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EMBRC EUROPEAN MARINE BIOLOGICAL RESOURCE CENTRE

Likely developments for exploring ocean territories

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MarineBiotech

Roadmap Launch & Stakeholder Meeting
12-14 October 2016
Hotel Marivaux, Brussels

Technological developments of the exploration toolkit depend on :

- What scientists wish to explore,
- What society wants them to explore,
- What society is willing to pay,
- **What is already available**

How to move on?

Coastal research: marine stations

Providing the toolkit, research, knowledge, and access provision to respond to the MarineBiotech roadmap:

access to:

- Marine ecosystems from shore-based stations,
- Coastal research vessels, ROVs, buoys, scientific diving, and animal borne sensors,
- Experimental facilities,
- Biological resources,
- Major equipment,
- Data sets and time series,
- Hosting and teaching facilities,

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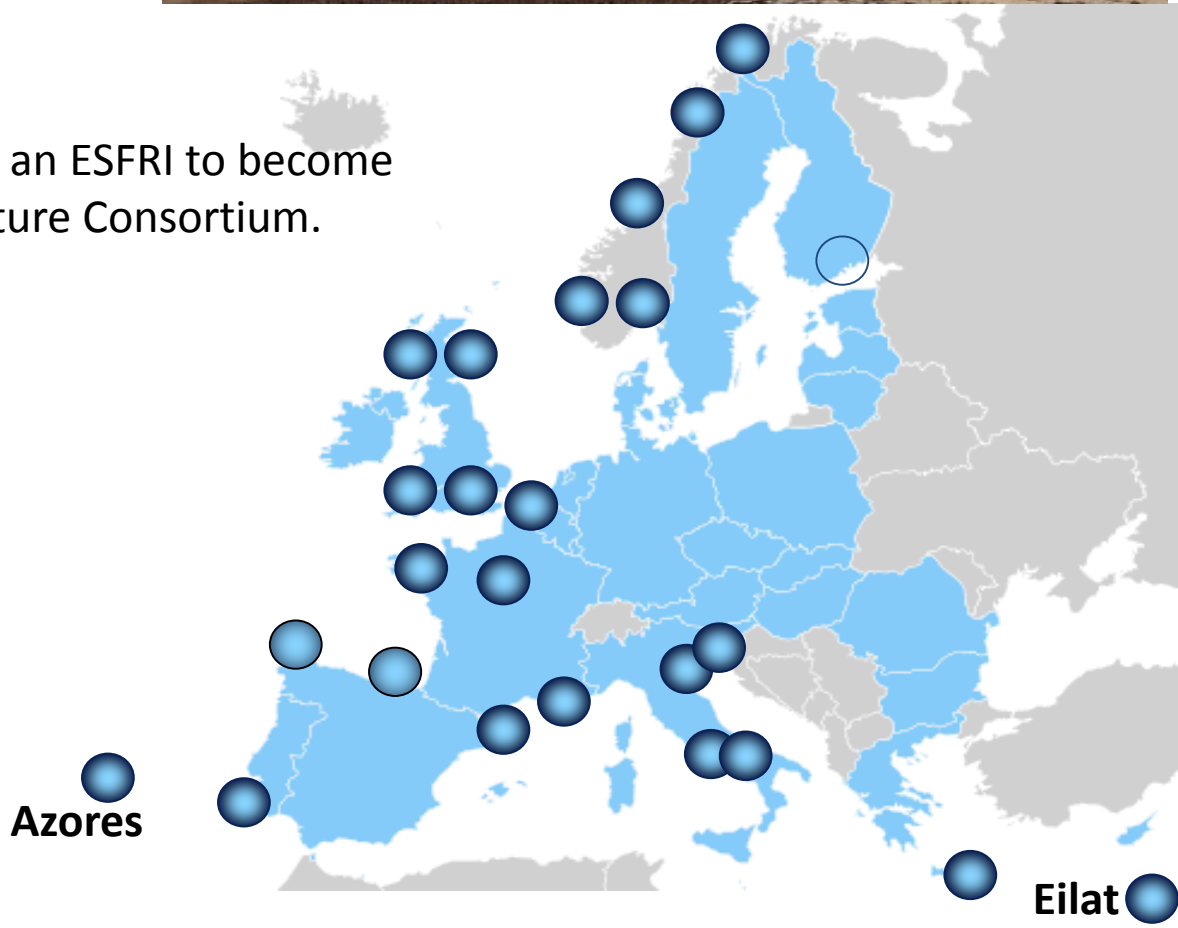
Many have grouped together in an ESFRI to become a European Research Infrastructure Consortium.

Member states:

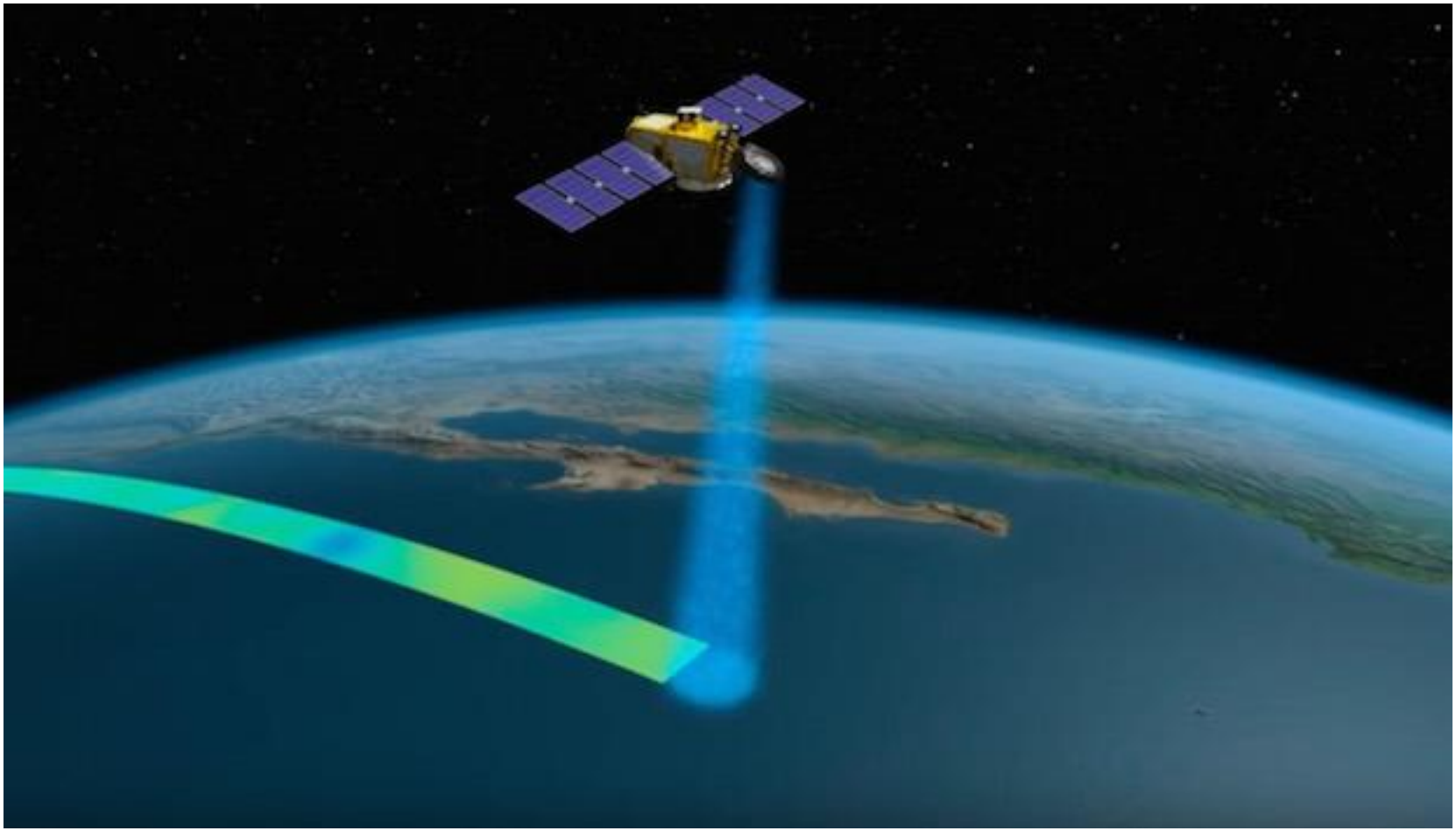
- France
- Belgium
- Greece
- Israel
- Italy
- Norway
- Portugal
- Spain,
- UK



And link with sister Research Infrastructures in the **RI cluster project EMBRIC**…

