Bio-Argo / Biogeochemical Argo

Organisation of the community, future plans

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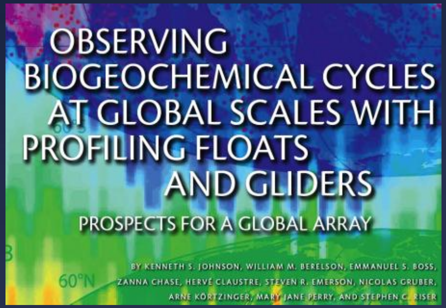
AST – 13, Paris March 2012

The “Bio-Argo” community is getting organized



Oceanography (2009)

Toward the Implementation of a Global Autonomous Biogeochemical Observing System, WHOI, June 2011

« Bio-Argo » Community White Paper,
« Integrated Bio-platform» Plenary Paper

Session and Town Hall meeting : Development of a Global Ocean Biogeochemical Observing System Based on Profiling Floats and Gliders

First participation of one Bio-Argo representative to ADMT meeting (2011)

Two large pilot projects and network implementation perspectives : profiling floats

- **remOcean**: REMotely sensed biogeochemical cycles in the OCEAN
- **NAOS**: Novel Argo ocean Observation System

Remotely-Sensed Biogeochemical Cycles in the Ocean

6-year project (2010-2016)

- Development of profiling floats to measure oceanic variables which are essential for the characterization of phytoplankton dynamics and related carbon fluxes.

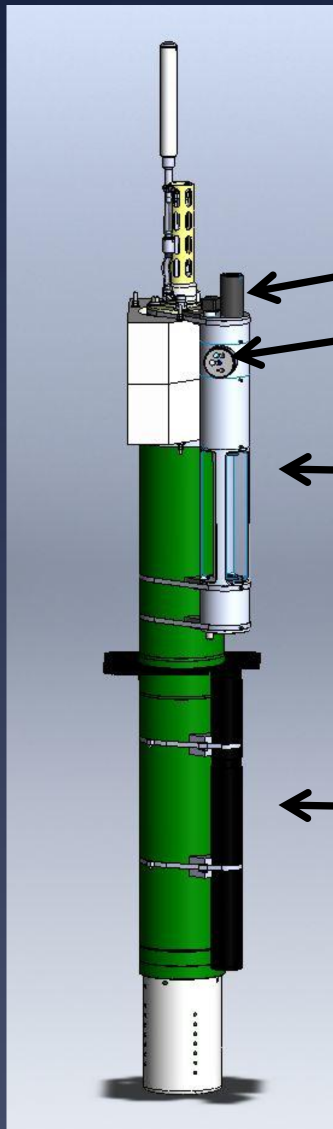
- Deployment of these floats in the four sub-tropical gyres (16 floats) and in the sub-polar North Atlantic (24 floats) automated investigation of biogeochemical cycles in these areas over a continuum of temporal scales and over a period of 3-4 years.

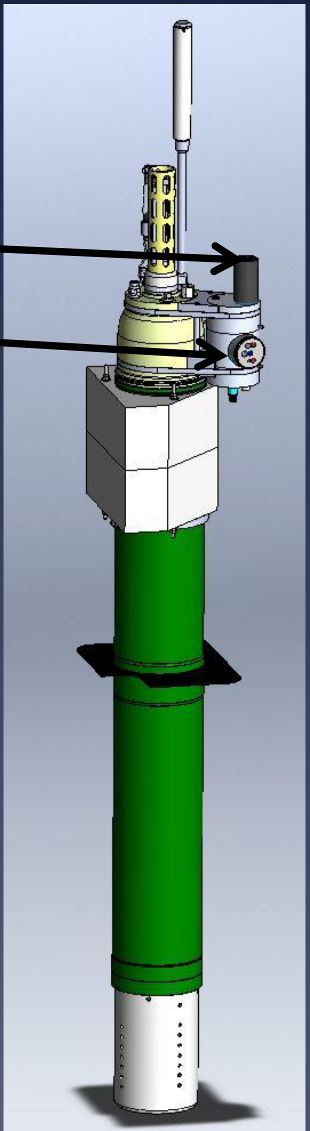
- Development of parameterisations linking surface biogeochemical properties to their vertical distribution in the ocean interior, and ultimately development of 3D fields of these properties by combining float and satellite data.

- Estimation of carbon fluxes by combining these fields with bio-optical modelling including retrospective analyses thanks to satellite data archives.

Pi: Hervé Claustre, collaboration with A. Körtzinger, AWI

On-going developments in our lab : two examples of (more complete) Bio-Argo "like" floats





