EuroGOOS
European Global Ocean Observing System

JERICO next

JERICO-RI: the European coastal observing system of systems, component of EOOS

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With
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Eurogoos conference, Bergen, Norway

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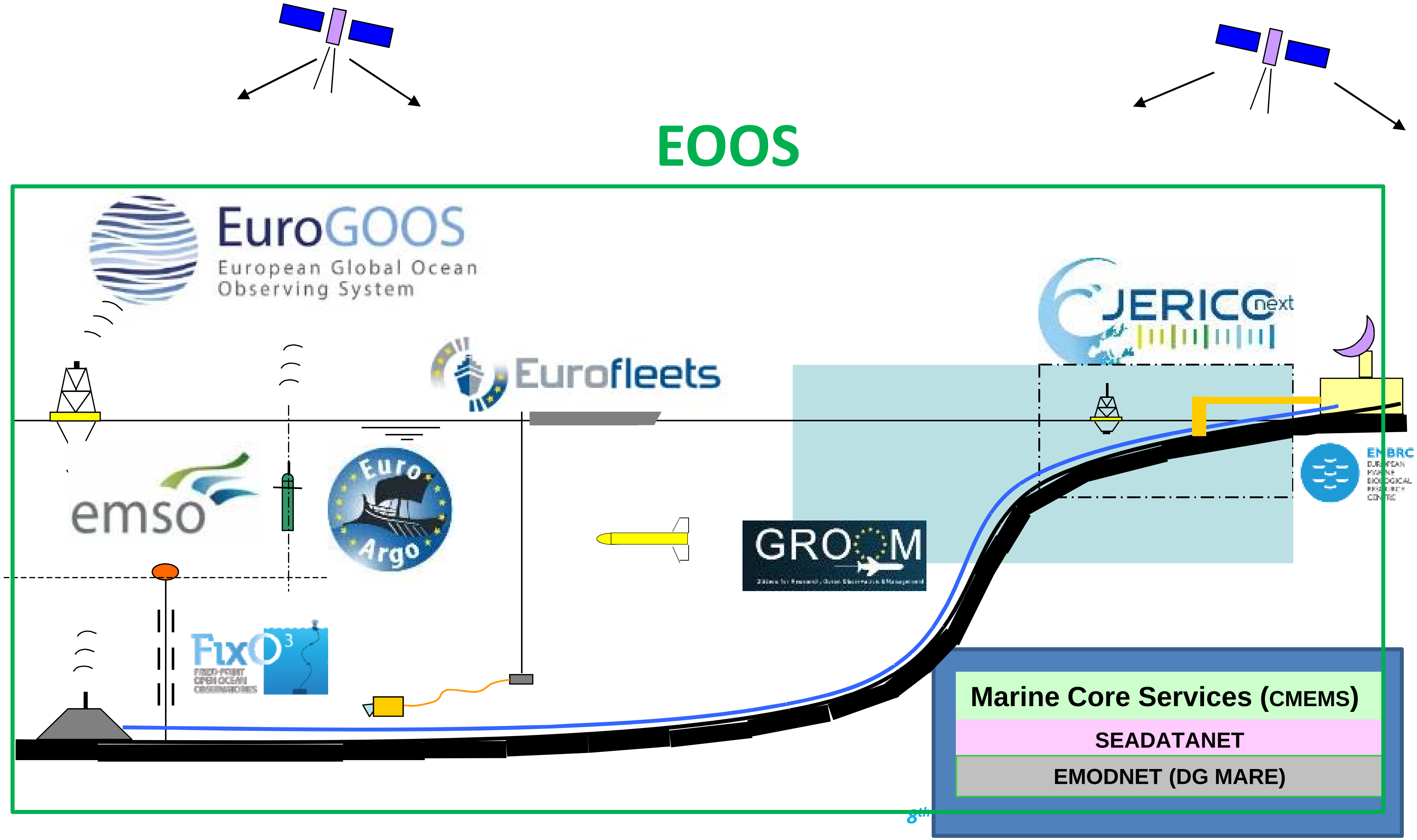
Toward a sustained Pan European JERICO-RI

Some components of the European Context



The JERICO statement

The JERICO-NEXT community

> **" We cannot understand the complexity of the coastal ocean if we do not understand the coupling between physics, biogeochemistry and biology."**

→ **a harmonized research infrastructure for coastal observations**

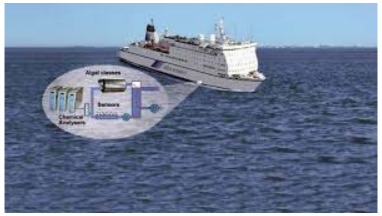
→ **ensure the sustainable provision of high-quality coastal multidisciplinary observations**

→ **new technological developments for continuous monitoring of a larger set of parameter with emphasis on biology**

Project acronym: JERICO
Funding scheme (FP7): Integrating Activities (IA)
EU financial contribution: €6.5 million
Duration: 48 months
Start date: 1 May 2011
Completion date: 30 April 2015
Partners: 27 from 17 countries

Project acronym: JERICO-NEXT
Funding scheme (H2020): INFRAIA 2014-2015
EU financial contribution: €9.99 million
Duration: 48 months
Start date: 1 September 2015
Completion date: 31 August 2019
Partners: 34 from 15 countries

Gliders



FerryBoxes

Fixed Platforms

Harmonization

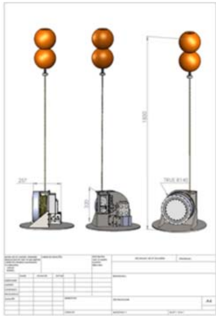
Standardization

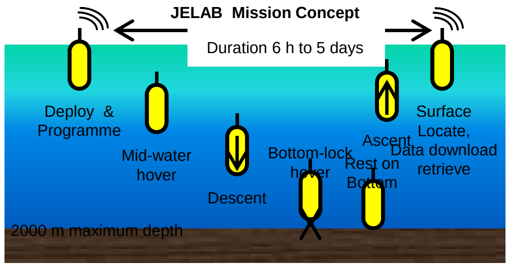
Best practise

Calibration and Assessment

JERICO Label (Technical Committee)