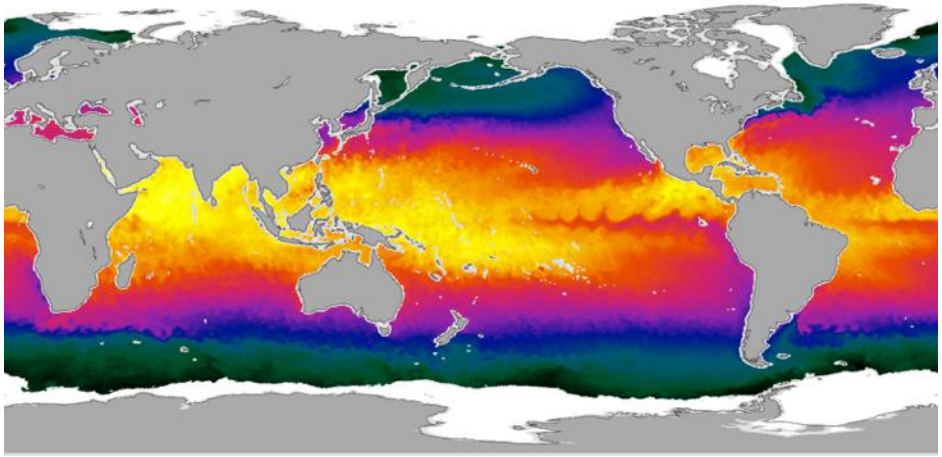
… to offer users infrastructure pipelines to enable research workflows on marine organisms all the way into marketable products