remOcean Remotely-Sensed Biogeochemical Cycles in the Ocean

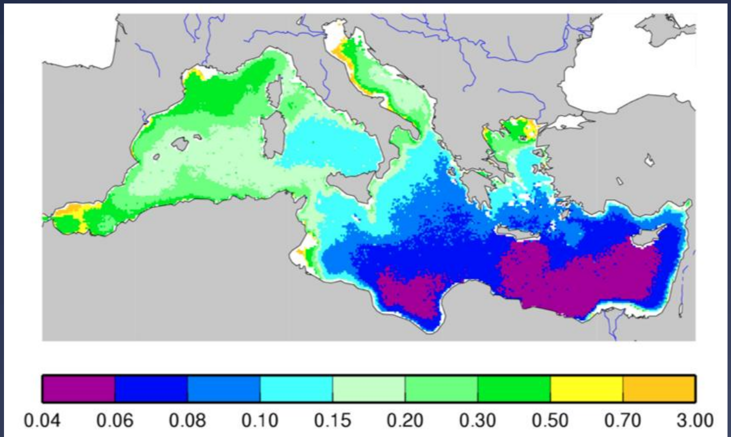
Novel Argo Ocean observing System

9-year project (2011-2020), french «equipment of excellence » funding scheme

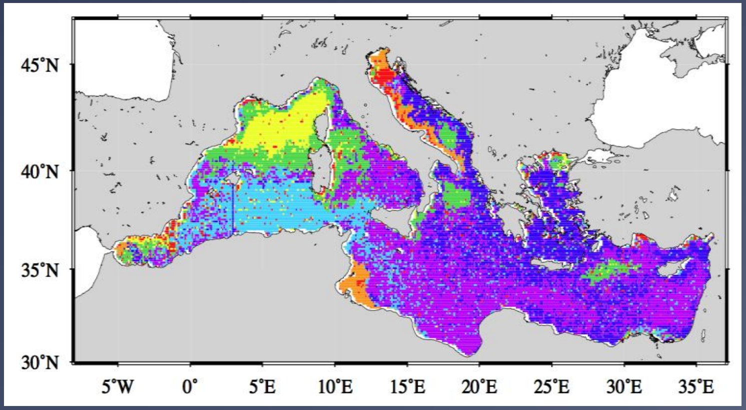
- Reinforcement of the French contribution to Argo (S. Pouliquen, Ifremer).
- Technological developments (deep floats, new transmission, towards biogeochemistry and under ice) (S. LeReste, Ifremer)
- North Atlantic: Deep Oxygen floats: 24 (V. Thierry, LPO)
- Med Sea: “remOcean” floats: 30 (F. D’ortenzio, LOV)
- Arctic (Baffin bay) : “remOcean” floats: 26 (M. Babin, Univ. Laval, LOV)

Mediterranean Sea: understanding phytoplankton dynamics (phenology) within various trophic regimes

chlorophyll a



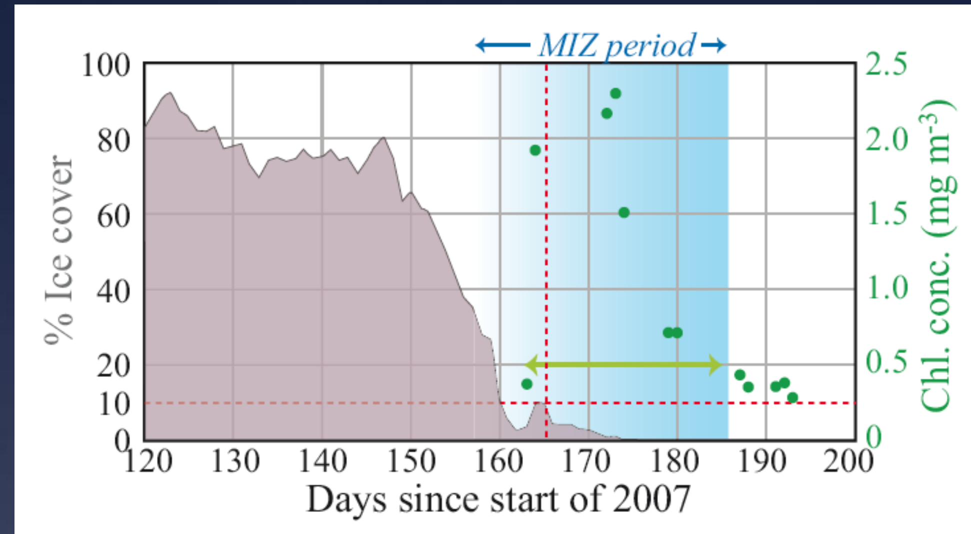
5 open-ocean trophic regimes



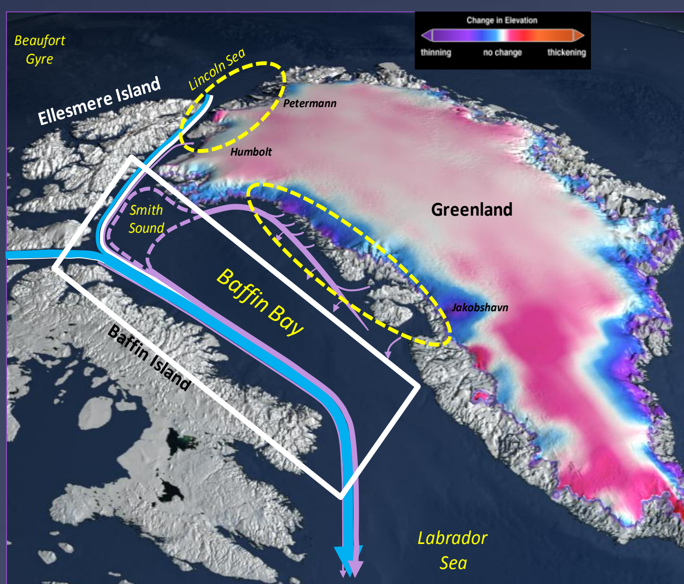
- deployments adapted to trophic regimes : seasonality in biomass
- Evolution of the Argo rules (every 10 days, more float density than 300 km x 300 km)
- intensification of observations (time / space)
- 30 “remOcean” floats