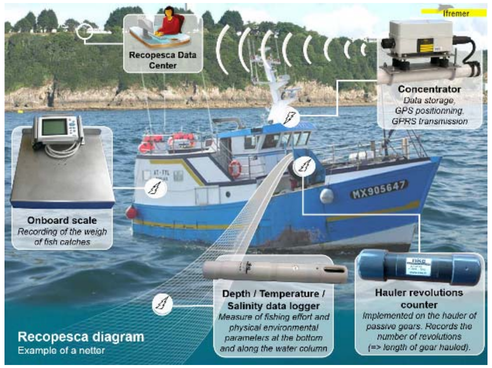
cabled



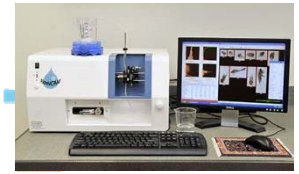


profilers

HF-radar



Fishery & Ocean. Observing System

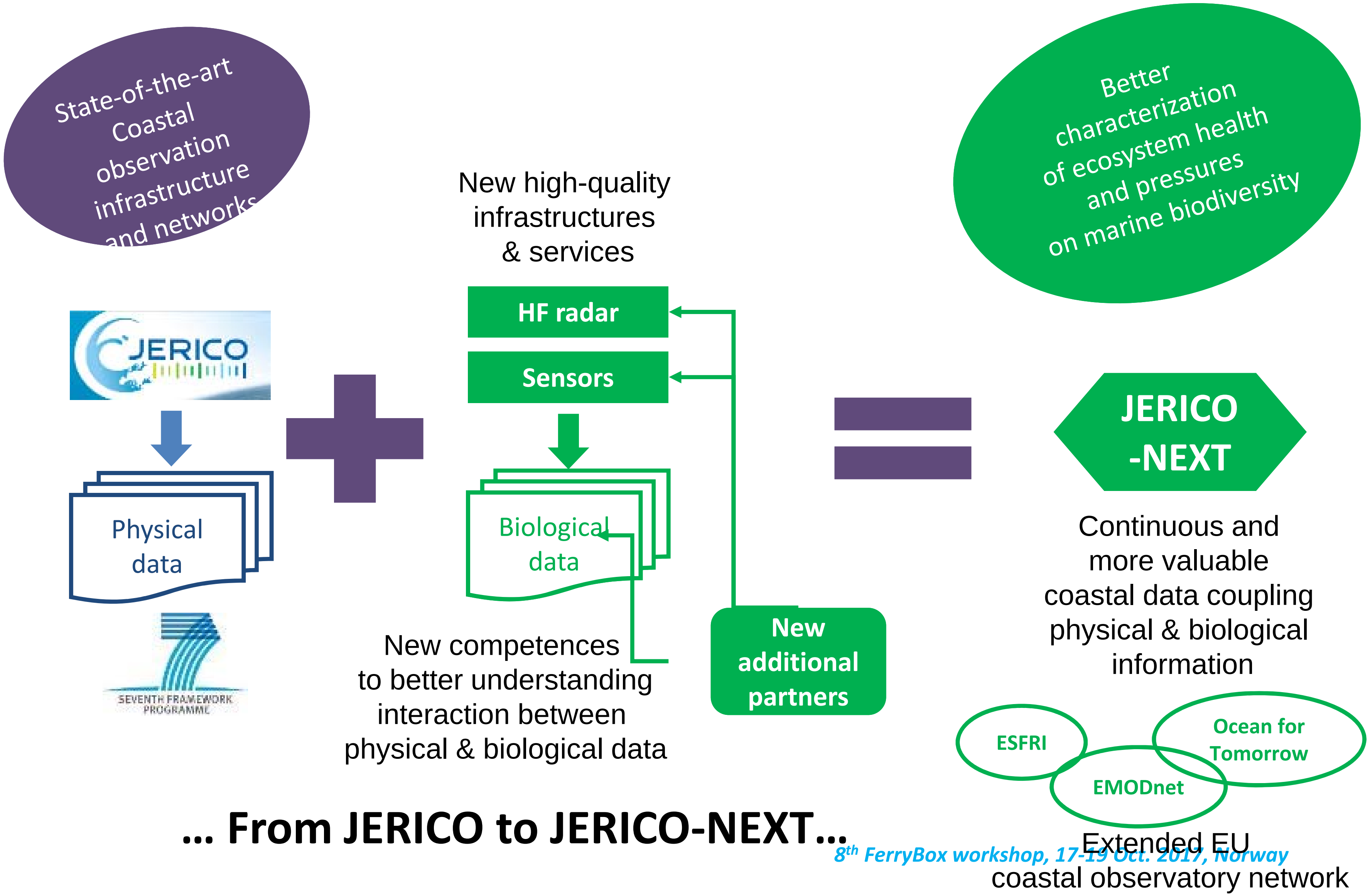


optical sensors

carbonate system

nutrients

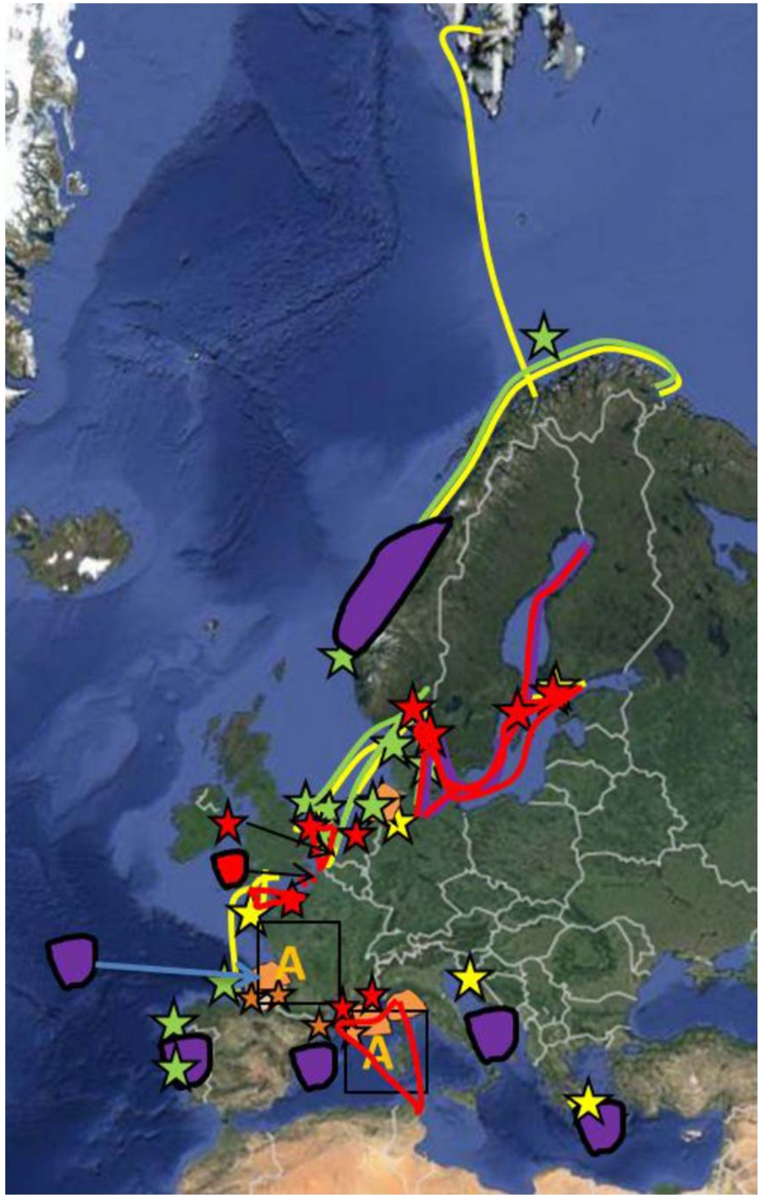
Developing the JERICO-RI



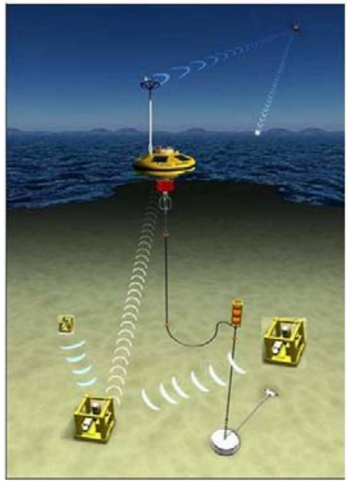
... From JERICO to JERICO-NEXT...