But the ocean is a lot bigger than the coastal regions of Europe

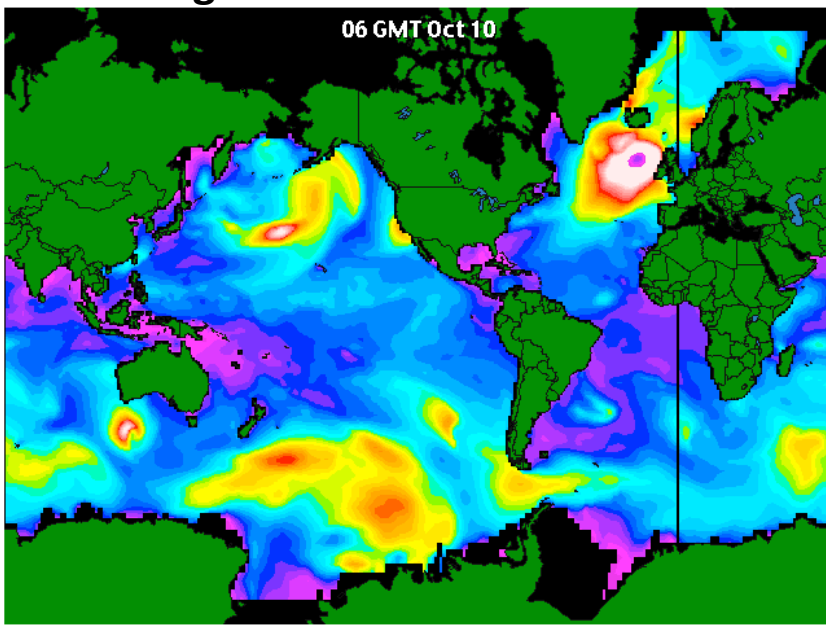


Satellite data & imagery

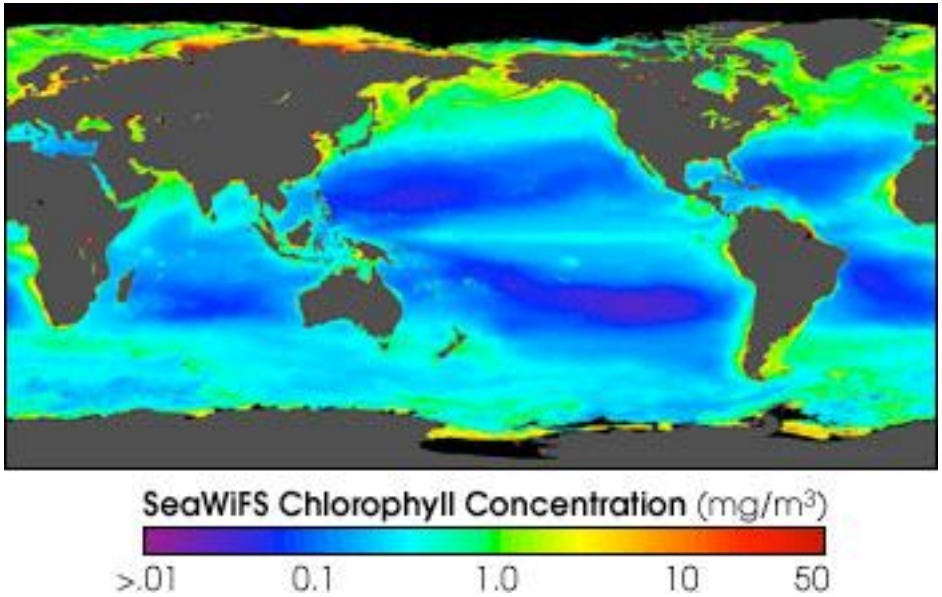
Temperature



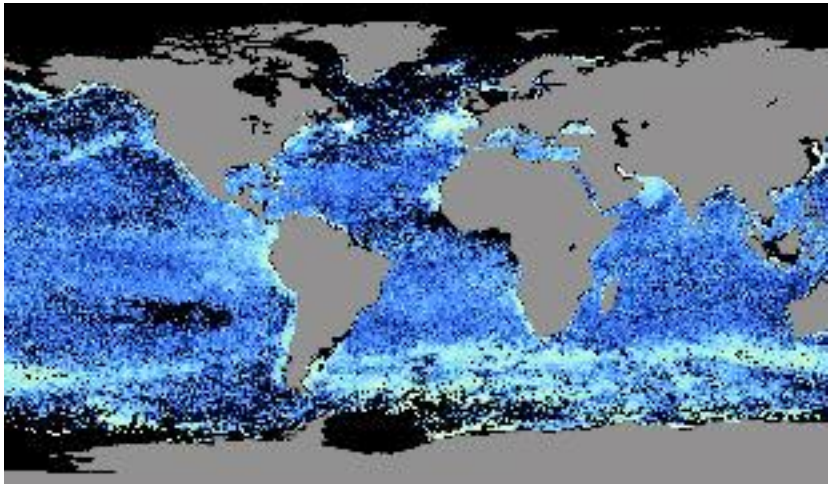
Wave height



Chlorophyll



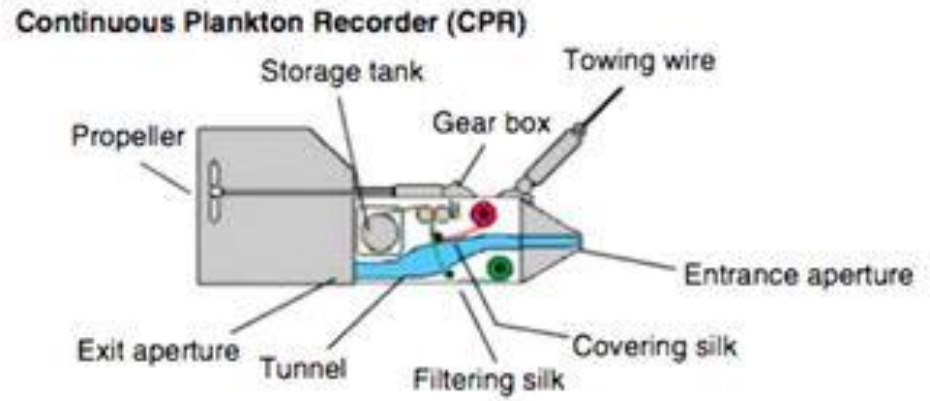
Coccolithophore calcite



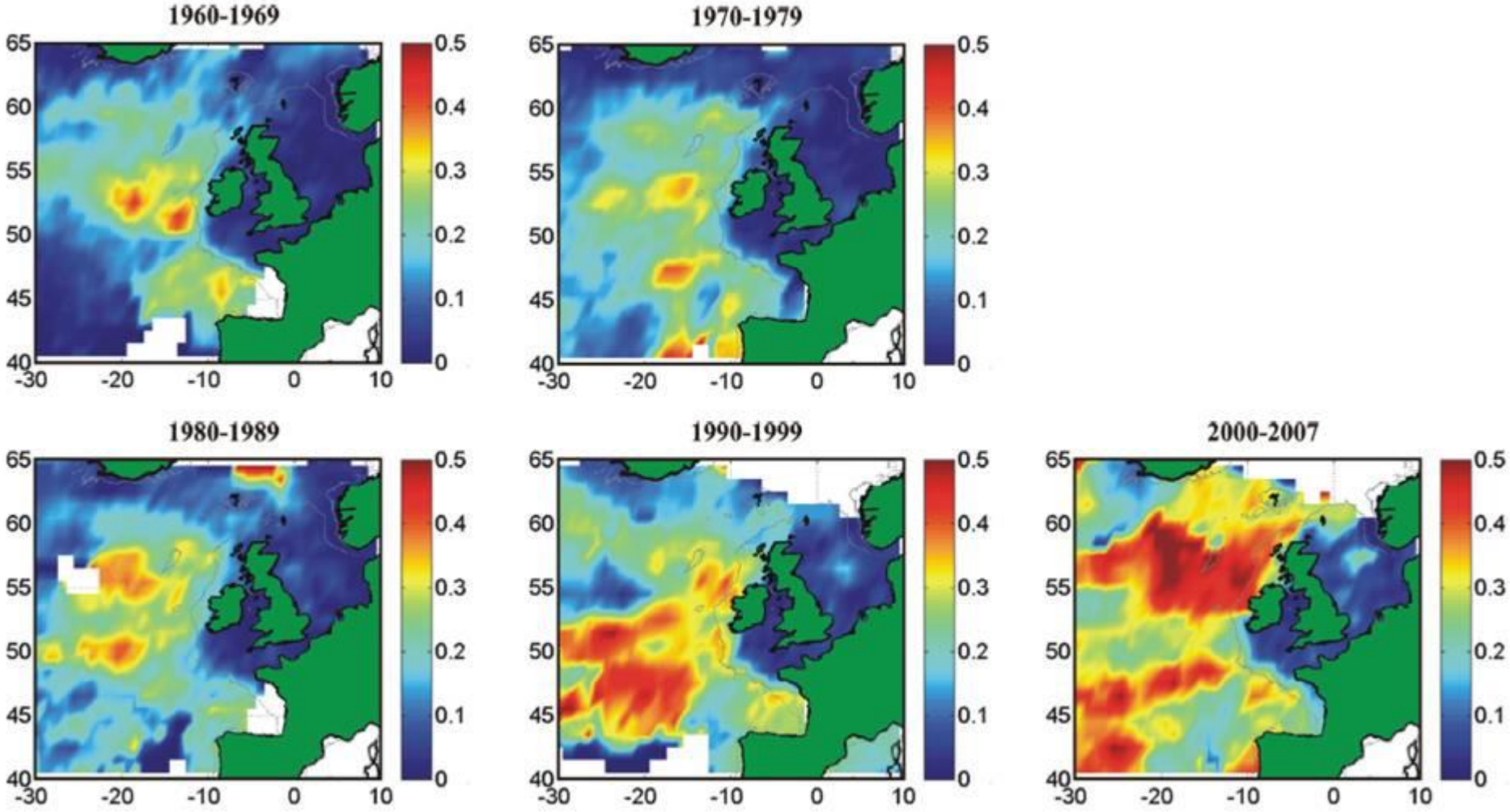
… but it only shows the surface
And it does not show the biodiversity

Alistair Hardy, continuous plankton recorder, ferry box

- Sample plankton, by towing a filtering – recording device behind a ferry and catch plankton on a silk “recording tape.”
- Assess diversity along ferry trajectory by enumerating plankton along the silk tape record

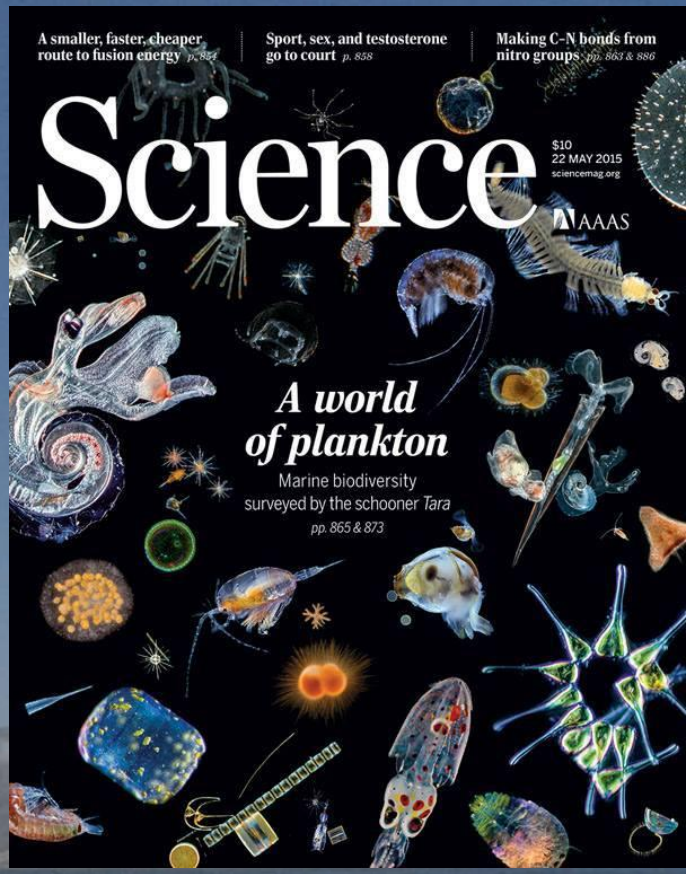


Distribution maps of foraminifera on CPR samples (frequency of occurrence)



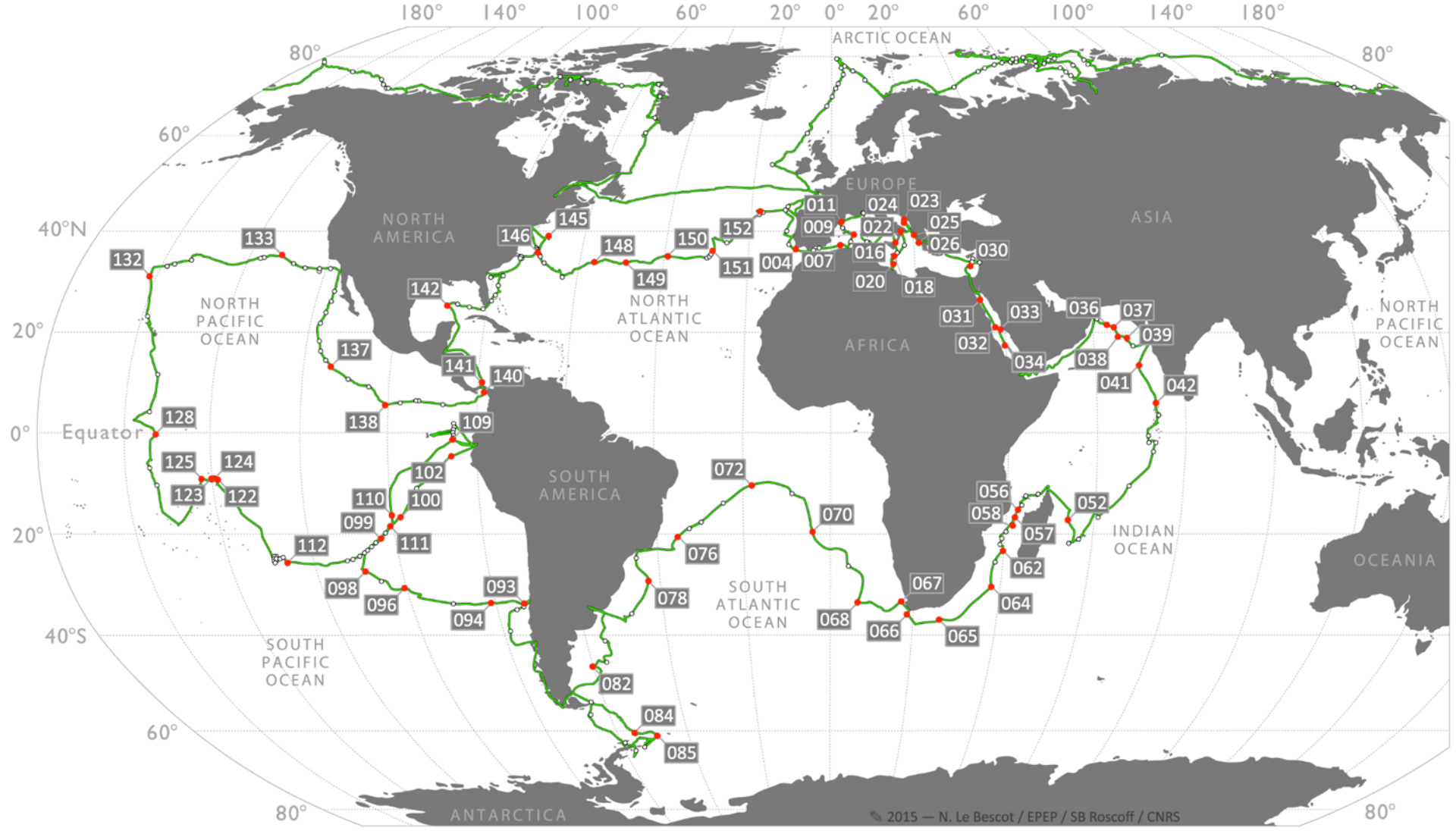
McQuatters Gollop et al, 2010. Atlas of Calcifying Plankton: Results from the continuous plankton recorder survey. SAHFOS, PLYMOUTH, UK,

TARA Oceans expedition 2009-2013



To collect eukaryotic plankton, DNA, R
metadata from many sites in the world's oce

TARA Oceans expedition 2009-2013



- **Repeated visits of sites next to impossible,**
- **Expensive to operate**

Jam-packed full, cramped?

