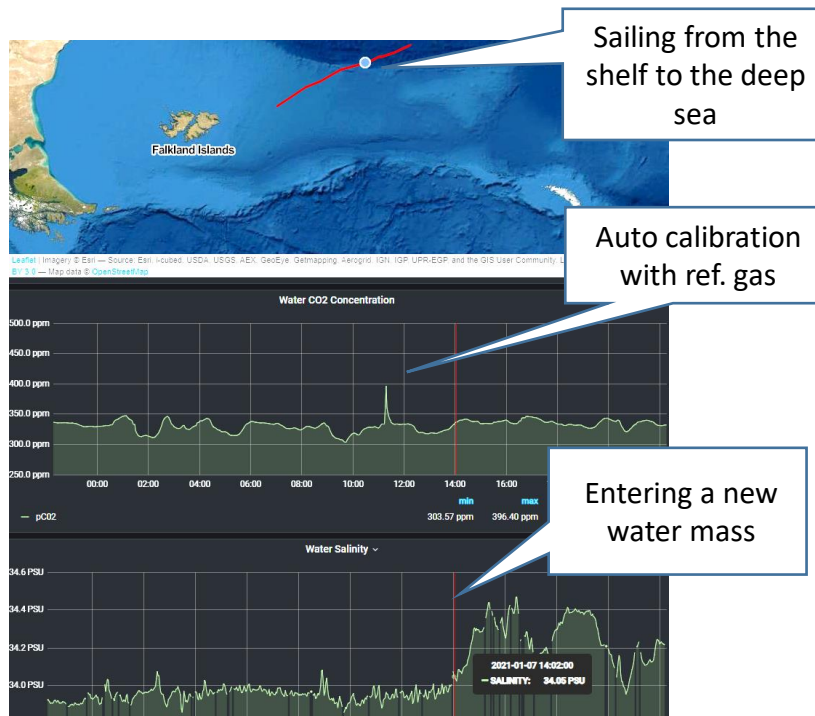
80 days 24/7, round the world:
- ➤ **not a single record is missing**
- ➤ **no errors**

RAW and **SOCAT** data by MPIM (Peter Landschützer) and GEOMAR (Toste Tanhua), Team Malizia - Seaexplorer –
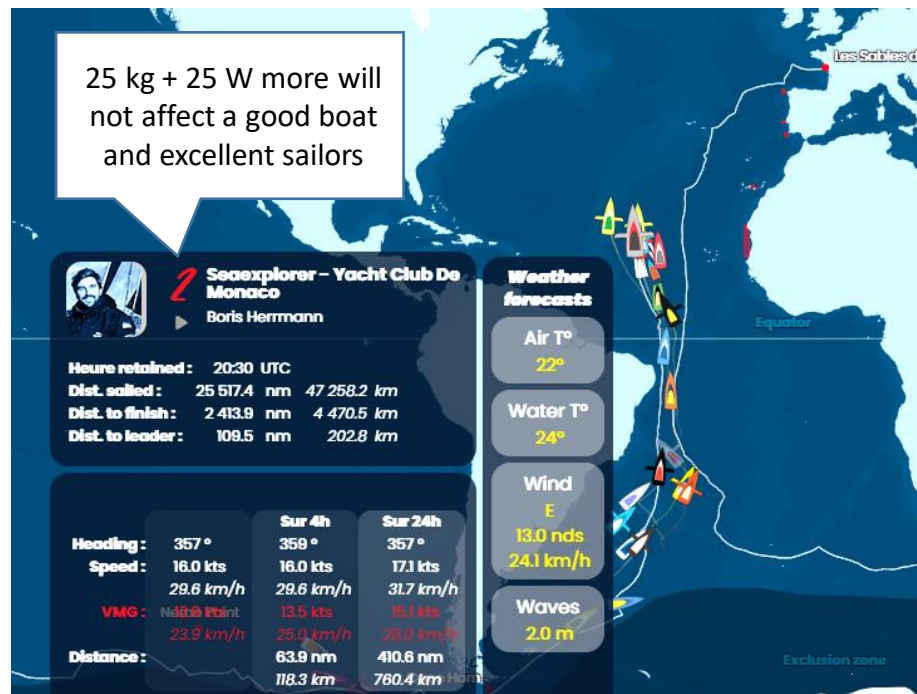Yacht Club de Monaco" Vendée Globe 2020/21.