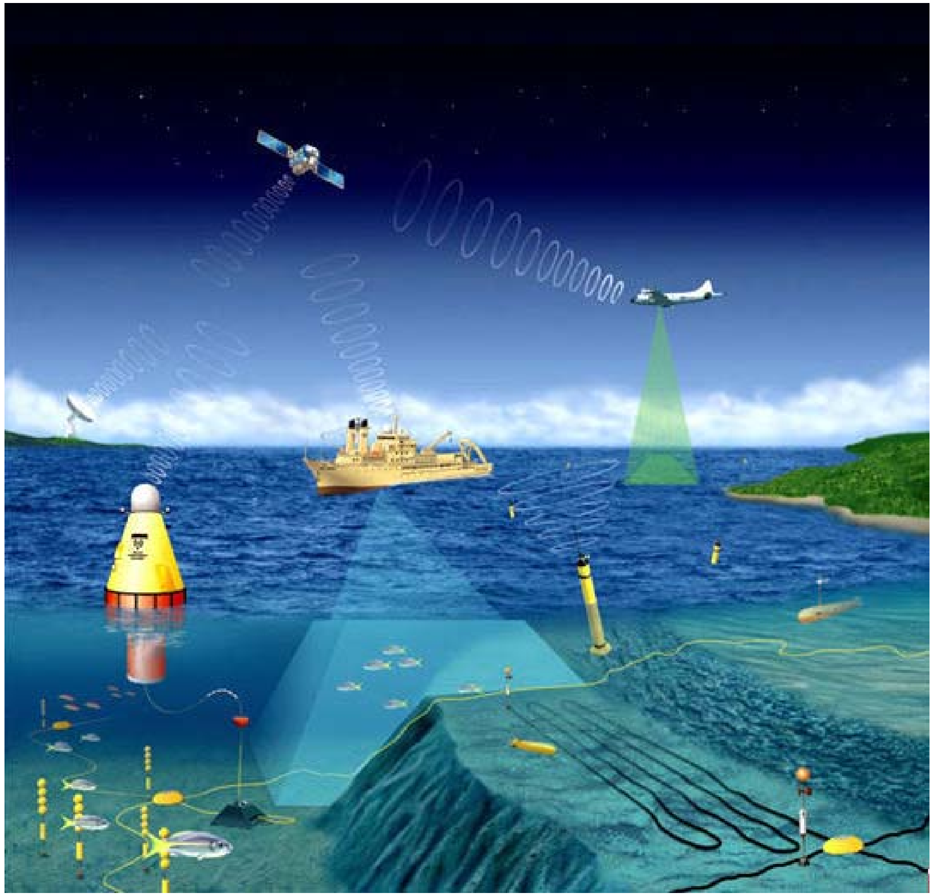
Research & Technology in JERICO-NEXT
Answering societal needs

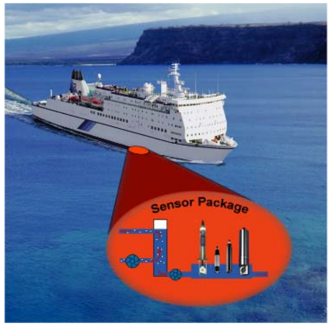
- 6 science areas:
  1. **Pelagic biodiversity**
  2. **Benthic biodiversity**
  3. **Chemical contaminant occurrence and related biological responses**
  4. **Hydrography and transport**
  5. **Carbon fluxes and carbonate system**
  6. **Operational oceanography**

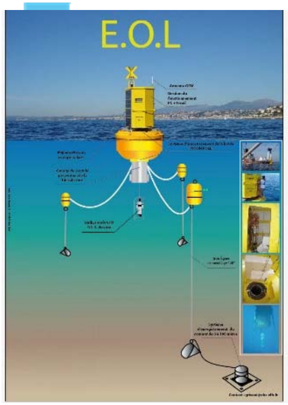


Multi platforms with multiple sensors in appropriate multi scales (temporal and spatial)









FerryBox

Advantages

- Cost effective (no costs for the platform)
- Real-time/near-real-time data
- High spatial and temporal resolution (repeat transects)
- Often covers regions of socioeconomic importance
- “Friendly” environment for the system
  - No energy limitations
  - Good for testing/operating new sensors that may be less robust, or sensors/ samplers that have high energy or sample size requirements
  - Easy maintenance and antifouling measures
- Water can be sampled/preserved for advanced analysis in the lab

Limitations

- Data limited to the transect
- No depth profiles, unless XBTs are used
- Voluntary ships/routes can change

HF Radars

Advantages

- Land based system with easy and relatively low cost of maintenance
- Real time high resolution and synoptic assessment of sea conditions
- Validation / data assimilation for numerical models
- Long Range radars coverage allow assessment in the buffer zone between Regional models (like Marine Core service) and downstream coastal models
- Scientific interest: Cover a wide range of spatio-temporal scales in a synoptic way to study ocean processes (HF, spatial structure)
- Operational key products for transport monitoring (Search & Rescue, pollution drift…), possibility of providing short term prediction forecast using only HF radar data.

Limitations

- No data coverage in the baseline between antennas that usually leads to poor coverage near the coast.
- Data coverage/quality in time change due to sea state conditions. Continuous QA/QC is required.
- Only water surface information (0-2 m)
- Second order information is limited (e.g. wave monitoring, tracking of discrete targets)

Gliders

Advantages

- They work 24 hours a day, 7 days a week.
- They cover large distances.
- They can go on long-term missions.
- They're autonomous, unmanned systems, so you don't need a large number of people on board, as you would on a boat. Therefore, they're much cheaper!
- They can include many different sensors to measure many kinds of data (temperature, salinity, chlorophyll, oxygen... even sounds!)
- They allow us to collect almost real-time data.

Limitations

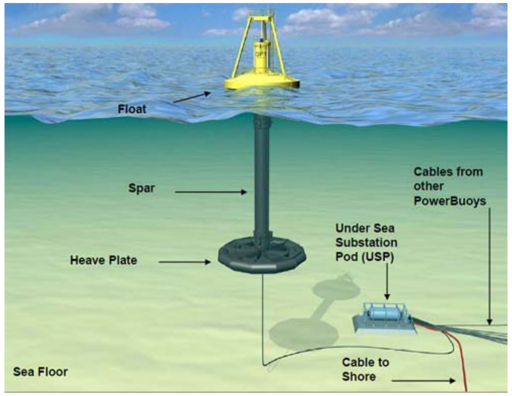
- They move very slowly.
- They can only go down 1000 meters. They can't go any deeper!
- They can't take samples on the spot. They don't have an arm that can take sand or water samples, for example. They can only collect data!
- Their sensors are still quite low-resolution compared to the ones available on boats.
- Their technology is very recent. They're still in the prototype stage, so things don't always work properly.
- Watch out! Danger! They can run into fishing nets, plastic objects, or collide with the sea floor or boats.Initial investment is high

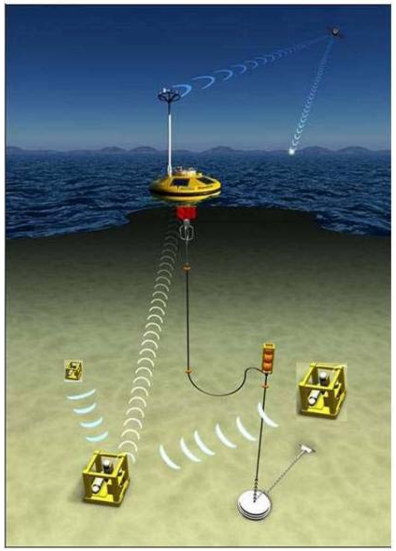
http://followtheglider.socib.es/en/estudiantes/whatisaglider/

Buoys/bottom platforms

Advantages

- Can be located almost anywhere
- Portable
- Stable position – long term observations
- Very good vertical resolution
- Relative high temporal resolution
- Near Real time transmitting of data
- Validation / data assimilation for models
- Configuration flexibility - can host many different sensors
- Cabled Sea bed platforms
    - Unlimited power
    - Unlimited bandwidth - video
    - Payload
- Cabled buoys
    - Unlimited power
    - Unlimited bandwidth – video
    - Maintenance cost

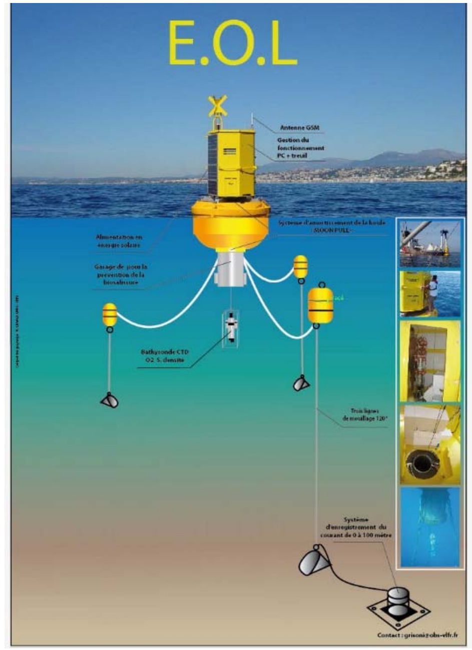




Limitations

- Can be expensive
- Biofouling
- Vandalism
- Energy
- Harsh environment – demanding for materials
- Need supporting infrastructure (calibration)
- Experienced personnel

Profilers



Advantages

- Vertical profiles of physical, biological, chemical and optical properties at a geographical location.
- Sub-meter scale vertical resolution from 1-2 m above the water floor to the surface in water depths up to 100 m.
- Precise control of the profiler’s vertical position in the water column, especially in dynamic surface wave environments.
- Able to “hide” in heavy seas – no need for buoy.
- Removes the need for a permanent surface buoy and mooring cable.