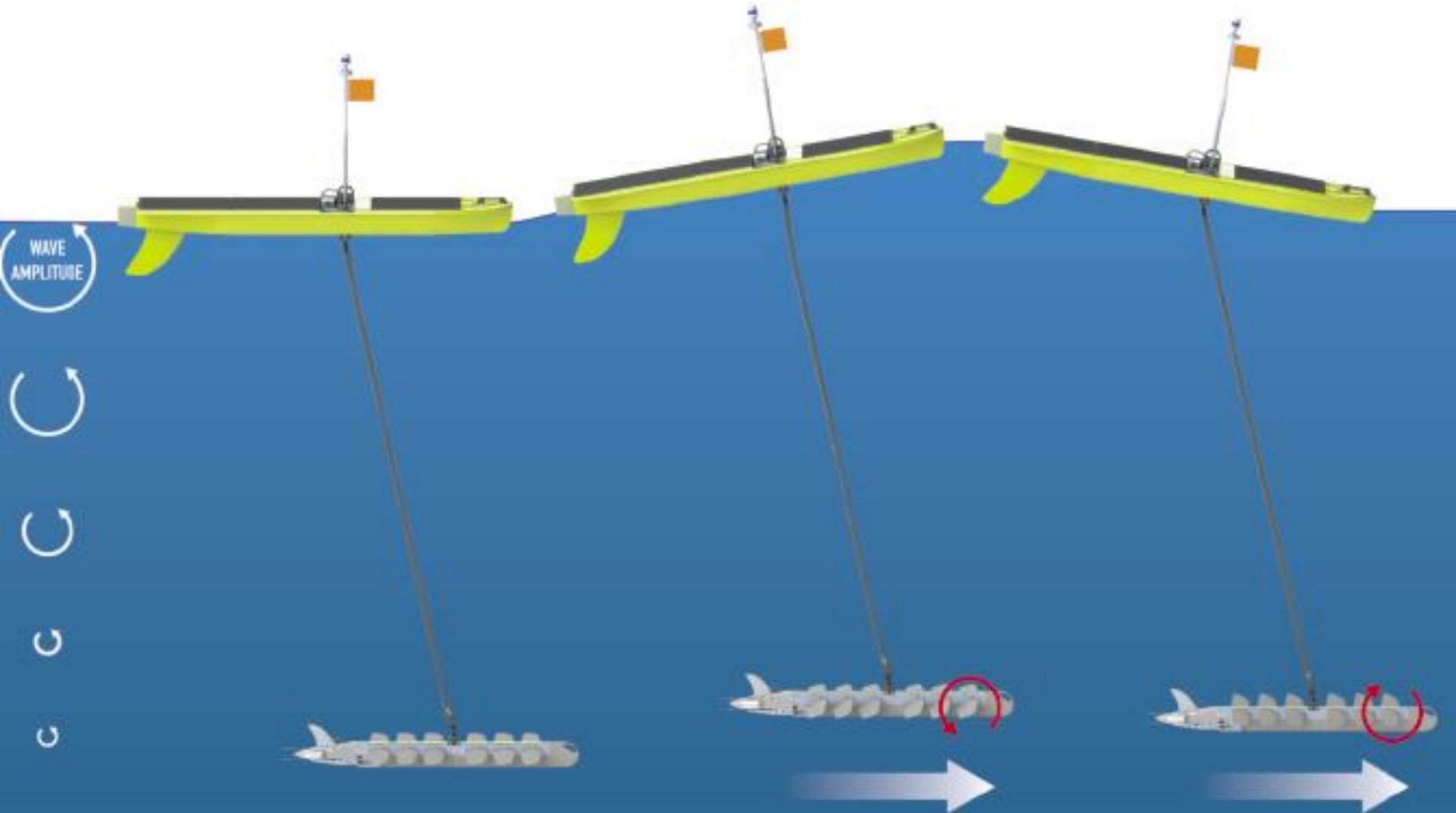
Well, … it's actually mostly empty space.

Autonomous Surface Vehicles (ASV) Wave Glider

- Charged by solar energy 5-20W
- Battery storage 0.9-4.5 kWh
- Can be directed
- Can steer away from approaching ships
- Water speed 2-6 km/h
- Operates ca 1 year
- Max operating depth 15m
- Tow capacity ≤500 kg
- Costs ca. € 300,000

- It “sails” in a most peculiar way

It “sails” utilizing the wave amplitude difference between surface and at depth.



Laboratory toolkit to “visualise” plankton

Flow cytometer

Flow-cam .

Laboratory toolkit to “DNA meta-barcode” plankton

Automated
DNA extractor

High Throughput Sequencer

From sequences to species id.

The DNA / RNA pipeline

Challenges to automation onto a buoy:

- Energy demanding
- Chemicals
- Bioinformatics processing
- Data storage and transmission

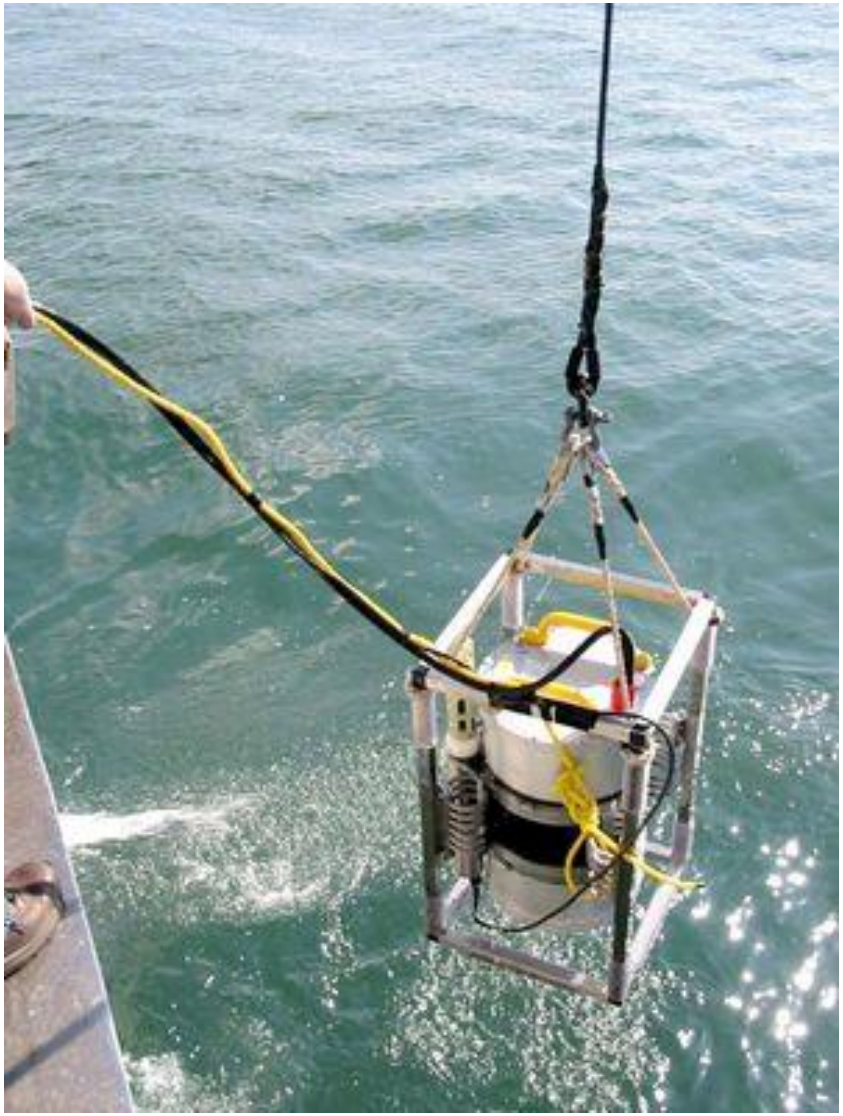
Advantages of processing in situ:

- No delay between sampling and processing

Fully automated flow cytometer and flow-cam in one single buoy

In a tethered surface buoy

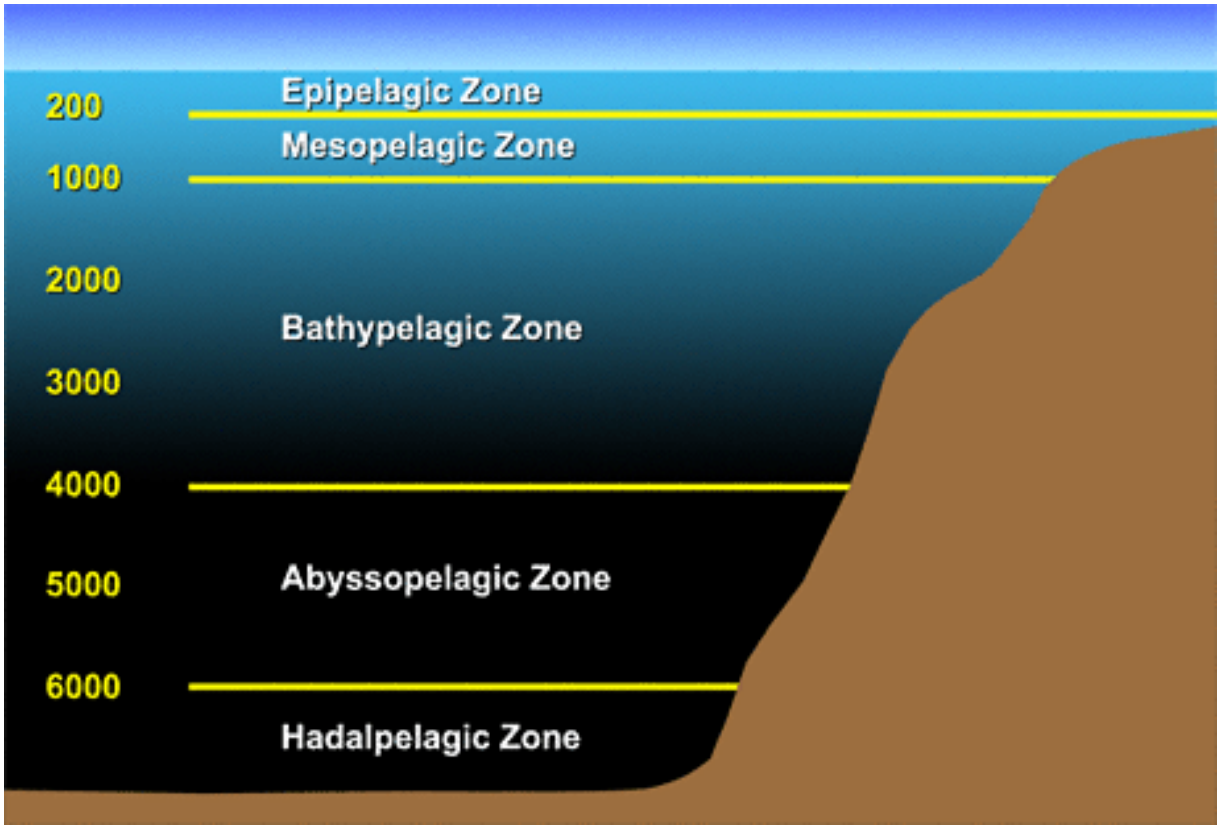
In a tethered submersible buoy



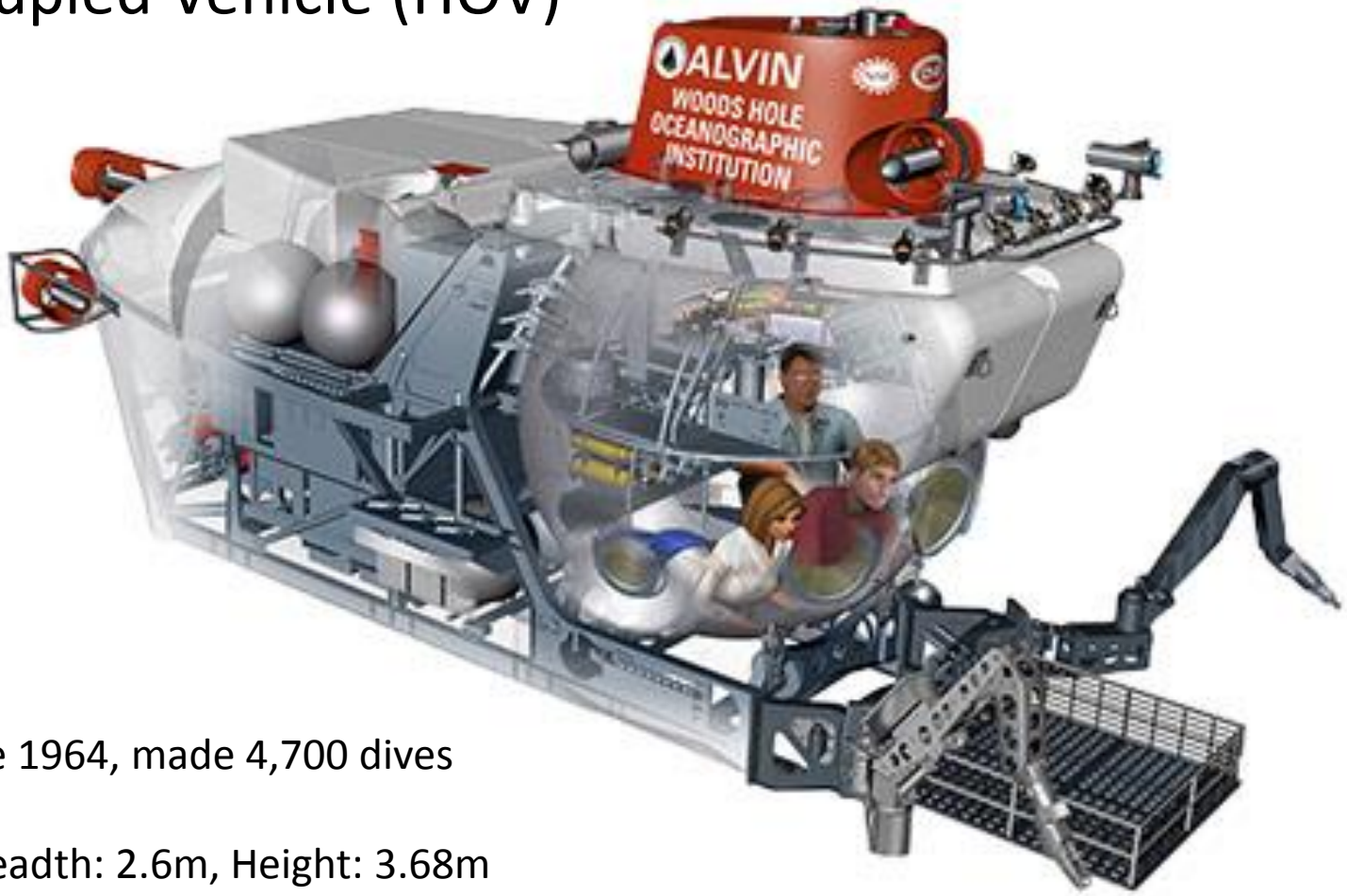
How it works:

- Flow cytometer takes measurements.
- In-situ computer decides whether also flow-cam picture is taken,
- Data transmitted in real-time to shore

What about exploring the really deep ocean?

