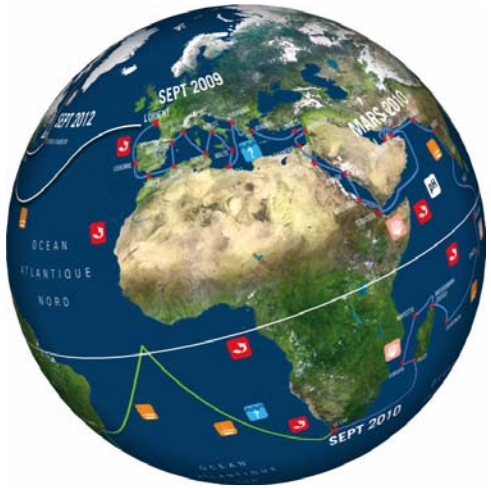
UNOLS: Greening the Fleet Workshop, 2012

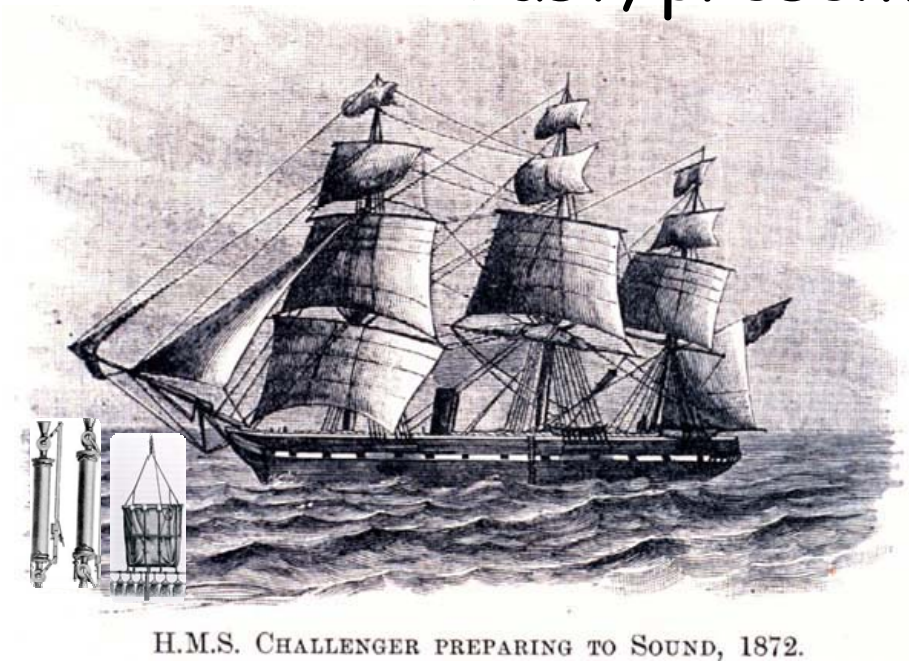
Oceanography under sail: what can be learned from the Tara Oceans Expedition?

Lee Karp-Boss[1] and Romain Troublé[2]
(on behalf of the Tara Oceans consortium)