Limitations

- Can be expensive
- Biofouling (less compared to buoys)
- Energy
- Harsh environment – demanding for materials
- Moored profilers climb up and down subsurface mooring cables
- Communication when there is no buoy

In situ Sampling

Advantages

- E2E study
  - Nutrients
  - Size fractionated Chla
  - Bacteria to mesozoo
  - Temp(CTD)
  - O_2 (CTD)
  - Fluorescence (CTD)
  - ……
- High quality measurements
- Very good vertical resolution

Limitations

- Labour intensive
- Costly
- Delayed mode data
- Low temporal resolution
- Low spatial resolution
- Visits depend on weather

Sampling

time

Again ?

Remote sensing

Advantages

- Observation of a large geographical area
- Temporal resolution
- Long-term and fast collection of data
- Lower collecting costs
- "Inaccessible" regions become accessible (e.g. Antarctica)
- Object is not being destroyed

Limitations

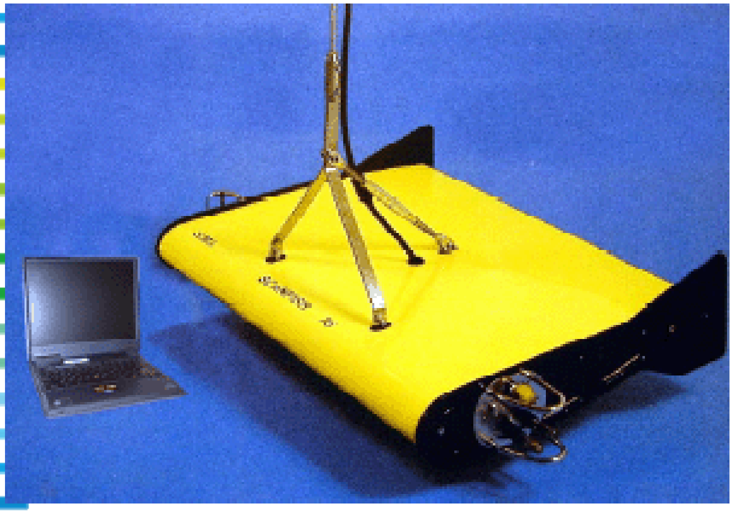
- 2D information for a 3D ocean
- Only clear days
- Algorithms in coastal areas can be problematic - Noise caused by another source than the desired one
- Lower spatial resolution
- Captured data need to be calibrated via in-situ data

Other methods

Animal telemetry

Drifters

Scanfish



New Technology

Vaimos

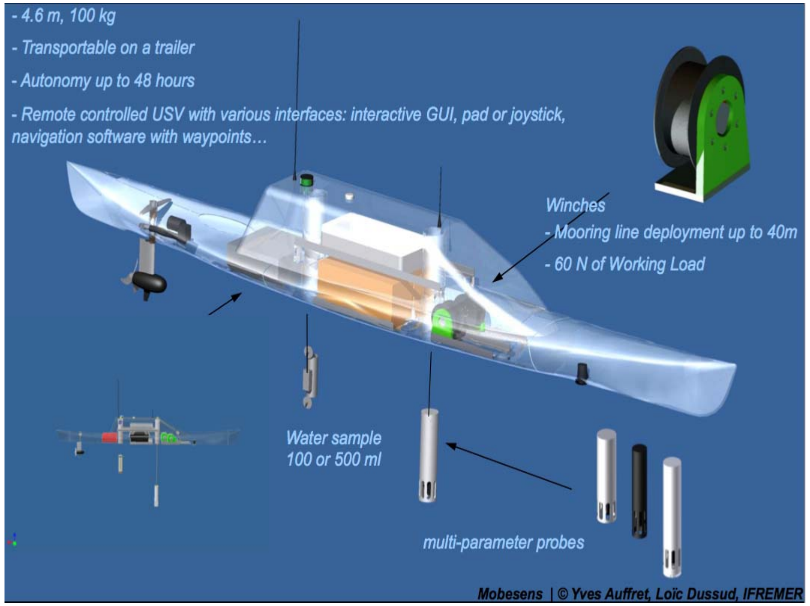
Laurent Delaney Ifremer

Objectives :

- Autonomous waypoint operation
- " Salinity and fluo measurement on the ocean surface layer
- " Surface layer perturbation at the minimum
- Solar panels
- Vertical wind energy mill
- Specific ringing adapted for automation
- Water inlet under hull and at the base of keel for
- Multiparameter probe measurement.

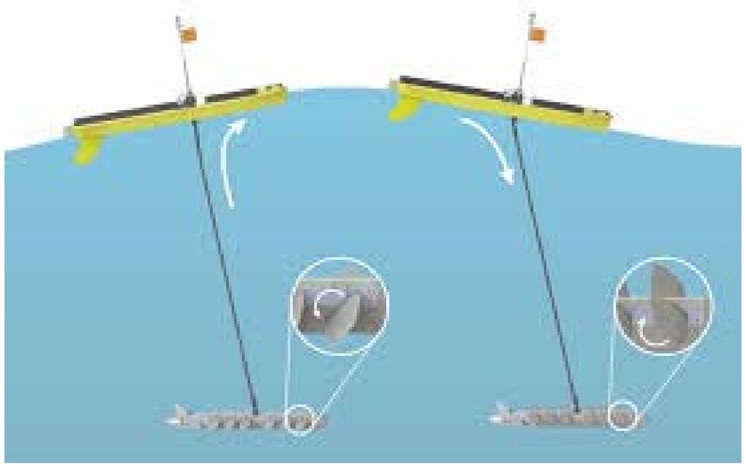
Saibuoy

Mobesens



Laurent Delaney Ifremer

Wave gliders



JERICO-NEXT WP3

(Innovations in Technology & Methodology)

3.1 Automated platform for the observation of phytoplankton diversity

- Pulse-shape recording Flow Cytometer
- Imaging Flow Cytometer
- Flow Cytometer
- FlowCam
- FastCam
- PSICAM
- Spectral fluorometer
- PAM or Phyto-PAM
- FRRF or spectral FRRF
- Underwater Vision Profiler - UVP5
- Automated data analysis

3.2 Developments on current observations from HF radars

- Procedures for current retrievals and data quality control
- Network development
- New products

3.3 Profiling technology

- MASTODON2D
- YOYO trawl-secured profiling system
- JELAB: Jerico Extended Lagrangian Bio-Geo-profilers

3.4 Microbial & molecular sensors

- Optimisation of biosensors for Toxic Algae
- Automated rDNA sampling

3.5 Combined sensors for carbonate systems

- pH & carbonate
- Total Alkalinity
- Spectrophotometric pH and potentiometric pH

3.6 Benthic compartment and process

- Integrated multi-sensors towed video system
- Organic matter mineralization

3.7 Observing system experiments

- Transport in high-resolution DA
- OSE/OSSE
- Optimization of HF-radar DA for the tracer transport

PHYTOPLANKTON

Development of innovative optical techniques for assessing phytoplankton abundance and/or biomass equivalents, per size/functional groups, photosynthetic activity/physiological status:

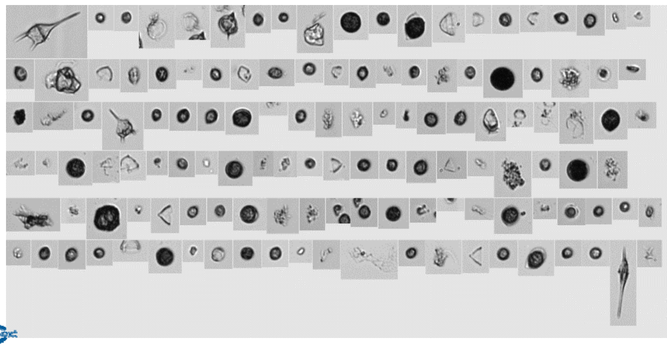
→ Image acquisition and analysis (in flow/*in situ*)

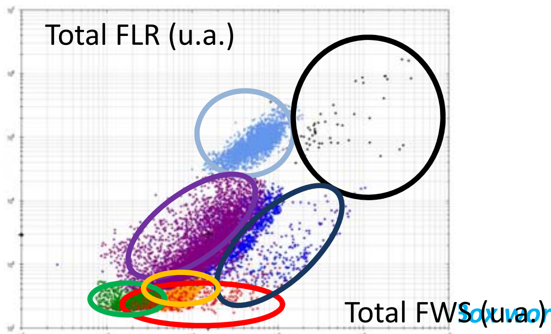
→ Single-cell optical analysis (pulse-shape recording FCM) #

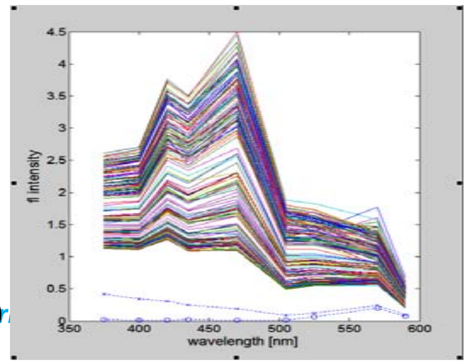
→ Optical bulk multispectral techniques (fluorometers, spectrophotometers)

1. Pulse-shape recording Flow Cytometer (+ Image acquisition) module
2. Imaging Flow Cytometer
3. Flow Cytometer
4. FlowCAM

5. Spectral fluorometer - AOA or Fluoroprobe
6. PAM or Phyto-PAM
7. FRRF or spectral FRRF
8. Underwater Vision Profiler - UVP5
9. (Semi-) Automated data analysis
10. FastCAM Absorption meter - PSICAM



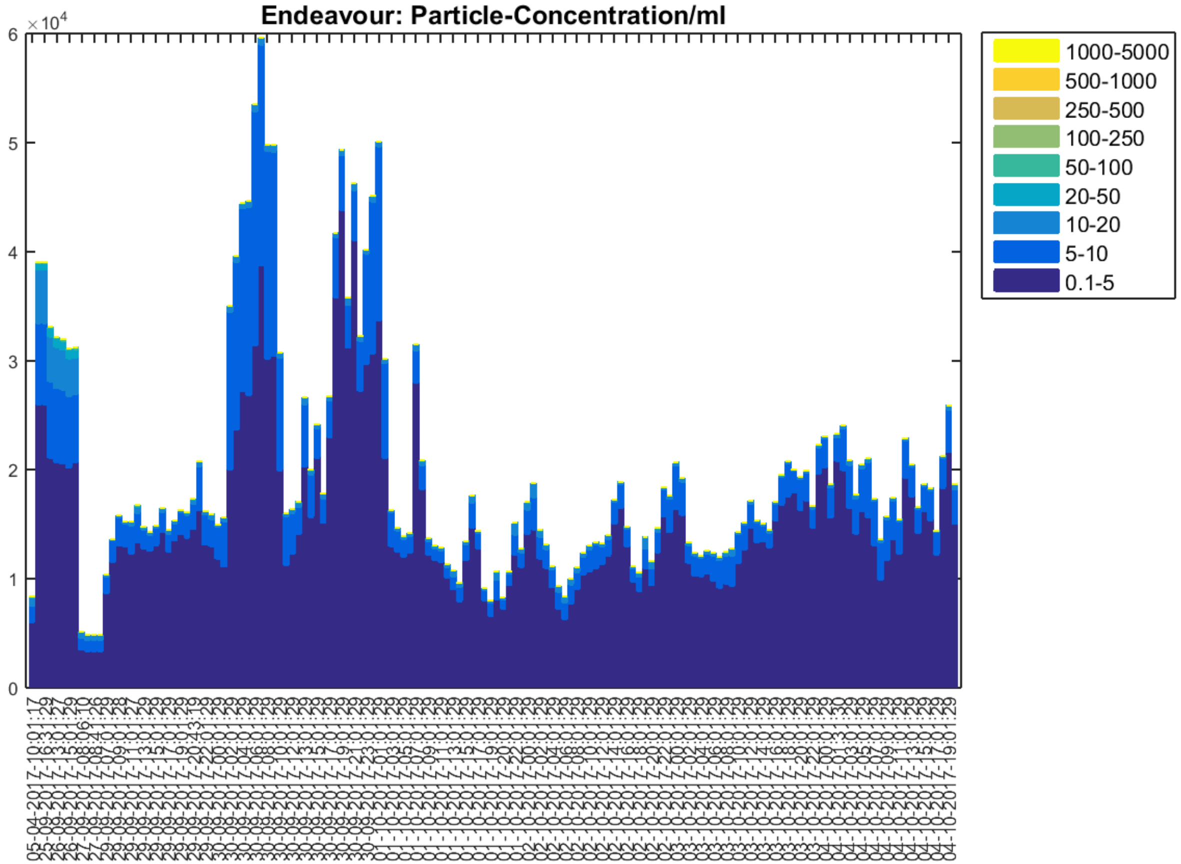




Flow cytometry

Live' results of several locations Water samples are collected in natural waters (marine or fresh) at a high frequency (e.g. every hour) automatically and without any interference of people. The flowcytometric analysis is done in a few minutes followed by an automatic data analysis and upload of results to this website, which is performed within 2 minutes after the flowcytometric analysis

These 'live' results are visualized in graphics and are even accessible by a mobile (smart) phone. This very recent development includes two 'live' locations. Other people are invited to have their 'live' results on this website in near future.

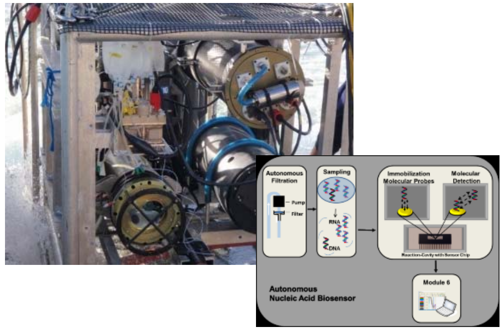


Live Results Endeavour

BIOSENSORS

Develop biosensors for harmful algal blooms, microbial community changes and pollutants and improve current platforms and sampling methods to accommodate these technologies.