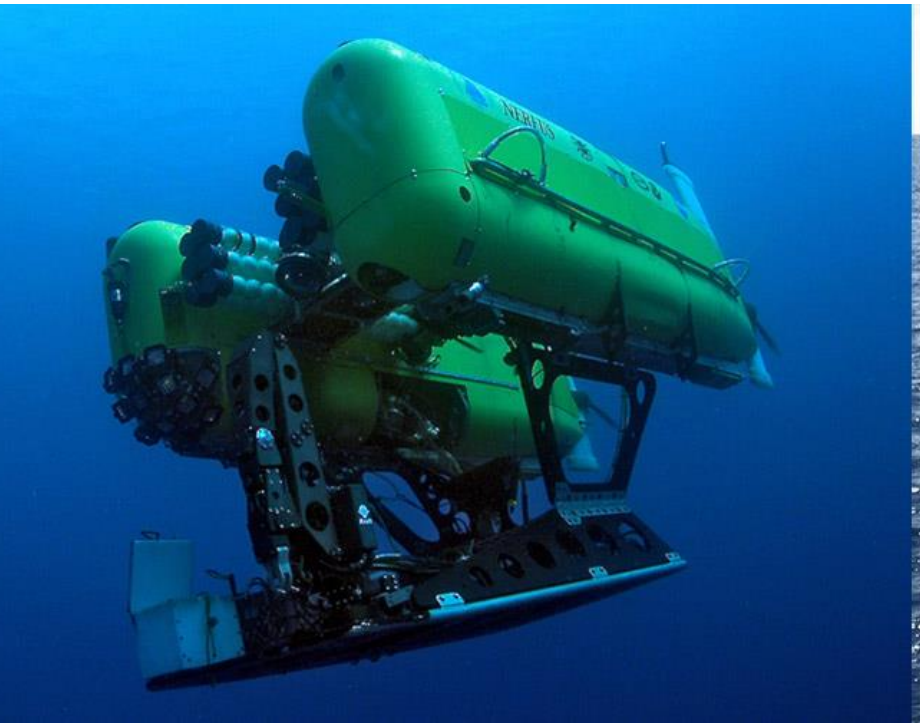


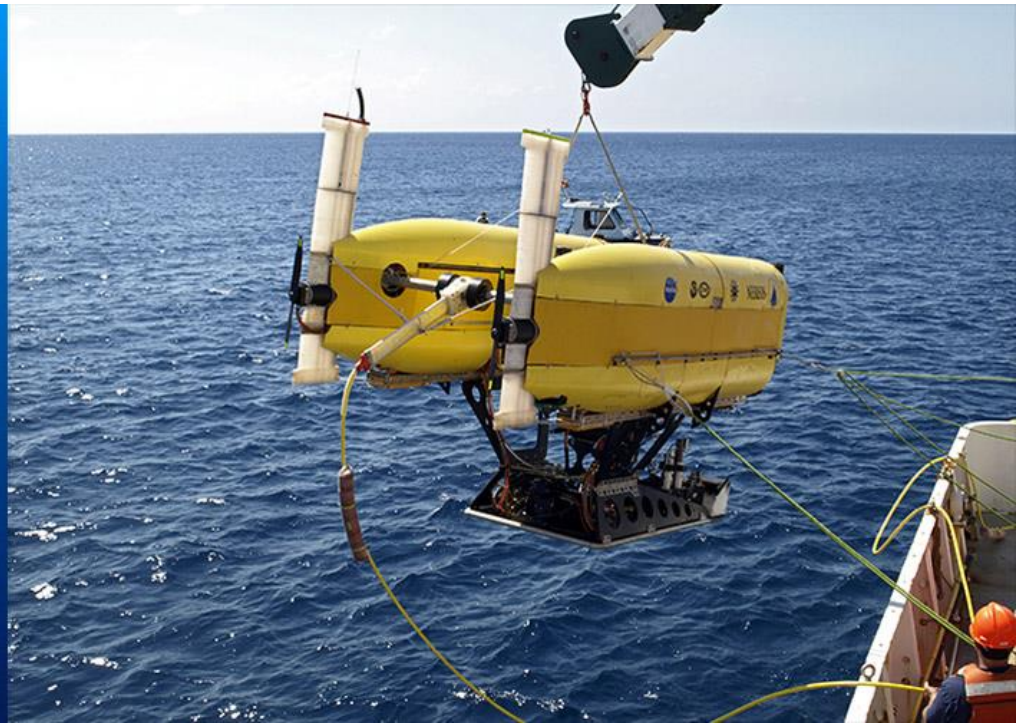
Human Occupied Vehicle (HOV)



- Operation since 1964, made 4,700 dives since then
- Length: 7m, Breadth: 2.6m, Height: 3.68m
- Operating depth: 4500 meters
- Normal dive duration: 6-10 hours
- Gross weight: 20.4 metric tons
- Science basket payload: 181.4 kilograms
- Personnel sphere volume: $4.8m^3$

Semi-autonomous (remotely operated) **hadal** vehicle NEREUS of WHOI imploded at 10 km depth in 2014





Autonomous underwater vehicles (AUVs)

Robot submarines:

Action radius 6000 m depth, 6000 km on batteries
Restriction, energy use, slow speed (0.4 m/s)

Before launch, the computers are programmed with instructions of where to go, what to measure, and what depths to go to.
No cable to the mother ship, communications limited to sonar when underwater (range of a few km) or satellite when on the surface.

Fixed-Point Ocean Observatories

- Autonomous system of sensors and samplers moored on sea bottom,
- Connected by fixed cables and relay stations,
- Data transmission in real-time
- Via cable or via relay buoys with satellite link to shore,
- Receives instructions from shore about acquisition method.
- Gathers data from deep sea, water column and lower atmosphere,

NEPTUNE
Canada
Observatory

european
multidisciplinary
seafloor & water-column
observatory

emso

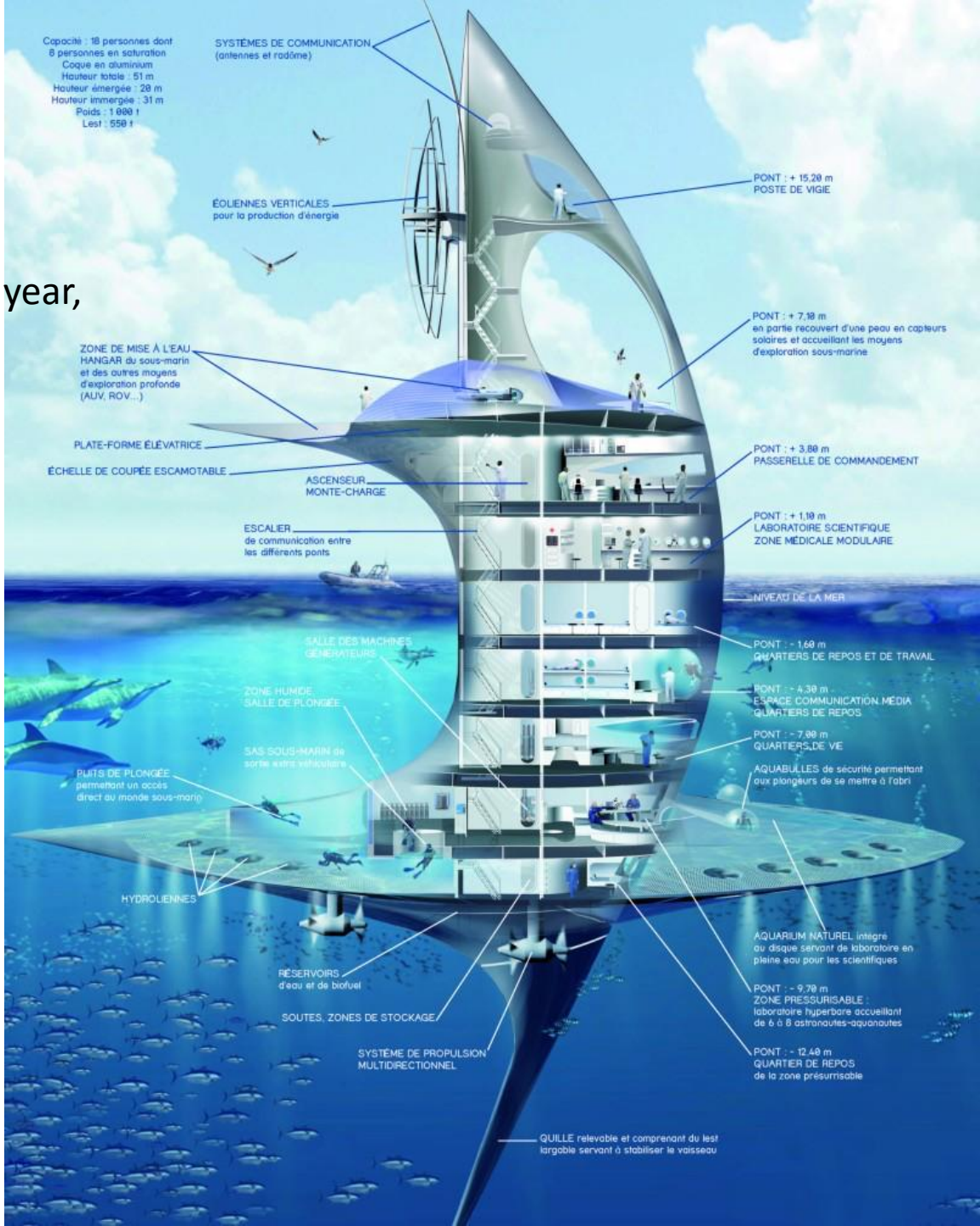
ESFRI Research Infrastructure
ERIC since 29/09/2016