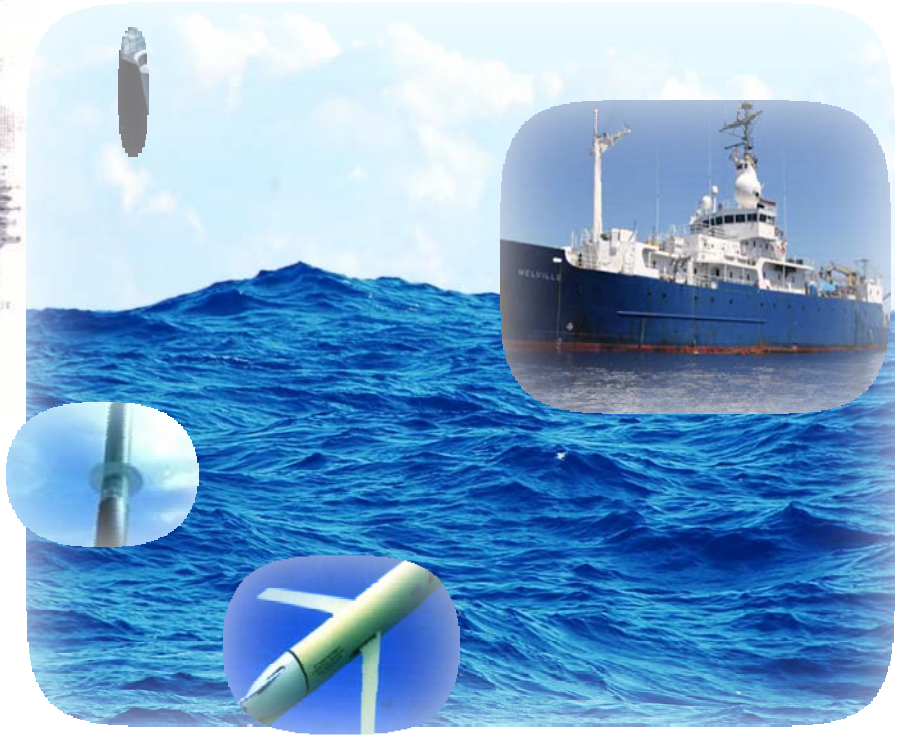
[1]School of Marine Sciences, University of Maine
[2] Tara Expeditions, Paris
(romain@taraexpeditions.org)

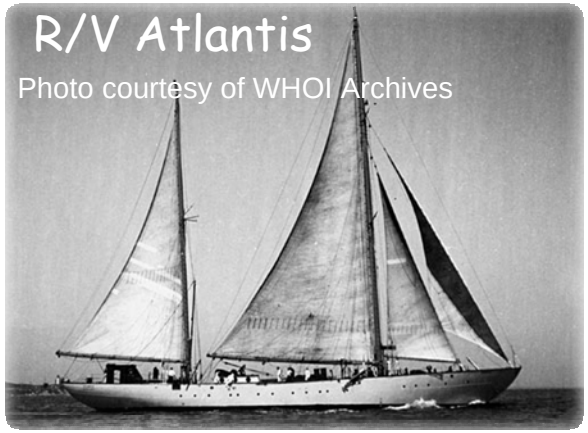


Sailboats as a platform for scientific research: Past, present and future



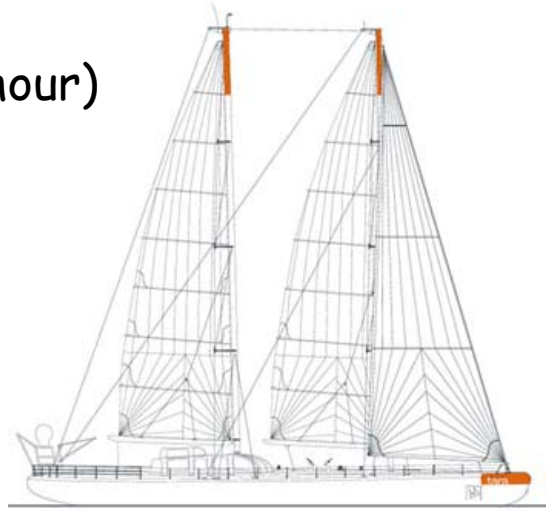
H.M.S. Challenger preparing to Sound, 1872.





Tara: specifications

Type: schooner
Built: 1989
Length: 118 feet (36 m)
Hull: aluminum
Masts: 2 (400 m2 sail area)
Draft: 5-11.5 feet (1.5-3.5 m)
Weight: 120 T
Displacement: 160 T
Max speed: 10 knots
Endurance: 100 days
Fuel Capacity: 10,567 gallons
Propulsion: 2 X 350 HP
Power: 2 @ 22kW and 1 @ 40 kW (EPA tier III).
Water tank: 1585 gallons + water maker (~ 80 gallons/hour)
Soiled tank: 1850 gallons



Owner: Etienne Bourgois and agnès b.
Flag: French
Homeport: Lorient, France

Tara: a brief history

1989 - 1996: "Antarctica" (Jean Louis Etienne)

- Built for polar expeditions.