Micro-Plastic data by GEOMAR (Toste Tanhua, Sören Gutekunst), © Image Volvo Ocean Race, "Turn the Tide on Plastic", Volvo Ocean Race 2017/18.

"A new era of sailing for science is beginning, with support for vital ocean observations from the high-profile round-the-world Vendée Globe yacht race."
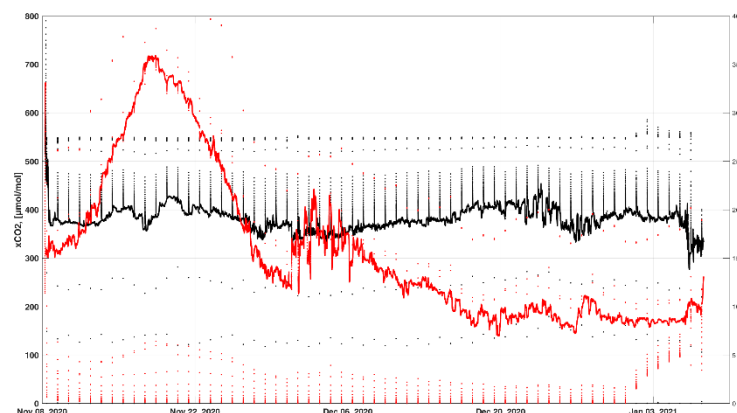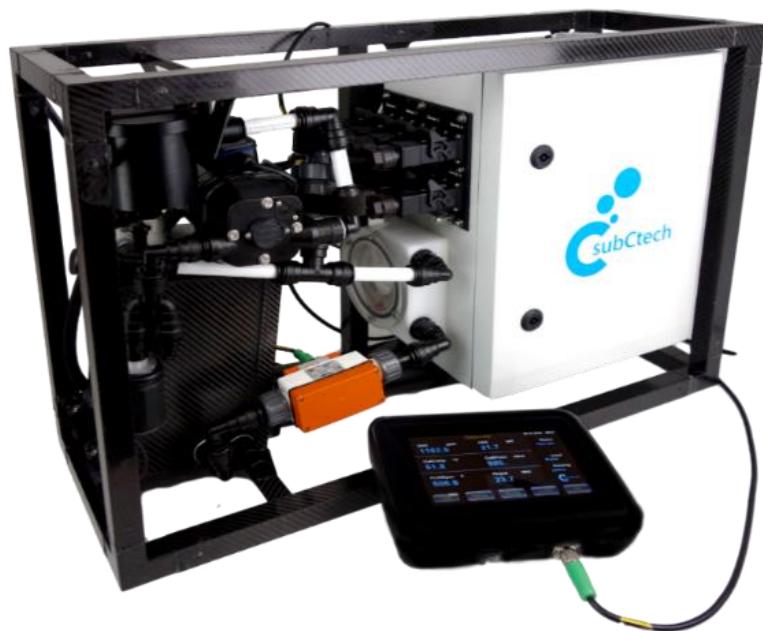
News from **WMO -** Sailing for Science |
World Meteorological Organization (wmo.int)

Open Data

Sailing from the shelf to the deep sea

Auto calibration with ref. gas

Entering a new water mass

25 kg + 25 W more will not affect a good boat and excellent sailors

All screenshots © BorisHerrmannRacing

- ■ Real-time telemetry to the dashboard
- ■ **Raw data!** No hidden gaps or peaks
- ■ Public dashboard. Everyone sees everything
- ■ Open data access directly to climate models
- ■ Interesting. Transparent. Open.