- development of sensors for the molecular detection of phytoplankton, harmful algae blooms, and pollutants **through their effect on microorganisms**
- Optimisation of a biosensors for the detection of toxic algae
- Automated sampling of rDNA adapted to the Ferrybox

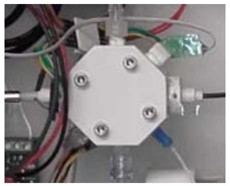


CARBONATE SYSTEM

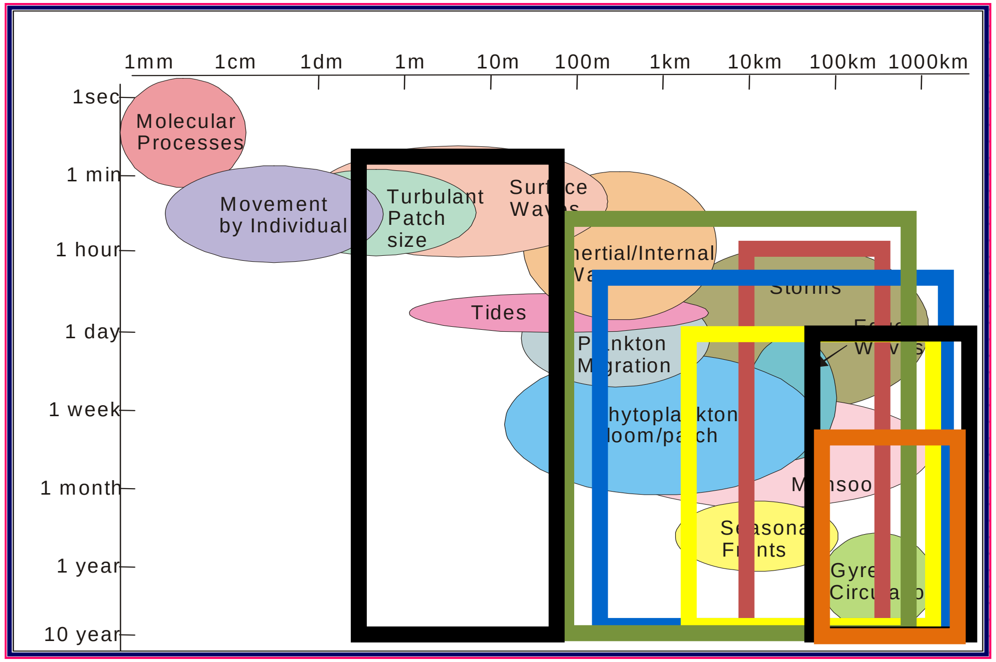
To develop sensors that can measure **two seawater carbonate system variables simultaneously**.

Three different systems are constructed and tested during the project:

- pH and carbonate,
- pH and total alkalinity,
- Spectrophotometric pH and potentiometric pH.



WHERE WE ARE?



Adapted from J. Tintore

FerryBox

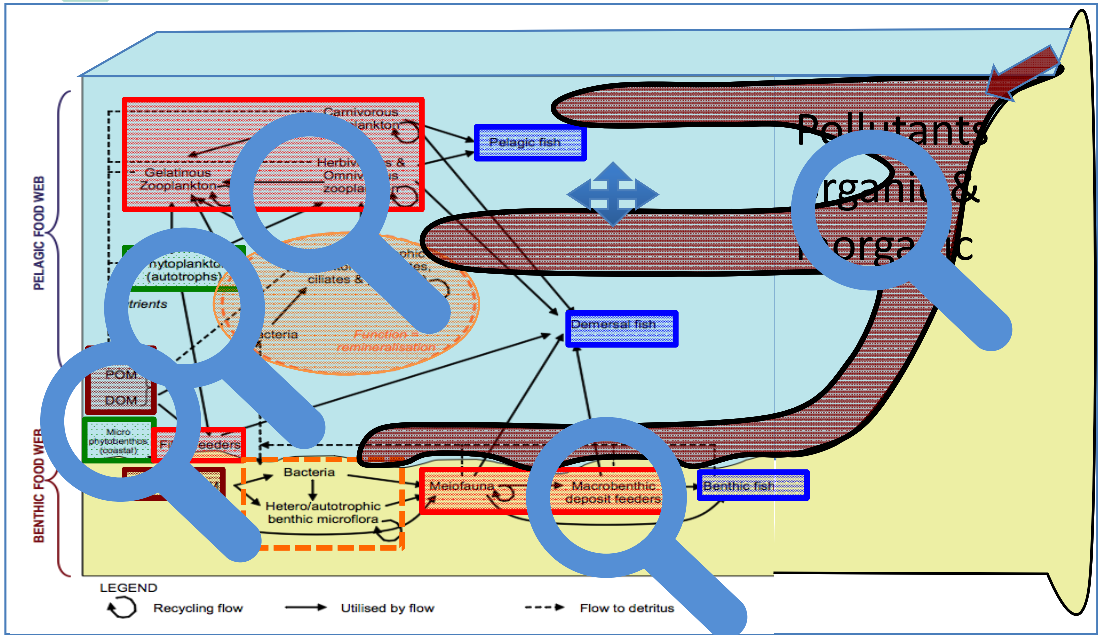
Gliders

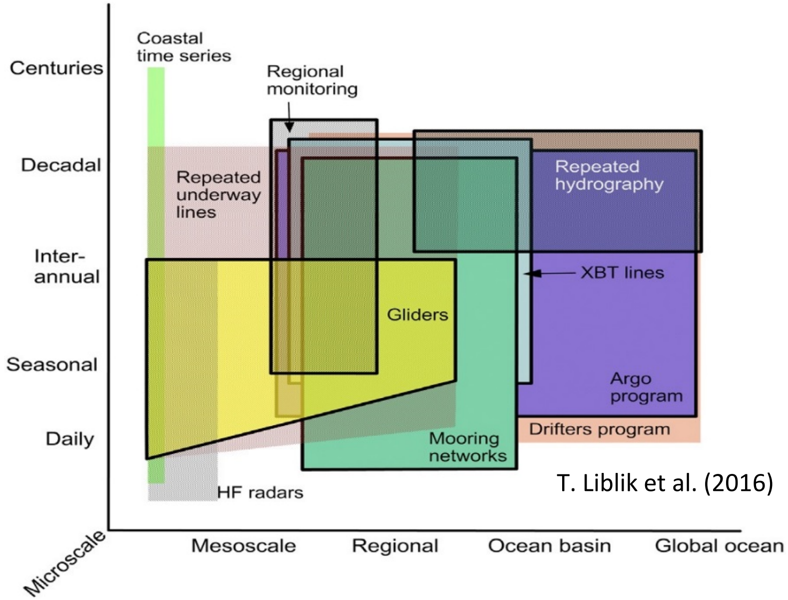
Fixed Platforms

HF radar

Satellite

Argo

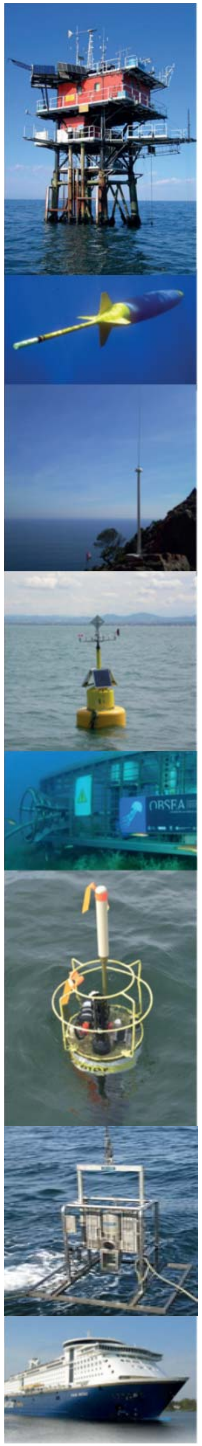




T. Liblik et al. (2016)

Some of the challenges ahead

- **Innovation in observing**: invest in research and development of new ocean sensors (e.g. biological, acoustics), platforms and cross-sector research to ensure marine science takes advantage of state-of-the-art developments.
- It is difficult to move from research funded technology developments to operational applications and industry based production but **fostering innovation** will be key to achieving success.
- **“intelligent sampling”** is transforming event-driven scientific research and marine management, offering the chance to interact with autonomous sensors in near real-time and to change the sampling time, resolution, depth profile or trajectory of the platform.
- Strengthen **co-operation** between infrastructure and to make the best use of human expertise.
- When it comes to data it is the **Quality** which is important but until now efforts were towards “quantity”.
- Science and technology are continuously evolving and an effective and relevant ocean observing system needs to be **adaptable** to respond **to new breakthroughs**.
- Are we ready for proposing an integrated European infrastructure ESFRI project ?



This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 654410.