1996 - 2001: "Seamaster" (Sir Peter Blake)

- Raise awareness of human impacts on (fresh)water and oceans.

2003- present: 'Tara'
(Etienne Bourgois and Agnés b.)

The Tara Expeditions Foundation for Marine Research

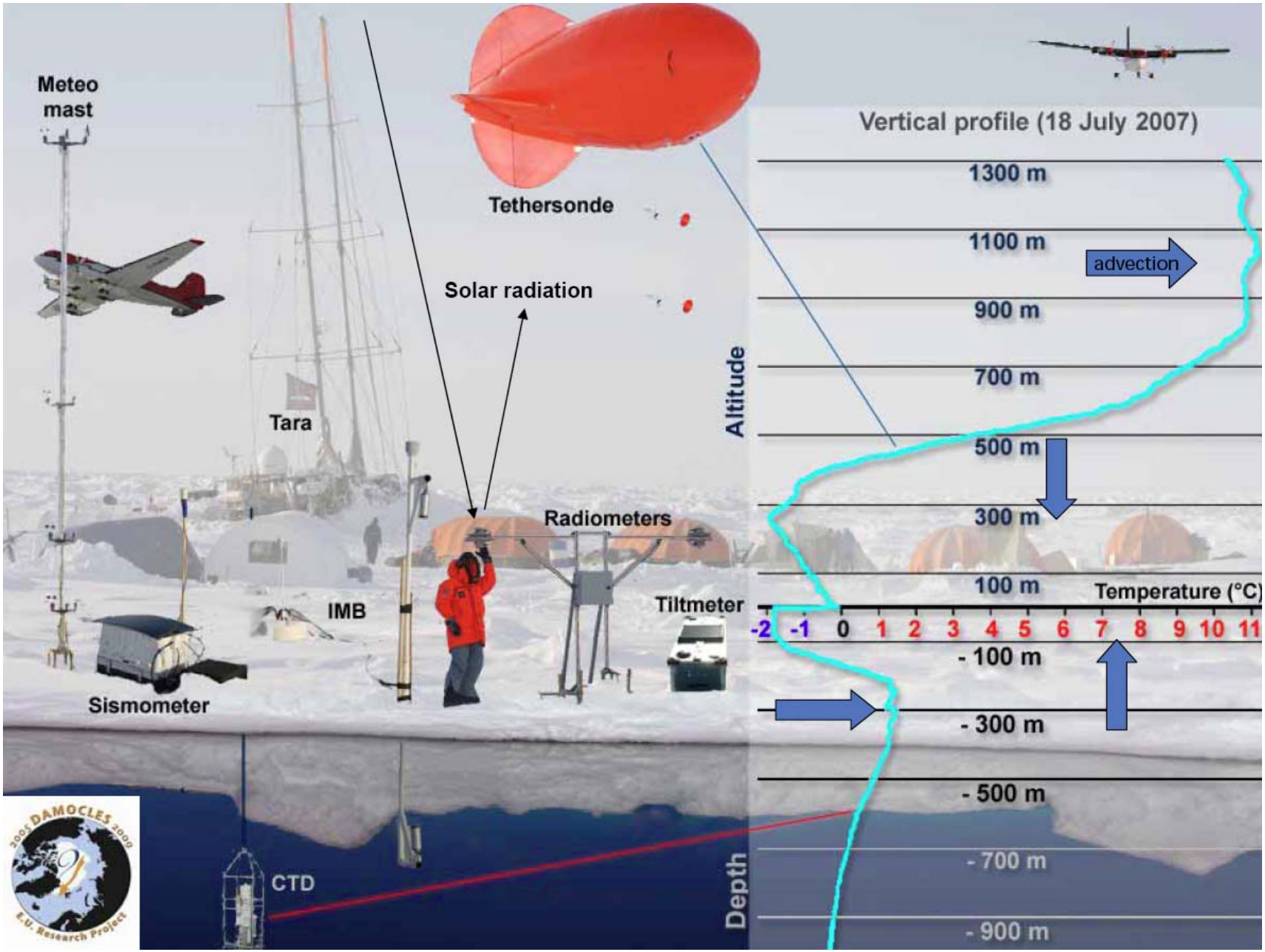
- Finance long-term scientific research concerning the impact of global warming on ecosystems.