F. D’ortenzio, LOV

Arctic: Ice-edge blooms



Perrette et al. (2011)



- 13 +13 « remOcean » floats with ice detection

TAKUVIK

NAOS
Novel Argo Ocean observing System

M. Babin, Univ. Laval, Quebec

Estimation of the costs for Bio-Argo implementation at an European Level

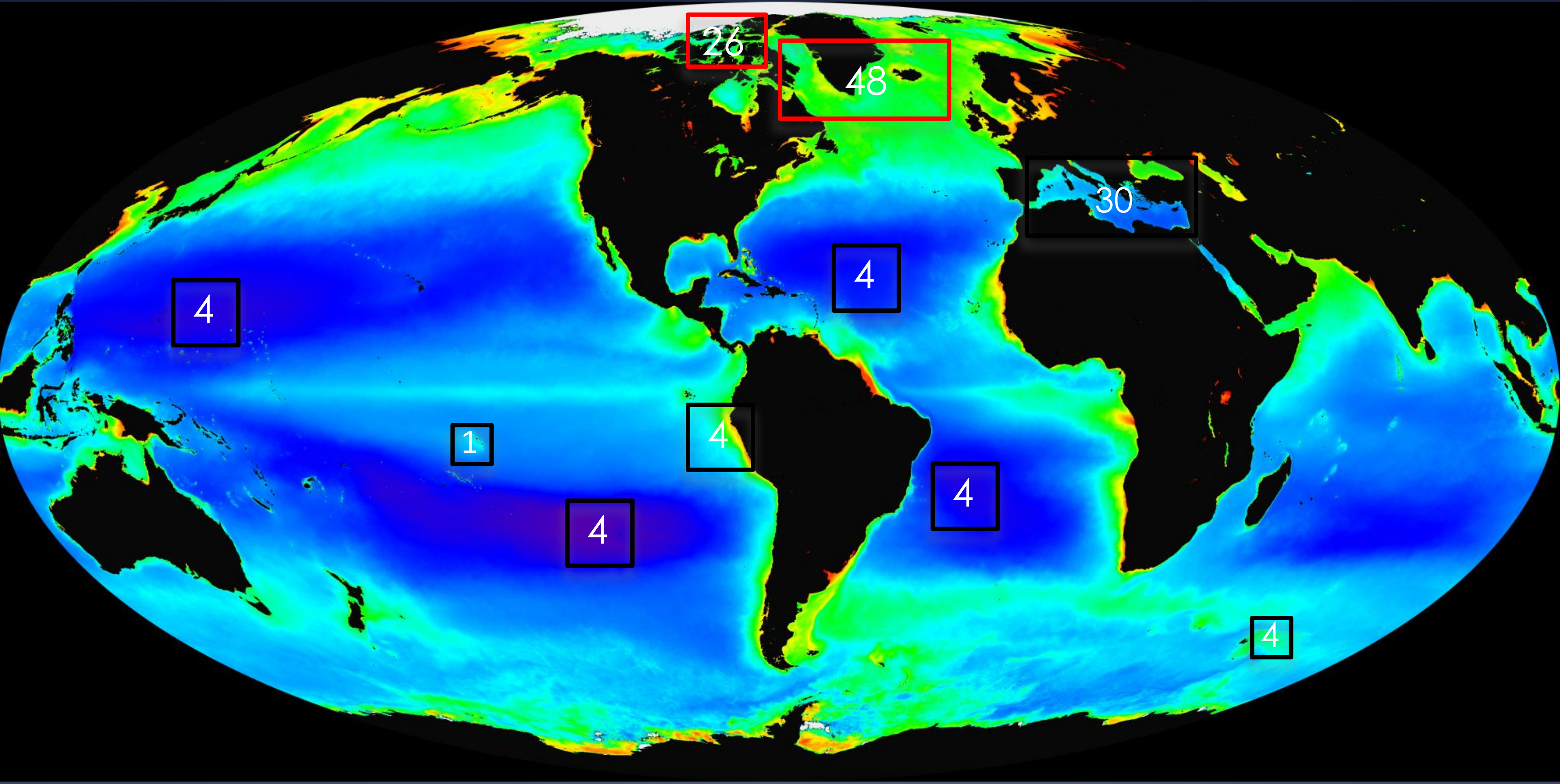
- OceanObs 09: community agreement that 20% of the floats should be on a “Bio-Argo” mode. For the Euro-Argo (250 floats year^{-1}) this represents 50 Bio-Argo floats year^{-1}

- The sensor additional cost together with iridium transmission : ~ 25 k€ float^{-1}

- Data QC/ management / distribution : 4 persons full time

- BIO-Argo first phase of implementation: 1.5 M€ year^{-1}

The coming playgrounds



Remotely-Sensed Biogeochemical Cycles in the Ocean

Sub-polar NA gyre and higher latitudes

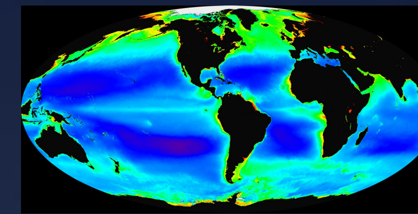
26 floats: 2013-2016
bio-optics, O_2,
NO_3 (some)
under-ice capability
+ gliders
(ice edge-bloom)