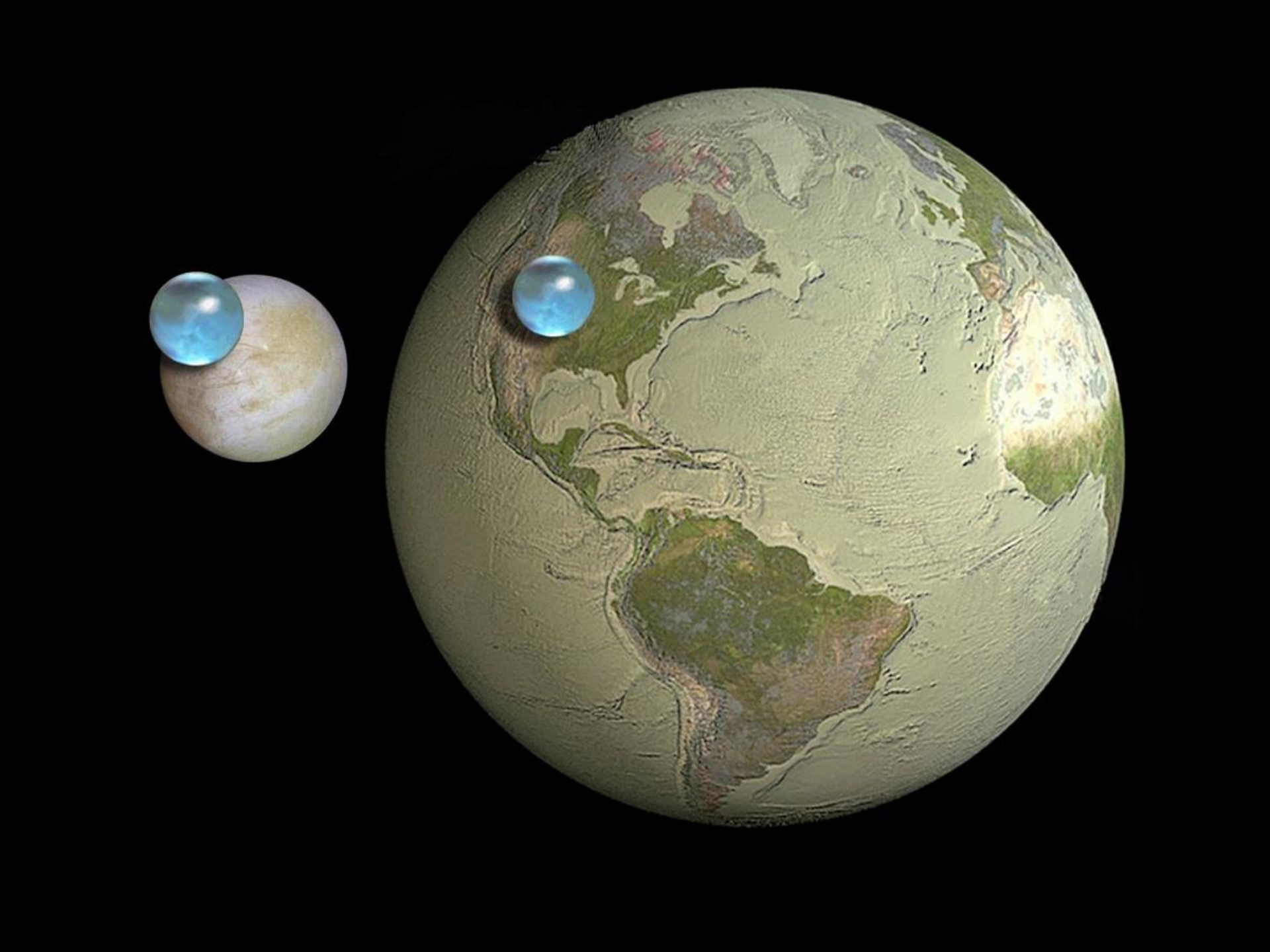
Member states

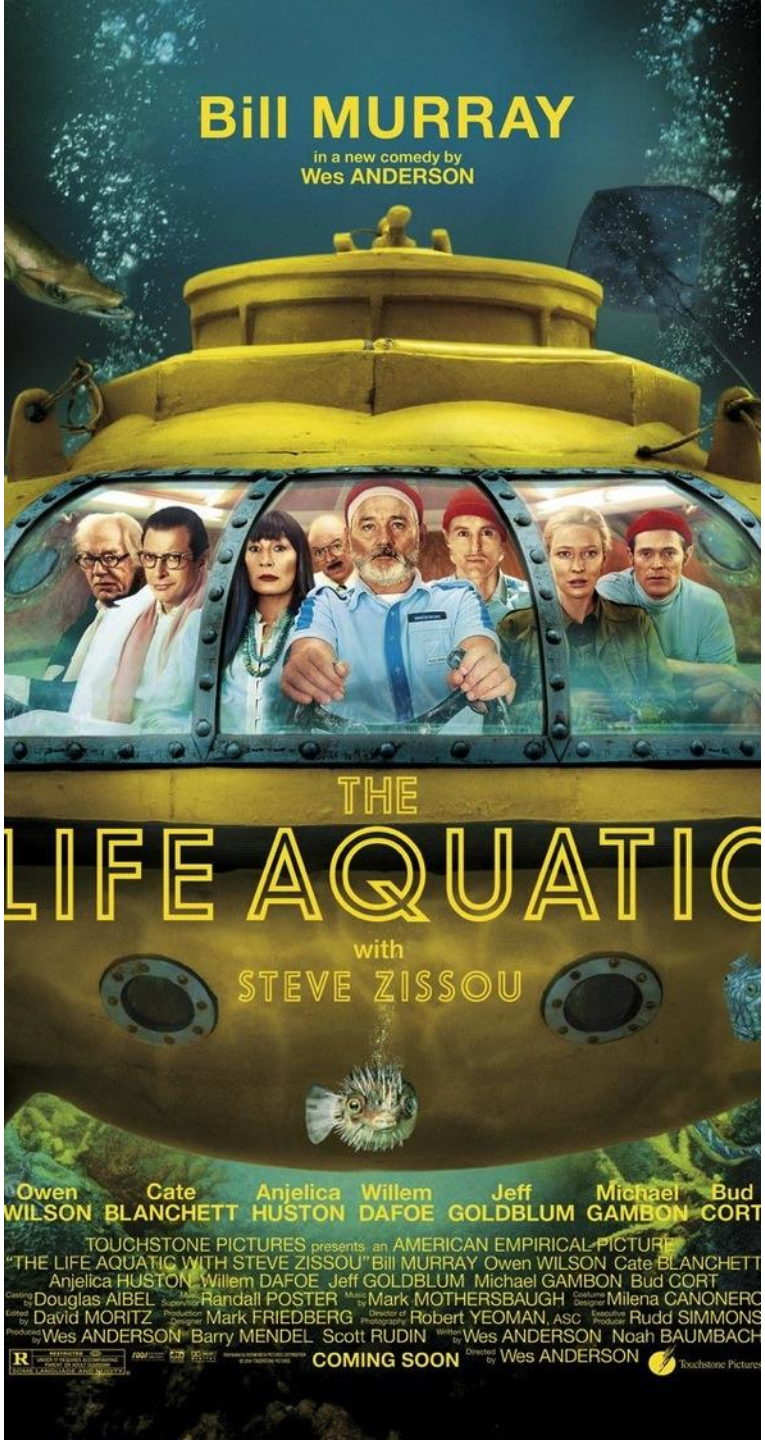
- Italy
- France
- Ireland
- Spain
- Greece
- UK
- Portugal
- Romania

SeaOrbiter

Futuristic oceanographic vessel,
Construction will begin spring next year,
Crowd funding campaign,
Solar, wind and wave power,
Gathered international support,
Rolex,