Ferrybox 4HJENA

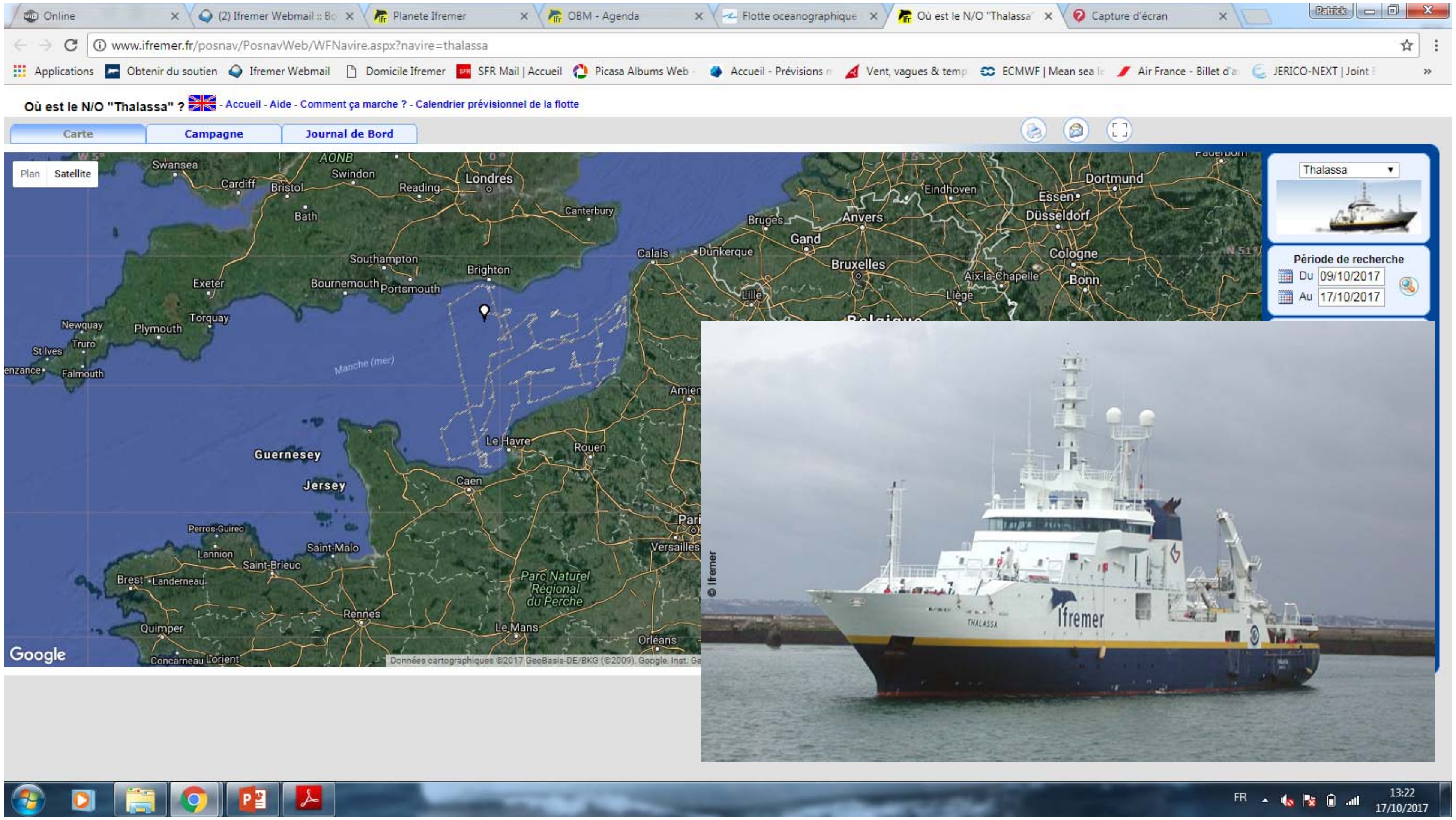
Underway Measurement system (FERRYBOX) – Main sensors

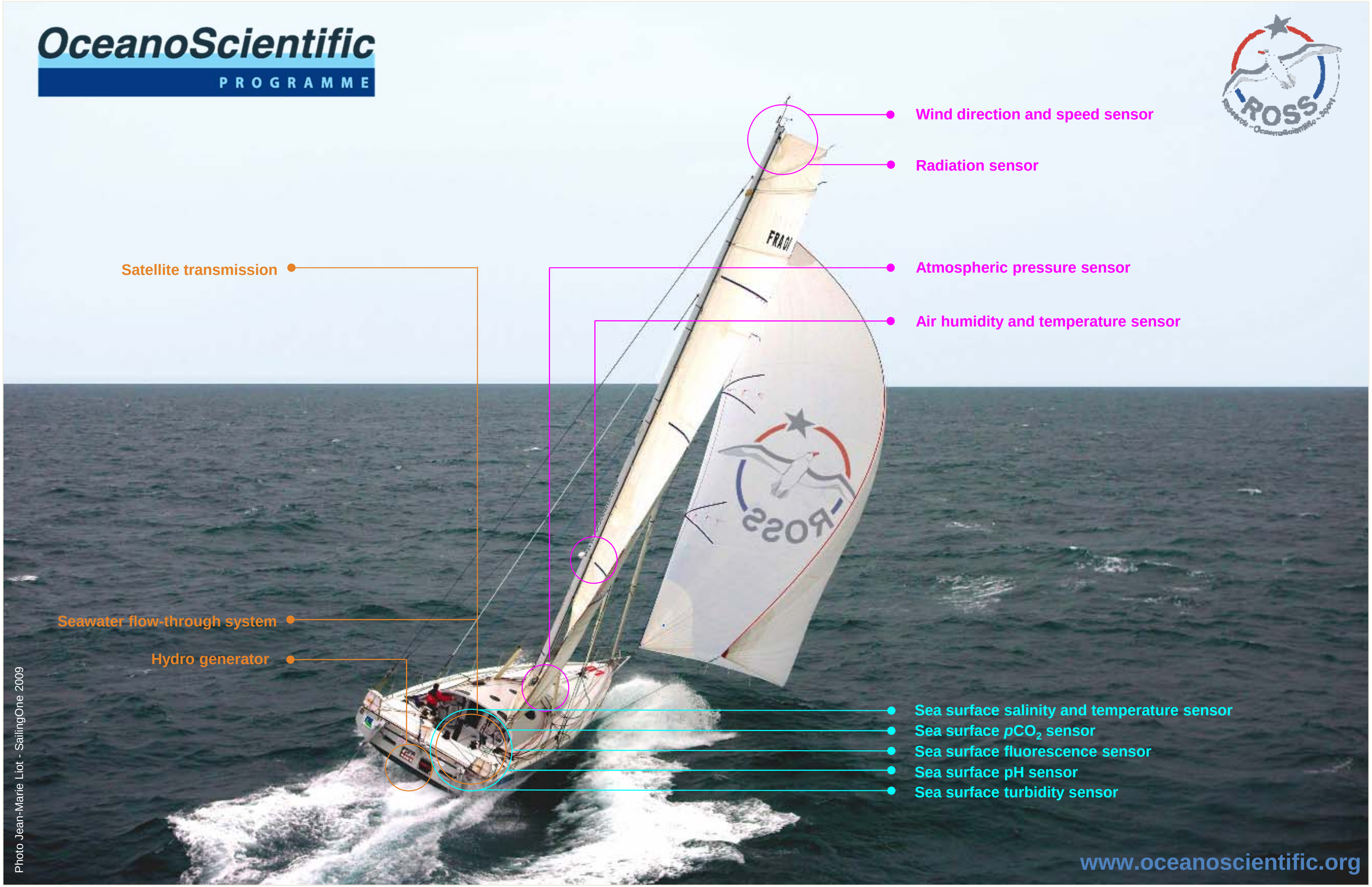
- Conductivity: SBE21 + SBE45
- Temperature SBE38/SBE3S at water intake
- Dissolved Oxygen
- Fluorimeter
- Turbidity
- PA
- pCO2

- Ferrybox piping circuit with a biofouling cleaning system
- New piping circuit for lab's sinks
- New piping circuit close to transducers for sound velocity senso