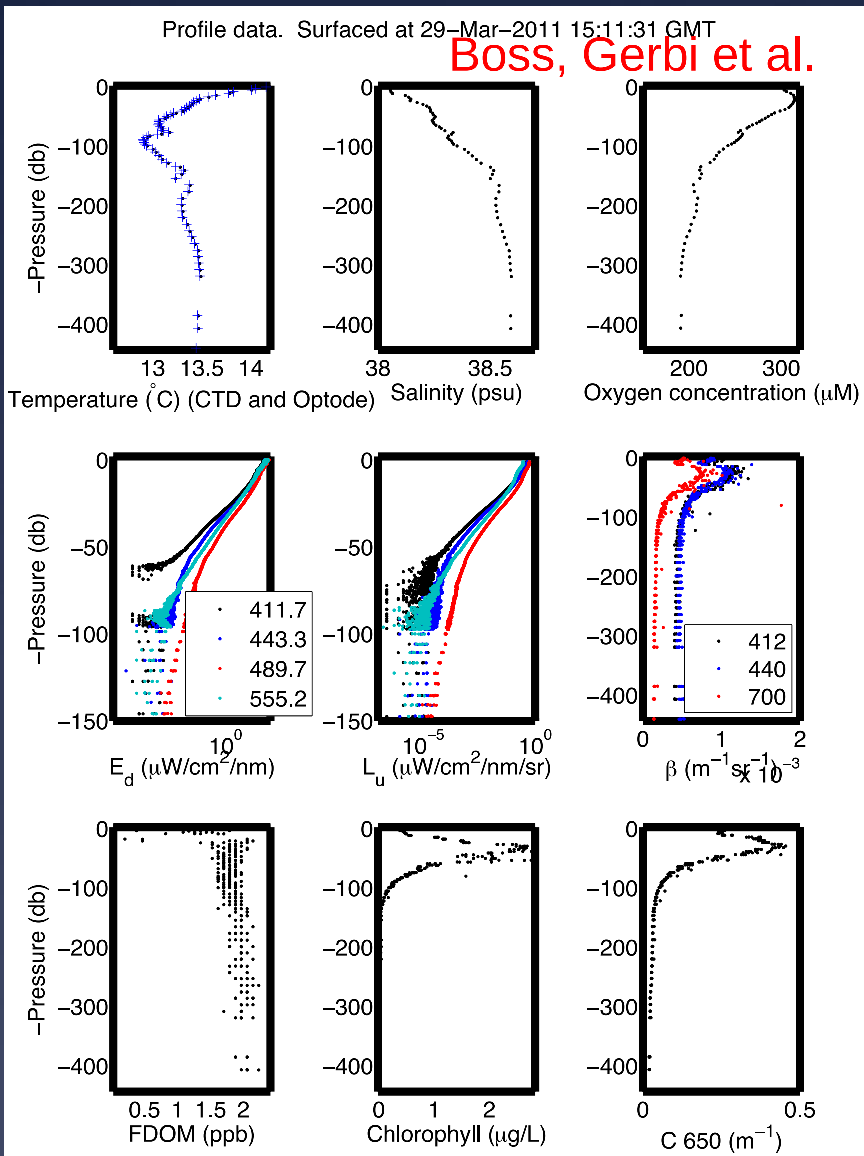
6 floats: 2014
bio-optics, O_2,
NO_3 (some)
proposal