Bill MURRAY
in a new comedy by
Wes ANDERSON
THE
LIFE AQUATIC
with
STEVE ZISSOU
Owen WILSON
Cate BLANCHETT
Anjelica HUSTON
Willem DAFOE
Jeff GOLDBLUM
Michael GAMBON
Bud CORT
TOUCHSTONE PICTURES presents an AMERICAN EMPIRICAL PICTURE
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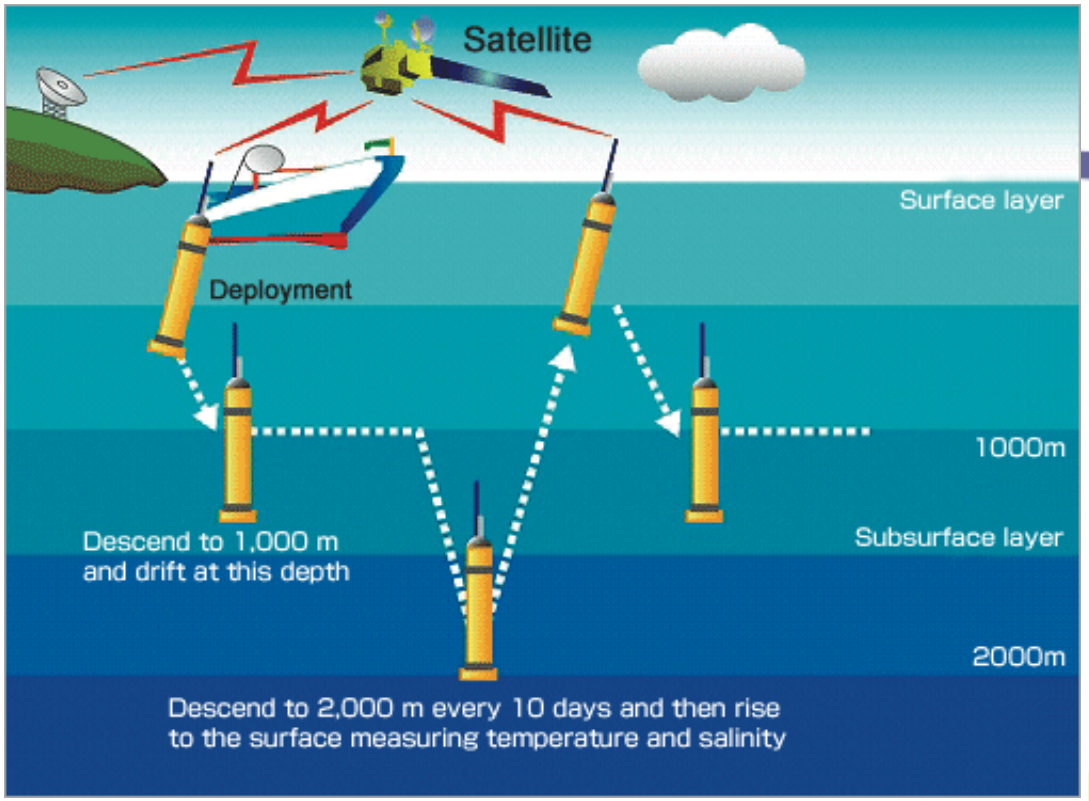
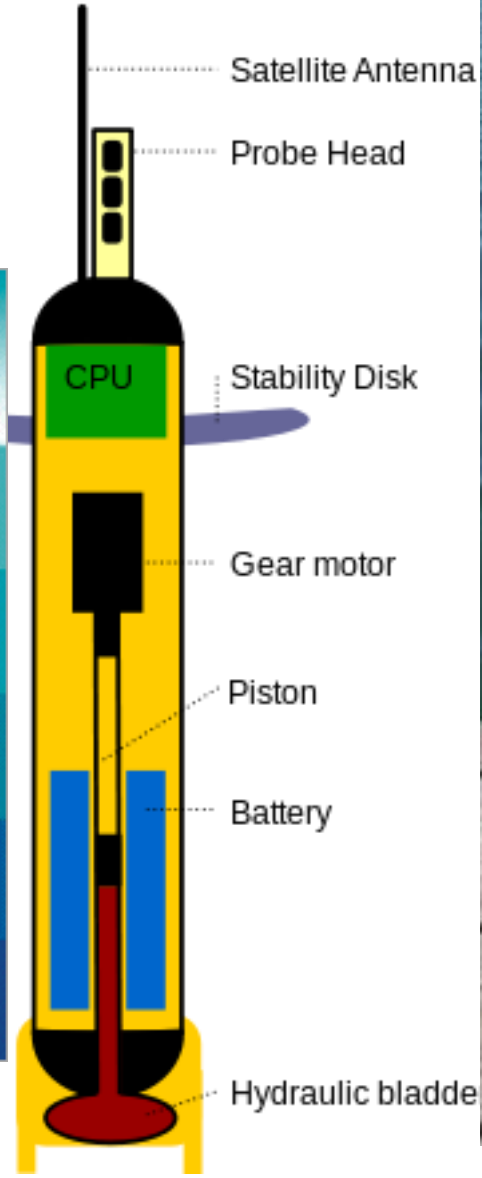
Douglas AIBEL Randall POSTER Mark MOTHERSBAUGH Milena CANONERO
David MORITZ Mark FRIEDBERG Robert YEOMAN, ASC Rudd SIMMONS
Wes ANDERSON Barry MENDEL Scott RUDIN Wes ANDERSON Noah BAUMBACH
COMING SOON
Wes ANDERSON
Touchstone Pictures

THANKS

Profiling floats

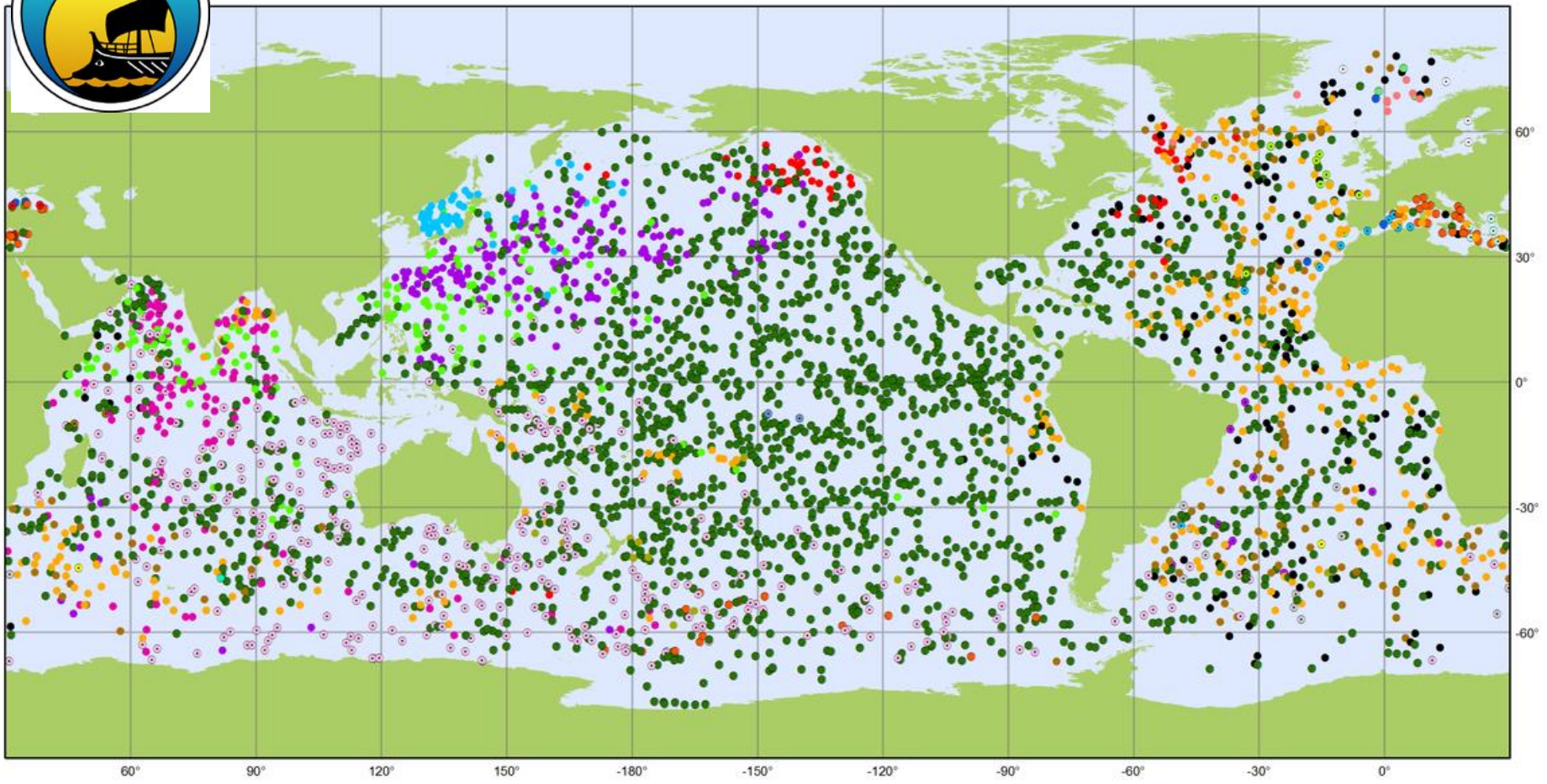
- 20-30 kg, ca. € 15,000
- Changes its buoyancy to move vertically,
- Common sensors (T, conductivity, pressure),
- Disposable, or deployed briefly and recovered.





http://www.argo.ucsd.edu/FAQ.html

Profiling floats all over the oceans



Argo

National contributions - 3829 Operational Floats

Latest location of operational floats (data distributed within the last 30 days)

April 2016

ARGENTINA (2)	CHINA (149)	GERMANY (133)	JAPAN (189)	NETHERLANDS (12)	SPAIN (9)	
AUSTRALIA (380)	ECUADOR (2)	GREECE (7)	KENYA (1)	NEW ZEALAND (12)	TURKEY (3)	
BRAZIL (10)	EUROPE (6)	INDIA (124)	KOREA, REPUBLIC OF (52)	NORWAY (10)	UK (134)	
BULGARIA (2)	FINLAND (5)	IRELAND (10)	MAURITIUS (3)	POLAND (3)	USA (2138)	
CANADA (58)	FRANCE (328)	ITALY (46)	MEXICO (2)	SOUTH AFRICA (1)		

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