- Increase general awareness about environmental issues.

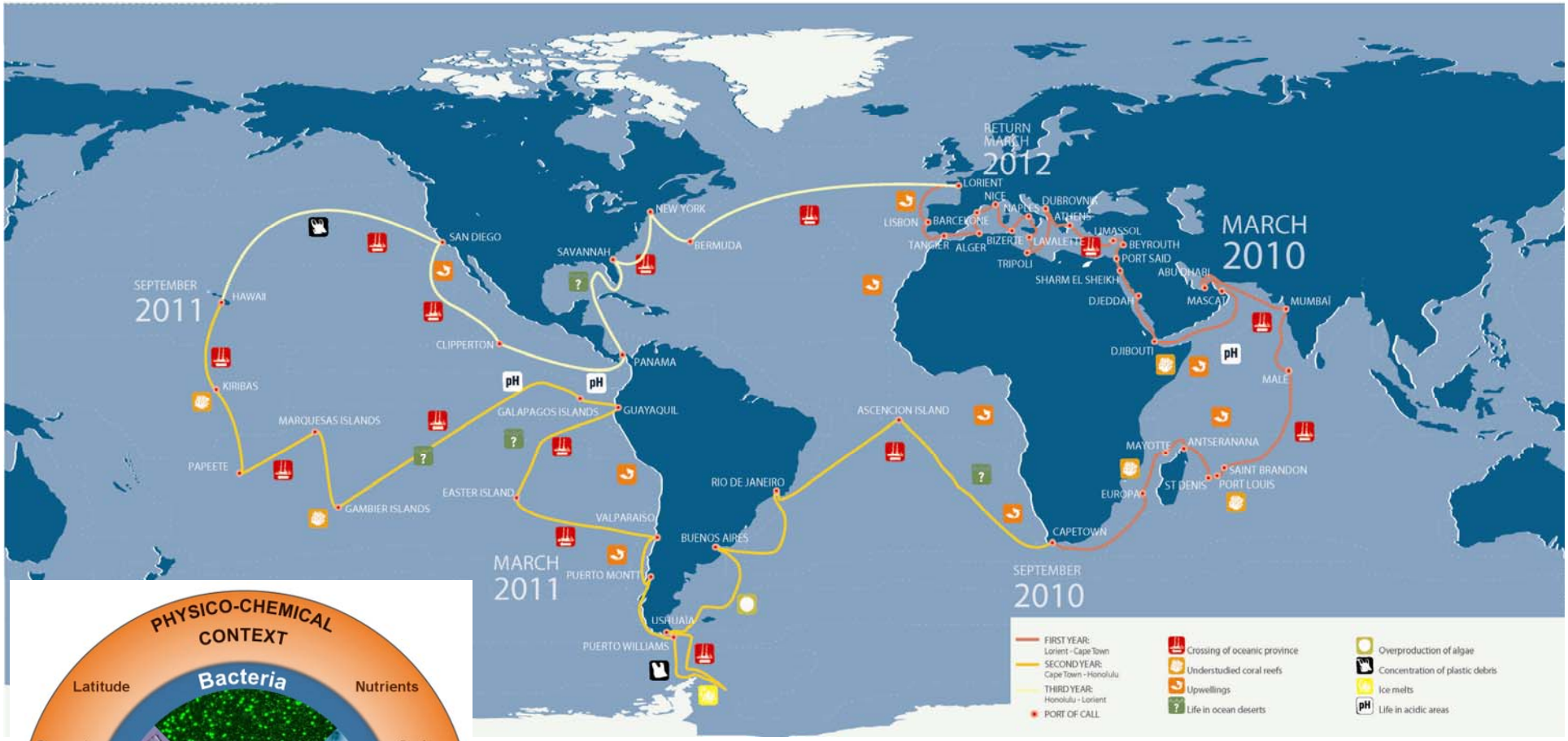
- Diffuse scientific data for educational and policy purposes.