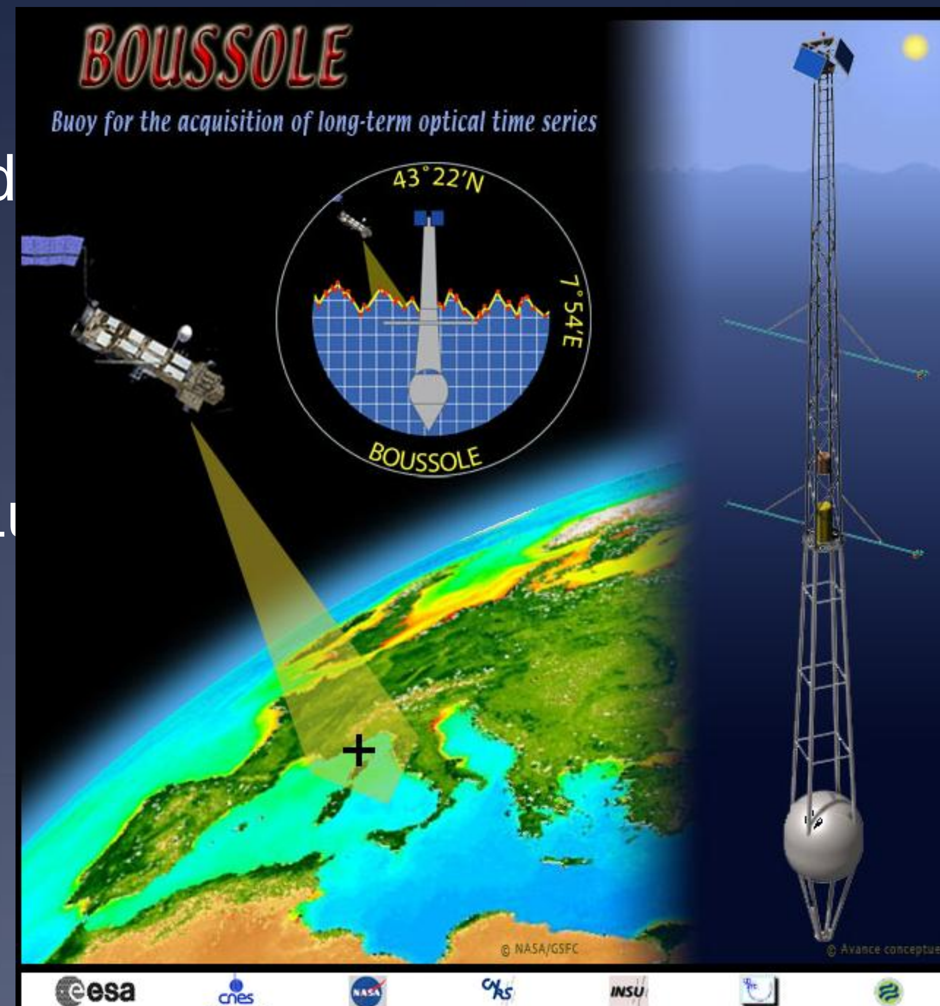
12 deep O_2: 2014
12 deep O_2: 2016

24 floats: 2012-2013
bio-optics, O_2, NO_3 (some)

Two examples of VAL-Float => acquisition of OCR validation data set

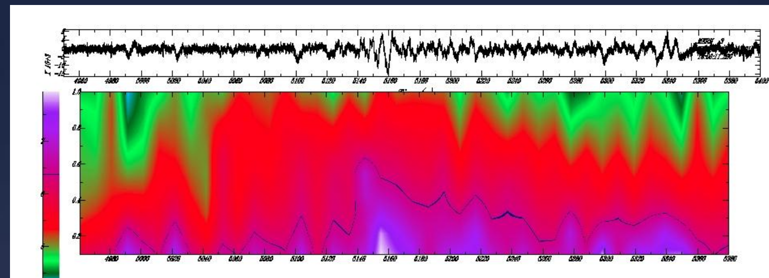






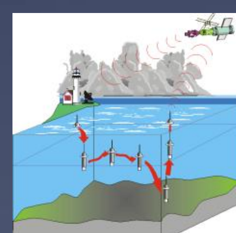
Other "new" variables: the potential of passive acoustic

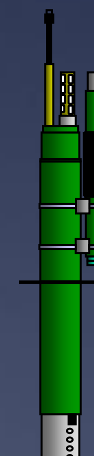
❑ Seismic waves : the mermaids float listen during the drift phase



Guust Nolet, Geoazur

❑ Multidisciplinary float : seismic during the drift + Bio-Argo during the ascent





❑ Other possible "combo applications" of acoustic during the float drift

- ice detection => float surfacing or not; rainfall and winds (Riser et al., 2008); mammals.

Bio-data management: issues and perspectives #1

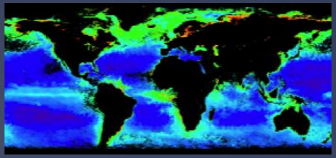
- Tremendous amounts of "bio" data will be acquired in the near future.

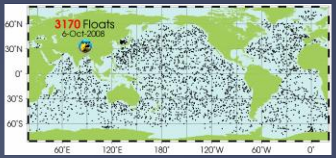
- An integrated observation system will be operationally useful and scientifically relevant if and only if it is supported by an efficient data management system….BUT

- The "problem" of biologists with data management
  - we are not used to the management of huge datasets.
  - we are not used to make data publicly available
  - we are not used with real time

- A "<u>revolution</u>" is thus required in the way we will apprehend data management

- Very efficient data management (and a good example for the "bio" community) : Ocean Color and Argo
  - **<u>Real-time</u>** delivery with real-time **<u>QC</u>** (operational data)
  - **<u>Delayed mode QC</u>** delivery after data reprocessing (scientific, climatic-trend value): real issue of climatologies for biology / biogeochemistry.
  - Generation of derived products

