Bio-Argo / BGC-Argo

Organisation of the community, future plans

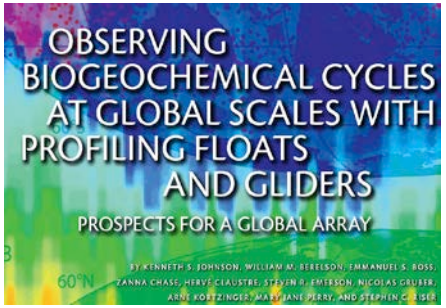
Hervé Claustre

AST – 14, Wellington March 2013

Outline

- The organization of the BGC- and BIO-Argo community
- Feedback from the ADMT 14
- The future deployment (and procurement) plans for BGD- and BIO-Argo floats

Progressive organization of The “Bio-Argo” community



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

Progressive organization of The "Bio-Argo" community

- **ADMT 14**, November 2012, Hyderabad, 2-day Bio-Argo

- **Scor UNESCO Working Group 142** "Quality Control Procedures for Oxygen and Other Biogeochemical Sensors on Floats and Gliders". (Körtzinger & Johnson)

- Submitted session to **Ocean Science Meeting 2014**: Towards a Global Ocean Biogeochemical Observing System Based on Profiling Floats and Gliders (Claustre & Johnson)

Argo Data Management Team
- 13th Meeting

12-16 November, 2012,
INCOIS, Hyderabad, India

FEEDBACK on the 2-day Bio-Argo session

(10 Bio-Argo scientists from 6 countries)

The context: Why are we here?

- Bio-Argo technology is emerging from its infancy.
- Several regional Bio-Argo programs are launched.
- Bio-Argo "science" will increasingly become prominent
  - Exploration; filling the gap in unexplored spatio-temporal domains / scales;
  - Regional budgets established with less uncertainties
  - Extraction of long term properties (climatic trends)
  - coupled GCM biogeochemistry models fed with "sufficient" data => assimilation of biogeochemical data
  - …..

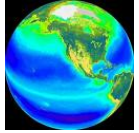
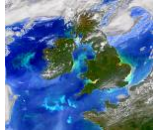
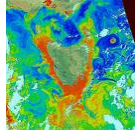
The context: Why are we here?

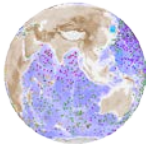
- To undertake this promising new science in the best way, we need to **anticipate** the data management in order :

  (1) not to be overwhelmed by too much data

  (2) to collectively and synergistically take the best profit of this new type of data

An efficient data management which guarantees a large use of high-quality biogeochemical data is a key step to maximize our chances of making Bio-Argo a real success.



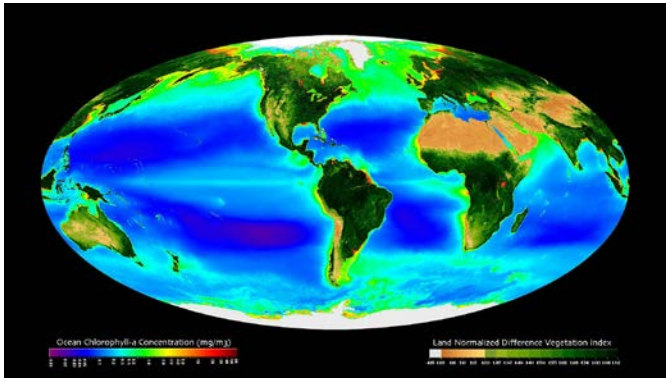
Beside O2, the biogeochemical community has identified the first variables ready to be implemented

- ❑ Oxygen: exchange with atmosphere, marine photosynthesis and respiration.

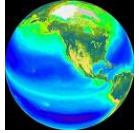
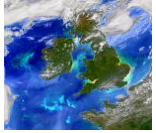
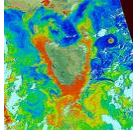
- ❑ Nitrate : New production (build up of organic material) ; remineralization; potential for being a core variable for GCM/biogeochemical.