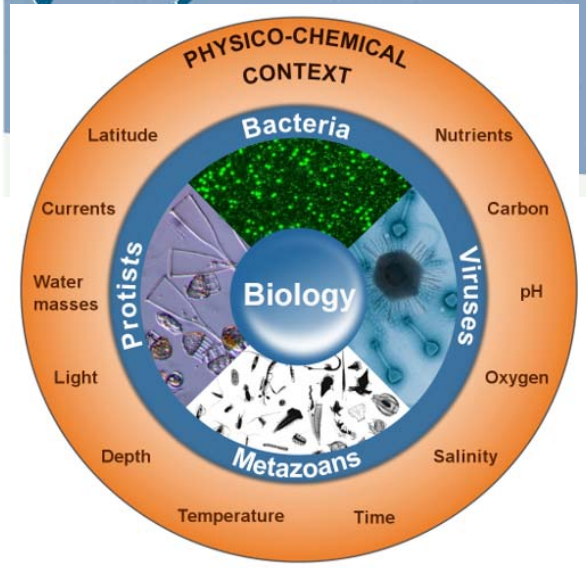
Tara's Arctic expedition 2006-2008 (Repeat Nansen's historic drift)

Science support during arctic mission



Tara Oceans Expedition 2009-2012





Choice of route:

- Scientific considerations
- Seasons
- In-line with prevailing winds

TARA OCEANS

A large interdisciplinary team

› 20 laboratories (~ 10 countries)

Karsenti, E.(EMBL, Germany): co-director

Acinas, S.G.(ICM, CSIC, Spain)
Bork, P. (EMBL, Germany)
Bowler, C. (CNRS, BENS, France)
De Vargas, C. (CNRS,Roscoff, UMPC, France)
Raes, J., (VIB, Vrije, Belgium)
Sullivan, M. (U. of Arizona, USA)
Benzoni, F. (U. of Milan, Italy)
Claverie, J-M. (CNRS, U. Marseille, France)
Follows, M. (MIT, USA)
Jaillon, O. (CEA, Genoscope, France)
Gorsky, G. (CNRS, LOV, France)
Hingamp, P. (CNRS, U. Marseille, France)
Iudicone, D. (Stazione Zoologica Anton Dohrn, Italy),
Kandels-Lewis, S. (EMBL, Germany),
Krzic, U. (EMBL, Germany),
Not, F. (CNRS, Roscoff, France),
Ogata, H. (CNRS, U. Marseille, France)
Pesant, S. (U. Of Bremen, Germany),
Reynaud, E. (U. College Dublin, Ireland),
Sardet, C. (CNRS, LOV, France)
Sieracki, M. (Bigelow laboratory, USA)
Speich, S. (LPO, CNRS/IFREMER, France)
Velayoudon, D. (DVIPC, France)
Weissenbach, J. (CEA, Genoscope, France)
Wincker, P. (CEA, Genoscope, France)

and the Tara Oceans Consortium

Challenge: characterize planktonic ecosystems on a global scale

- Sample all microscopic life 'end to end' (from viruses to fish larvae), by size classes
- Sample ecosystems down to 2,000m
- Multidisciplinary approach from oceanography to genomics
- Modern instrumentation (high throughput genomics and fast imaging methods)
- Sample throughout all the oceans

(+ continuos data acquisition)

Facilities and equipment

Crew:7, **Scientists:** 7

Working deck area, wet lab, air-conditioned dry-lab
Sample storage: freezer, refrigerator, liquid N_2

Facilities and equipment (continue)

Oceanography:

- A frame + 3,000 m oceanographic winch capstan
- A small crane
- Flowthrough: Thermosalinometer + attenuation/absorption meter
- An industrial peristaltic pump (2,000-6,000 liters/station)

Meteorology:

-Station Bathos II Météo France.