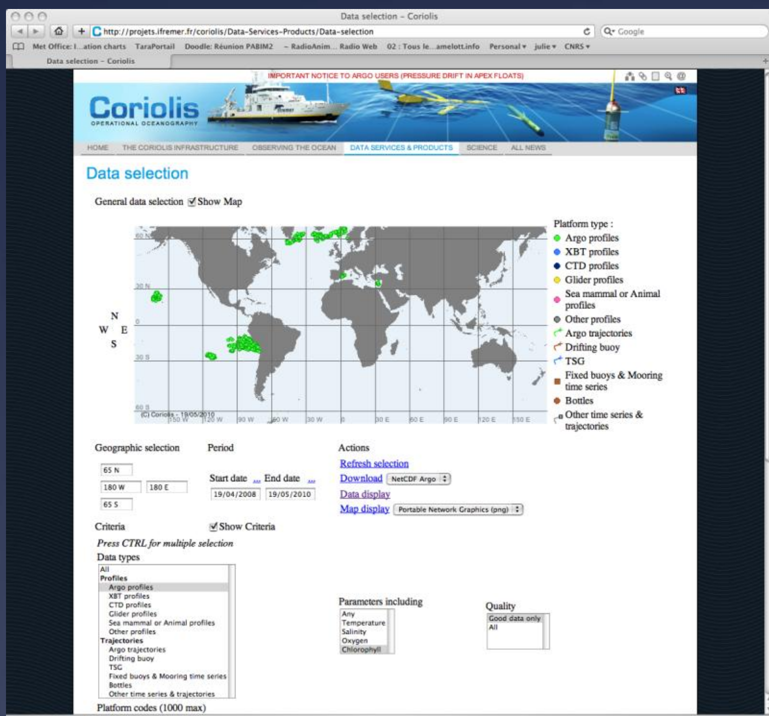




“Bio-data” management issues and perspectives #2

Coriolis data center has begun to implement management of “Bio-data” in real-time

Chlorophyll a



Oxygen

“Cross-calibration” of sensors

European large project:

<u>integration</u>

floats + glider + satellite + model & assimilation

The OSS 2015 project

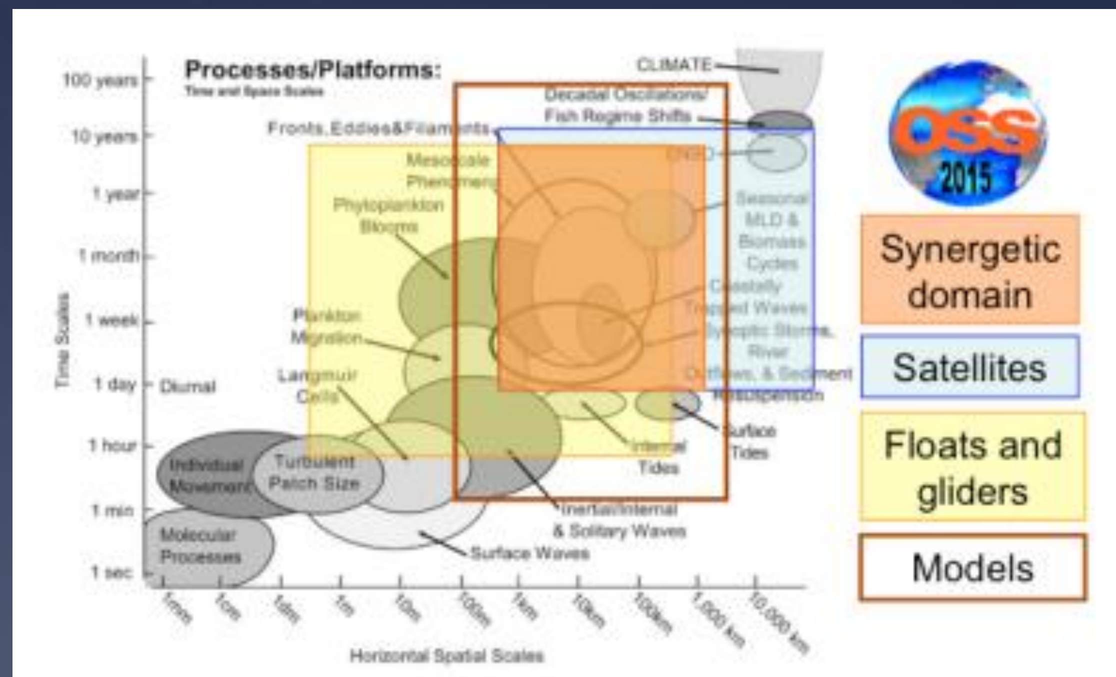
OCEAN STRATEGIC SERVICES

Ocean Strategic Services beyond 2015

funded by the EU Seventh Framework Programme (FP7) – Space 2011. Project duration : 3 years

Objectives:

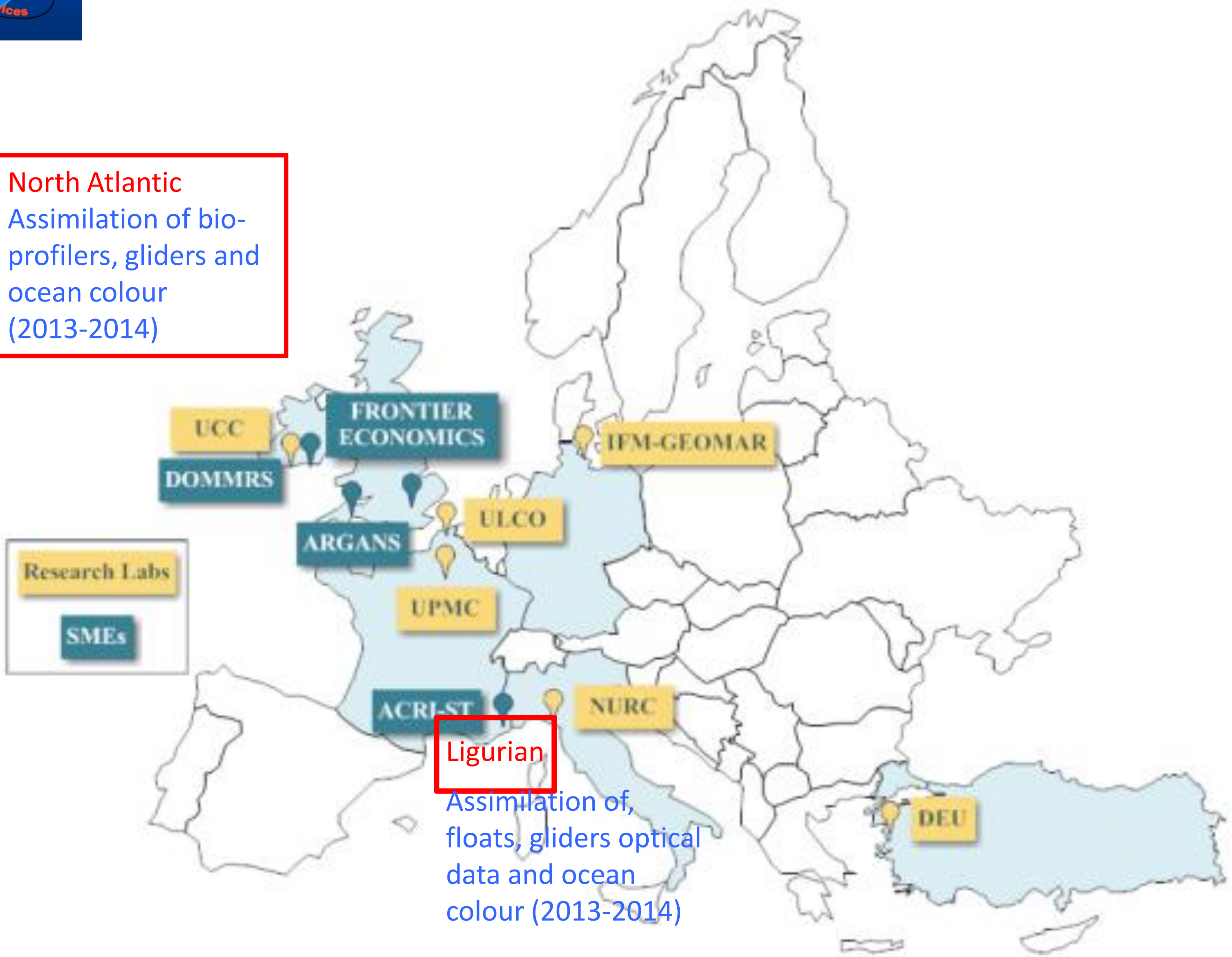
- Promote the assimilation of ocean colour and in situ observation data into biogeochemical models
- Contribute to a better characterisation of Chl-a vertical distribution vs surface information
- Define and test methodology for optimisation of observation network and of complementarity between in situ and EO measurements
- Provide research support to the European Marine Core Service (MyOcean)
- Develop new products relevant for the biogeochemistry status analysis of the oceans



Space and time scales of oceanic processes and domains covered by satellite remote sensing, *in situ* autonomous platforms and models addressed by the OSS2015 activities(adapted from Prof. T. Dickey)

Partnership / pilot sites

North Atlantic
Assimilation of bio-profilers, gliders and ocean colour (2013-2014)



Ligurian
Assimilation of, floats, gliders optical data and ocean colour (2013-2014)

Bio-Argo
& outreach activities

Activities

- website for scientific and non-scientific public
- creating a community
- school children - “**adopt a float**” concept: real-time data at school
- training of early career scientists
- training of teachers (including retired) and science mediators

Themes

- NW Mediterranean: “Ocean model” and oasis linked to currents
- North Atlantic: sub-polar Ocean and CO_2 sink
- Subtropical gyres: oceanic deserts
- Arctic: Ocean under ice and its changes linked to climate change