All 80 days raw data incl. calibration

© Photo Volvo Ocean Race

OceanPack™ RACE® 6th generation

- Maintenance free and simple to use
- NMEA-0183 data recording
- State-of-the-art LI-COR® gas analyser
- Automatic calibration
- Proven track record since 2009

- Operating at ±30° roll, high speed
- Low-power 25W to 75W
- Compact and lightweight
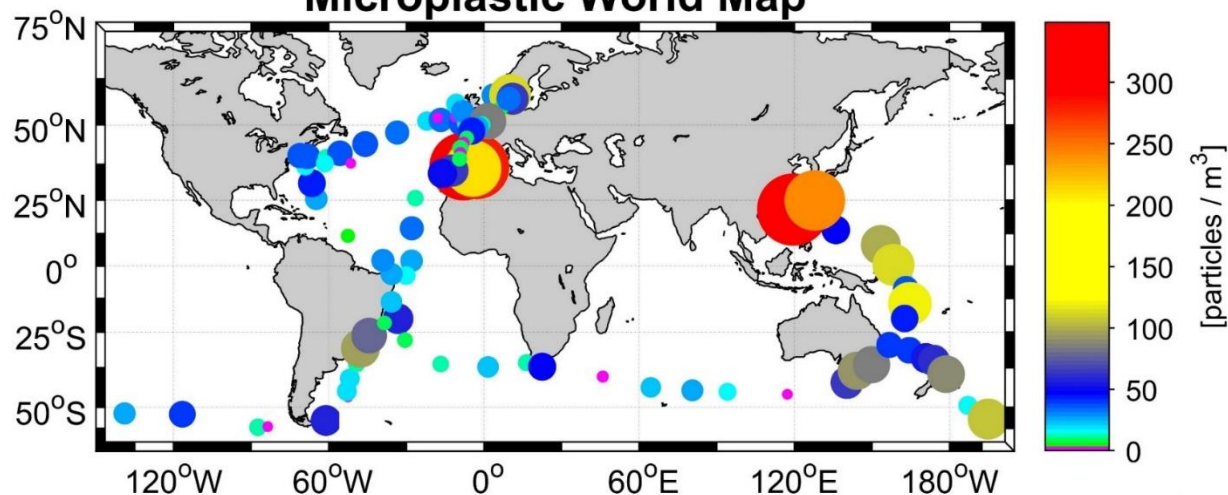- Modular and expandable
- Real-time telemetry

© Jean-Marie Liot / Newrest – Art & Fenetres. 2020

Microplastic World Map

VO65 TTOP and AN Data ©S. Gutekunst, GEOMAR Helmholtz Centre for Ocean Research Kiel

- Subsurface sampling
- >230 samples
- >90 locations
- Size and colour of these dots refers to the particles per m³ (1000 L)

- Mobile OceanPack™ solution for smaller / charter vessels
- Ruggedised; robust flight case
- Simple installation: Plug & Play

- *p*CO2 Analyzer *with auto-calibration*
- Sensor integration: debubbler / bypass
- External sensors: benchtop, meteo, etc.
- Automatic cleaning

© Kaarel Kruusmägi
MarineTraffic.com
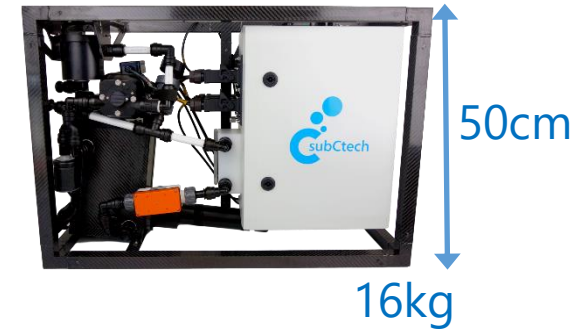
RACK

2m

200kg

CUBE

1m

50kg

RACE

50cm

16kg

RSV Nuyina, © AAD/Flying Focus

UCadiz © Uni Cadiz

© BorisHerrmannRacing

A RACE WE MUST WIN
CLIMATE ACTION NOW!

- **A**utonomous **U**nderway **M**easurement **S**ystems (autonomy for several months)
- Measuring of all typical parameters of the ocean surface and meteorology
- Latest sensors: highest precision and accuracy
- Automatic: water supply, calibration, cleaning, diagnosis, processing, recording, transmission

OceanPack™

Ocean

Monitoring

Systems

subCtech