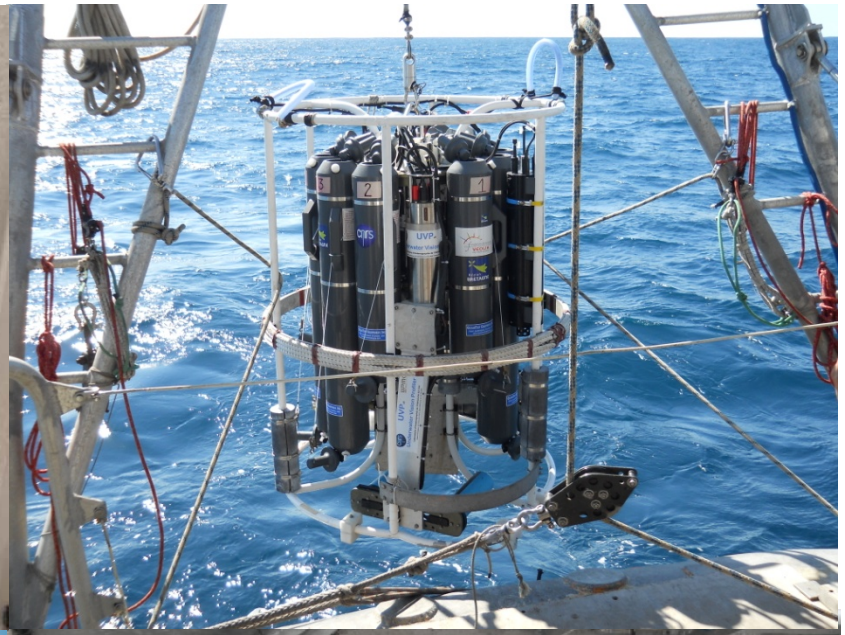
Communication:

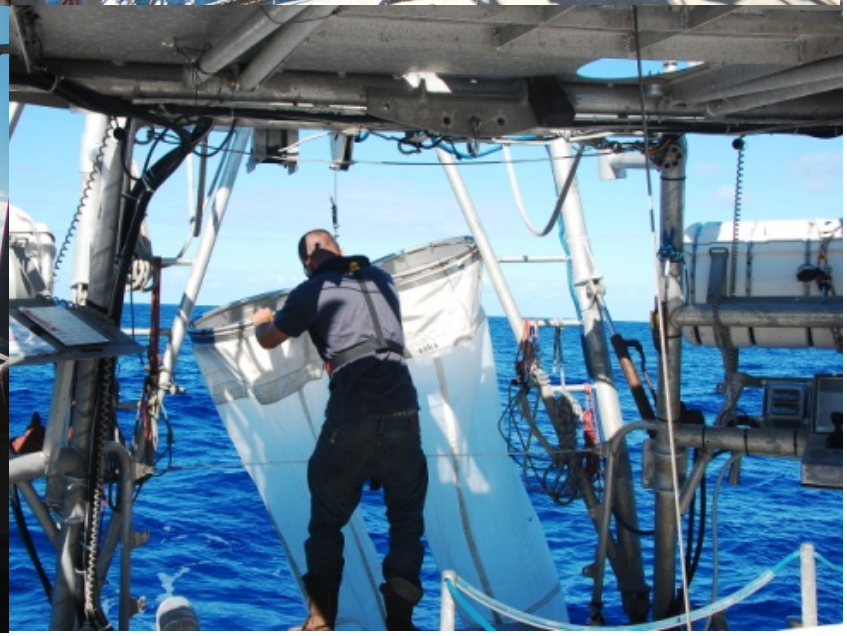
-Fleet BroadBand, Iridium open port, Radio HF, Sat C and VHF