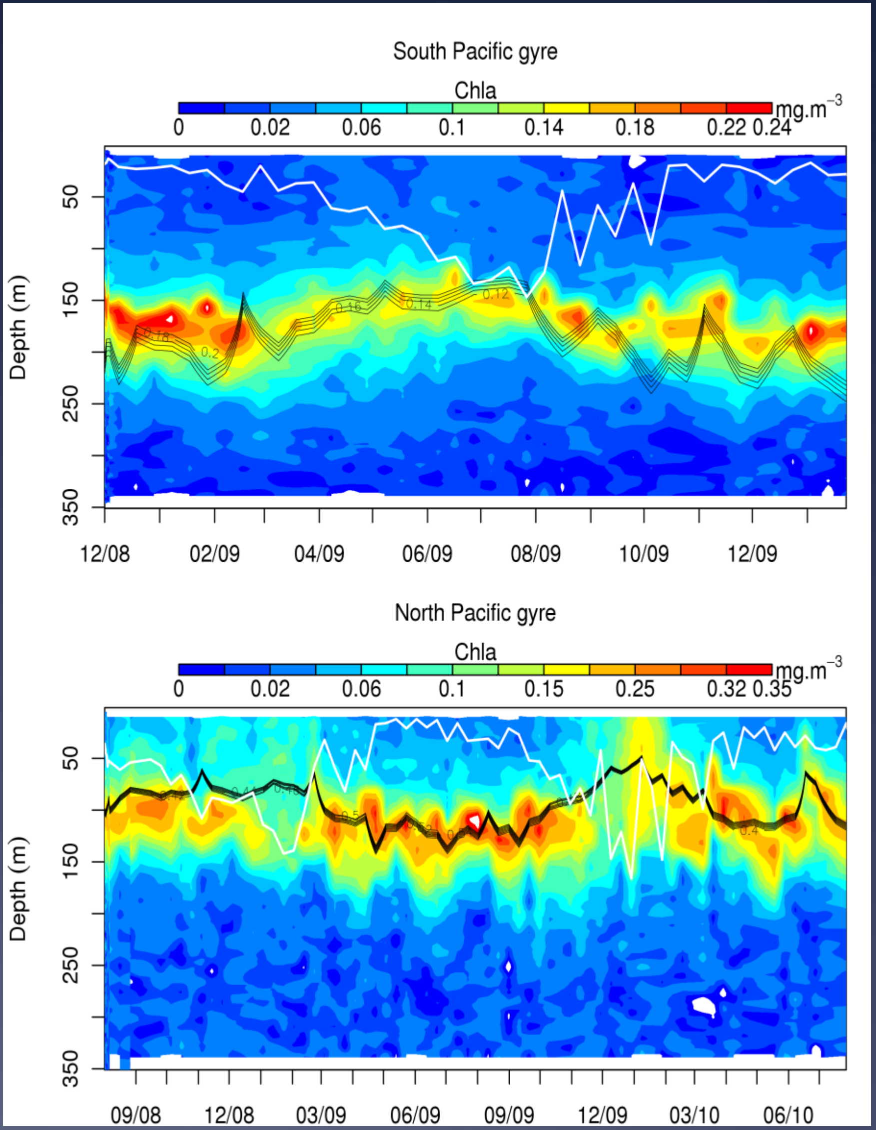
➢ *Integrating profiling floats with extended capabilities in future education and outreach activities. COSEE Vision paper - Scheurle, C., Claustre, H., Antoine, D., Boss, E., Johnson, K., Körtzinger, A., Mangin, A., Nolet, G., Perry, M.-J., Schofield, O. and J. McDonnell (2010).*

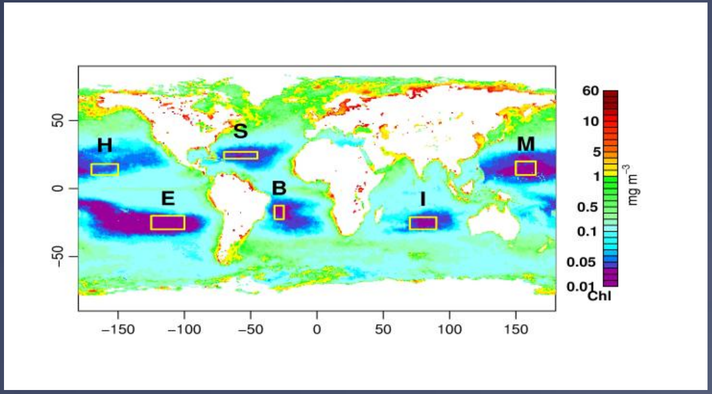
Thank you

sub-tropical gyres

- 40% of the global ocean.
- <u>primary production (NCP)</u>: controversial
  - ✓ classical (incubation) methods & models: 2-3 times lower than:
  - ✓ «non-intrusive» techniques (O2 isotopes; O2 floats budget)

- <u>inter-gyre variability :</u>
  - ✓ N limitation (North & South Pacific) vs P limitation (North Atlantic)
  - ✓ seasonal





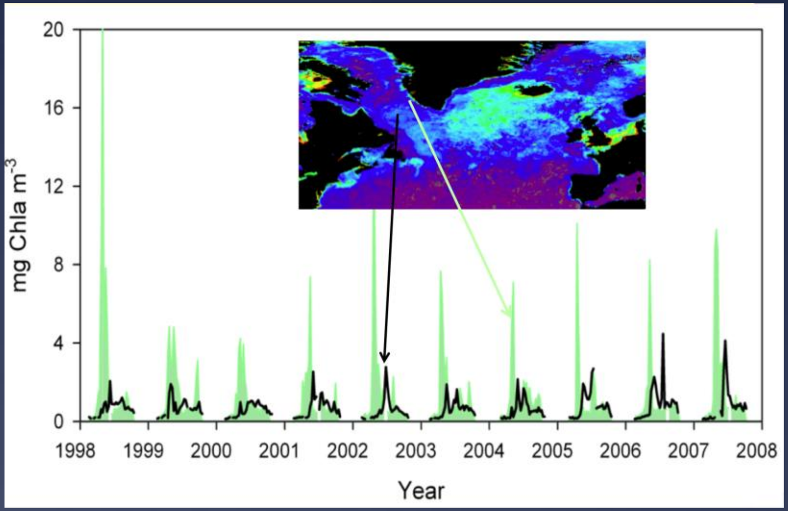
NA sub-polar Gyre

• 1.5% surface, ~ 20% of CO2 sink

- <u>timing and magnitude of blooms</u>

  ✓ haline stratification (early) : intense and « quick » bloom
  ✓ thermal stratification (progressive): «classical bloom »

long term : ice melting and bloom dynamics



- <u>small scale variability (day, week) in Zm and bloom</u>

  ✓ intermittency in stratification/mixing during bloom period

long term: NAO, "storm tracks" and bloom dynamics