S. Duduyer, NavOceano SHOM-Ifremer Meeting, 26th-27th April

Pseudo random transects



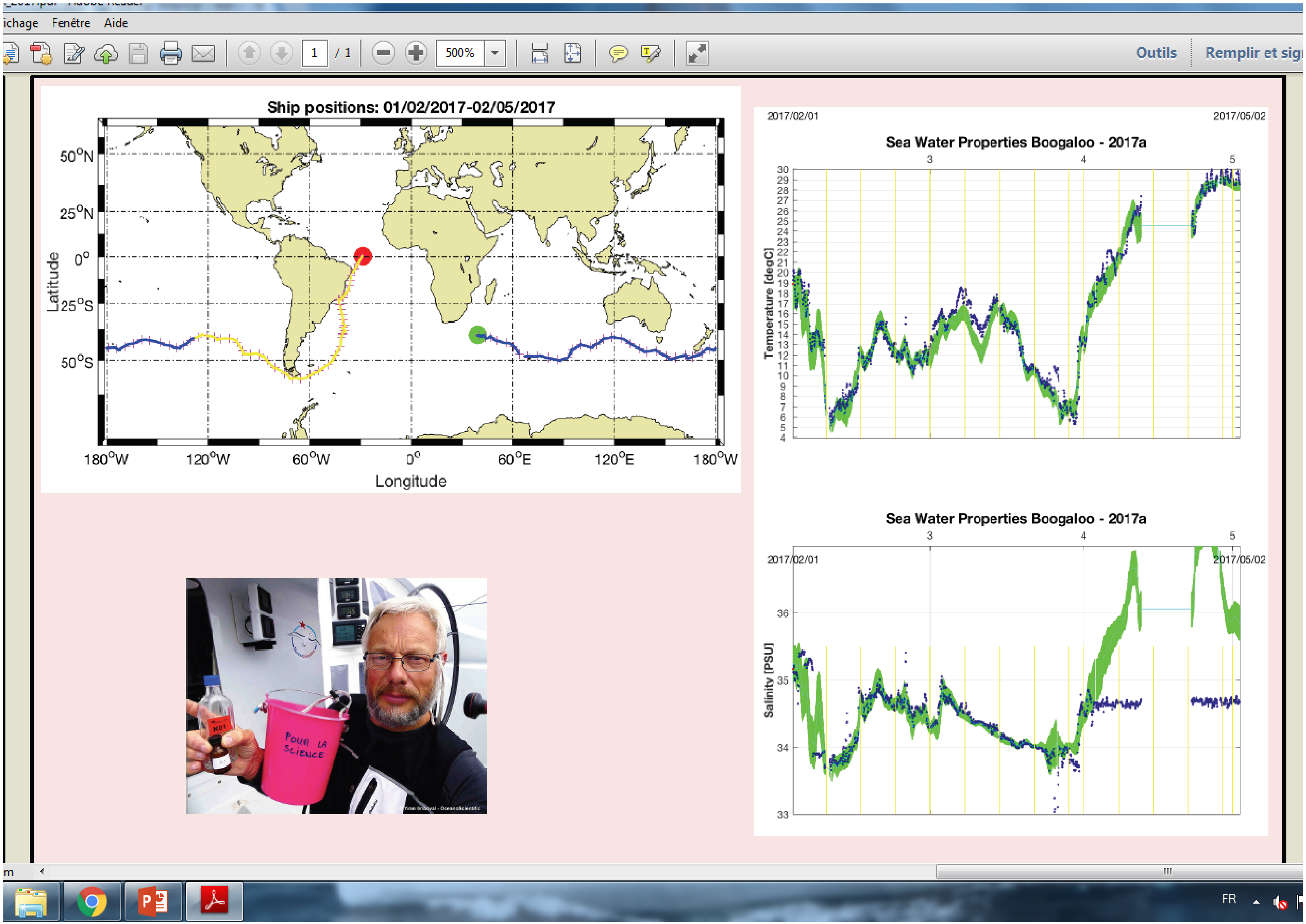


SailingOne

subCtech Subsea Technologies

Ifremer

METEO FRANCE
Toujours un temps d'avance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POUR LA SCIENCE
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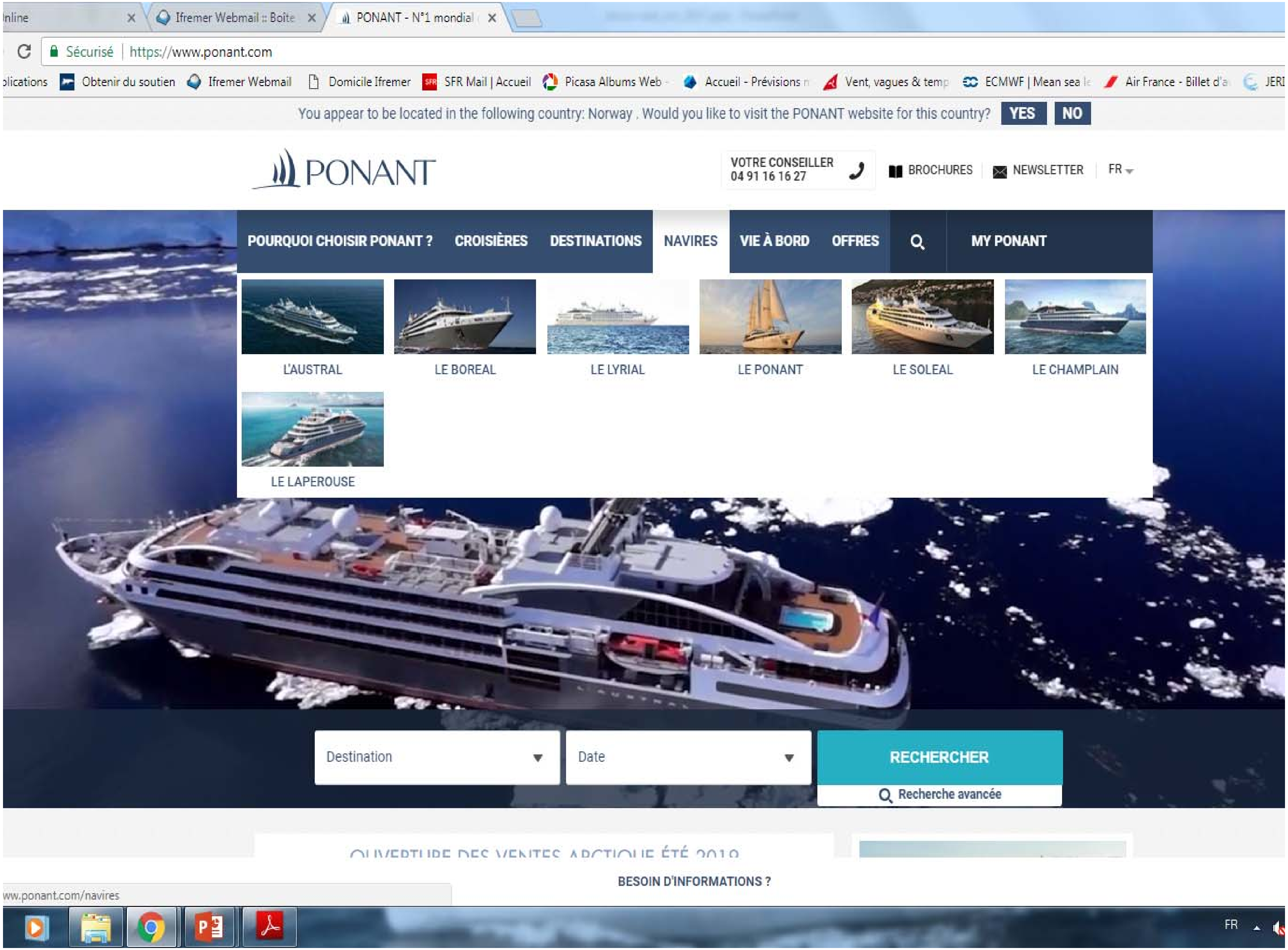
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