Others:

- Diving compressor and equipment for 4 persons.
- Two semi-rigid 30 and 40 HP

Facilities and equipment (continue)





Tara's dry lab (imaging and continuous sampling)

1. Flow cytometer
2. Fast repetition rate fluorometer
3. FlowCam
4. Flowthrough: temp, salinity, absorption/attenuation

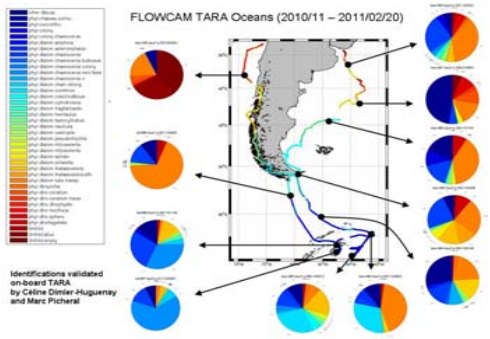
Tara's 'office'/meeting space






Achievements

- Covered 54,000 nm (Med., Red sea, Indian Ocean, Atlantic, Southern Ocean, Pacific)
- 150 station (nutrients, Carbonates, mercury, HPLC-pigments, Taxonomy, DNA, RNA → 'end to end')
- ~ 560 CTD casts
- 30 glider deployments



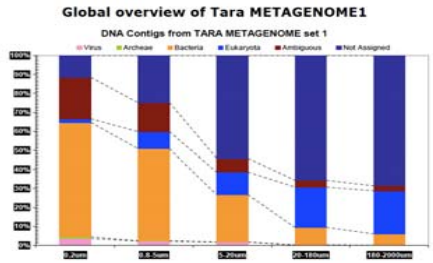
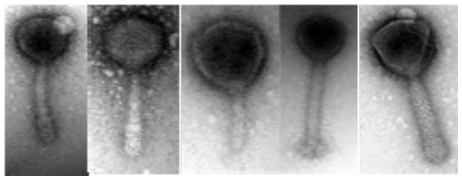


Fig 1 : Distribution of DNA metagenomic contigs in sampling filters (expressed as percentage of total DNA size for each filter).



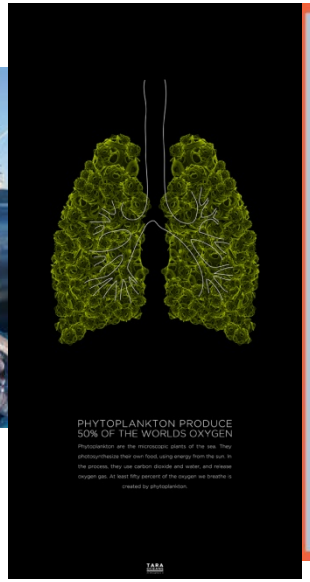
Data courtesy of E. Karsenti

Outreach and education

School visits

Reports

Art



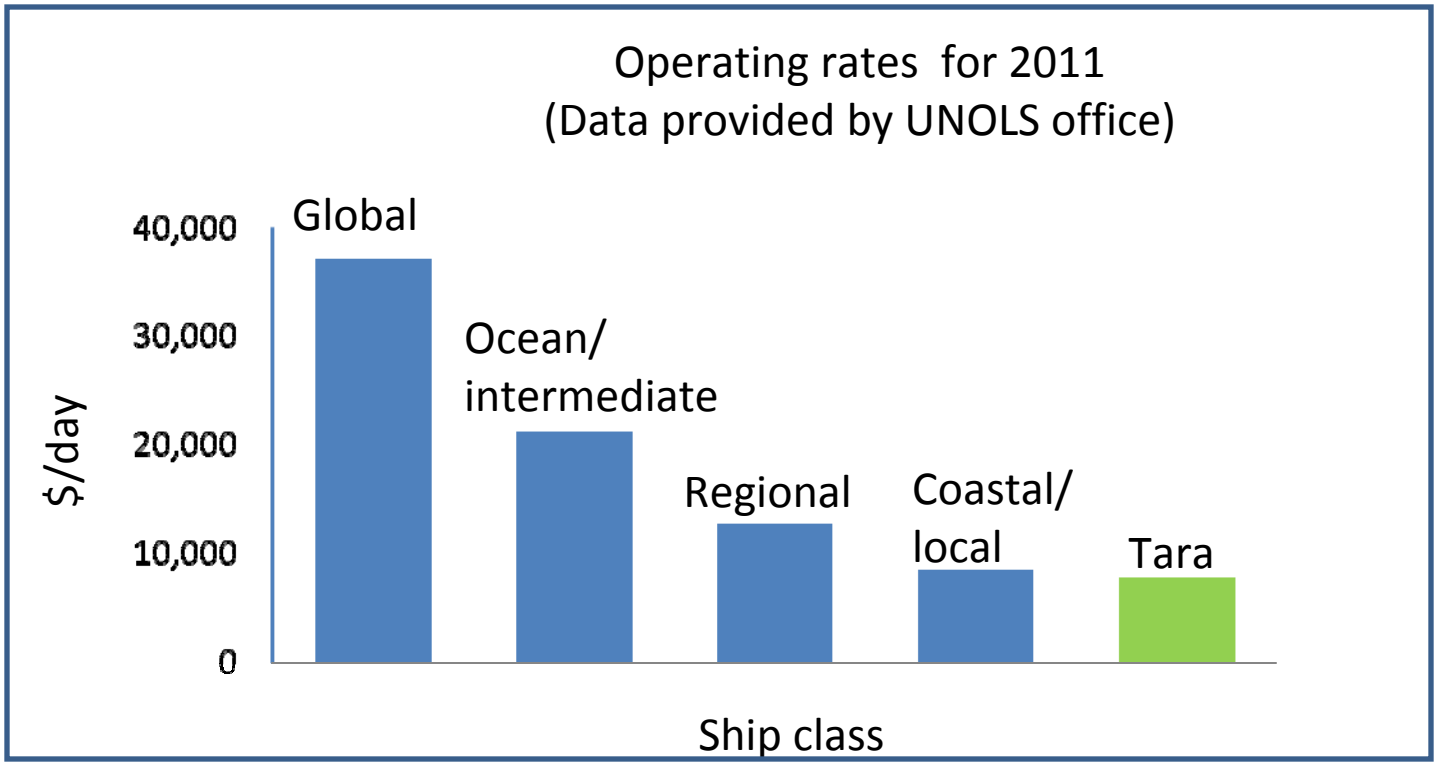
Exhibits

Fashion

Films

Tara is not a 'green' boat but...

- Cheaper (by scale of operation)



- Wind-assisted sailing reduced ~ 50% of fuel use/costs (engine hours/hours at sea)

- Wind/solar panels on board- insufficient in supplying power needs for science (but yes on the ice).

Drawbacks/limitations

- Holding a station (difficult at wind speed >15-20 knots).
- Only accommodates a small team.
- Chemicals use and storage.

Oceanography under sail: lessons from Tara expeditions

- Support integrated, state-of-the-art interdisciplinary research
  - Process studies, deployment of gliders/floats and some monitoring programs.

  - Can operate world wide
  - Polar regions, Global ocean, Shallow water environments (e.g., coral reefs, Amazon)

  - Realistic in terms of current economy

  - Small ~~size~~ → resources conservation
  -Integrated projects, shared resources.
  -New advancements in sensor technology.

❖Economic efficiency and environmental sustainability depend on boat design, area of study and scales of operation (trade –offs).

Thank you!

http://oceans.taraexpeditions.org

Tara stopover in Savannah, GA January 21- 25 ,2012
Tara stopover in NYC Feb 5-12, 2012.
Visitors are welcome!