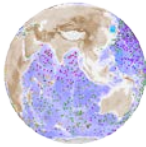
- ❑ Chlorophyll a : Proxy of phytoplankton biomass, photosynthesis; required by spatial agencies (OCR); potential for being a core variable for GCM/biogeochemical.

- ❑ Particulate backscattering : Stock of particulate matter (detrital and living). Proxy of Particulate Carbon. required by spatial agencies (OCR) potential for being a core variable for GCM/biogeochemical.



Selection of these variables through an international consensus : IOCCG Working group"Bio-optical sensors on Argo floats Argo", OceanObs09

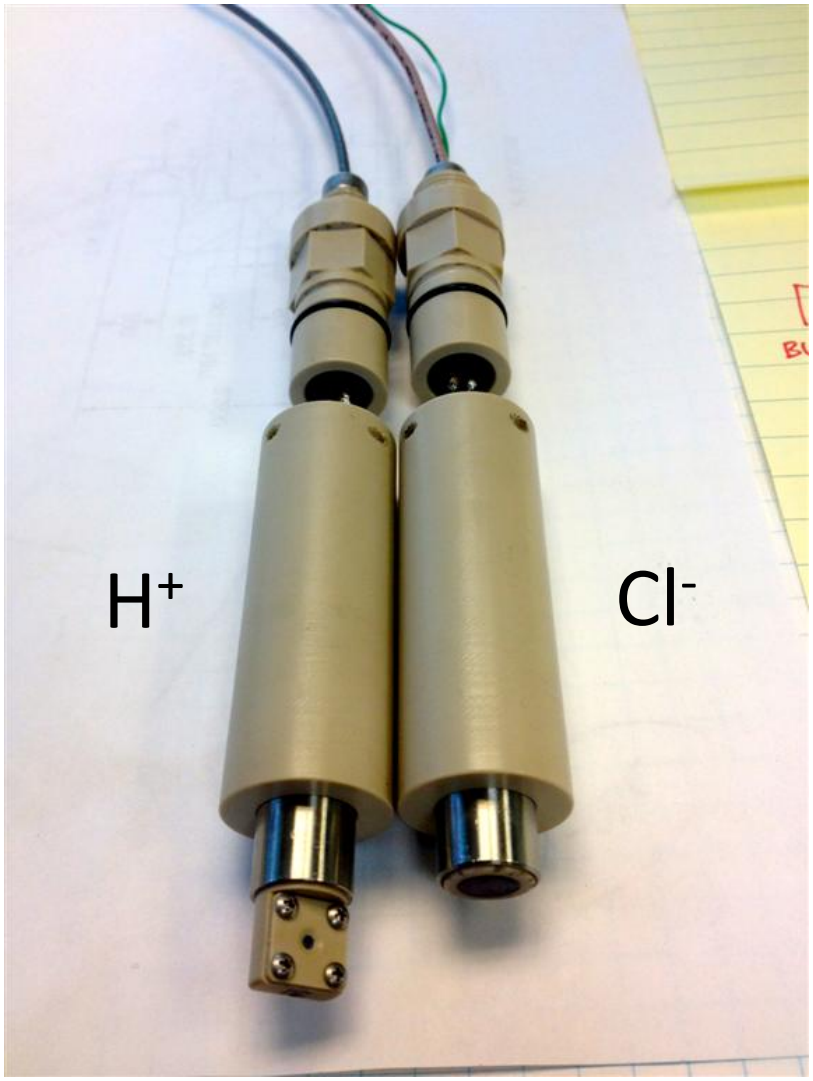






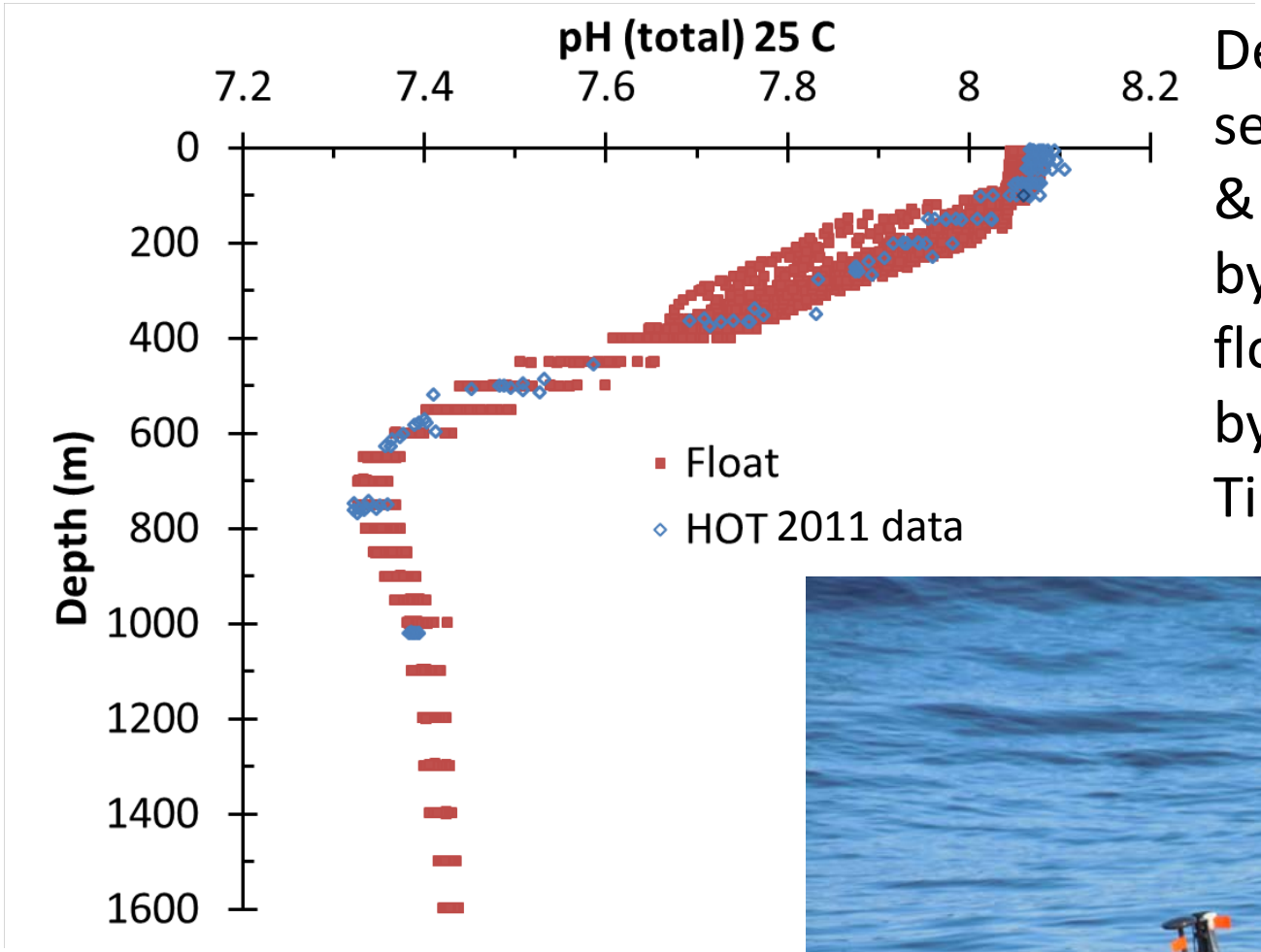
Other variables on their way to become mature

- pH: Great potential for a global array

Really two sensors, one for H^+, one for Cl^-, sensor response is proportional to $(H^+) \times (Cl^-)$

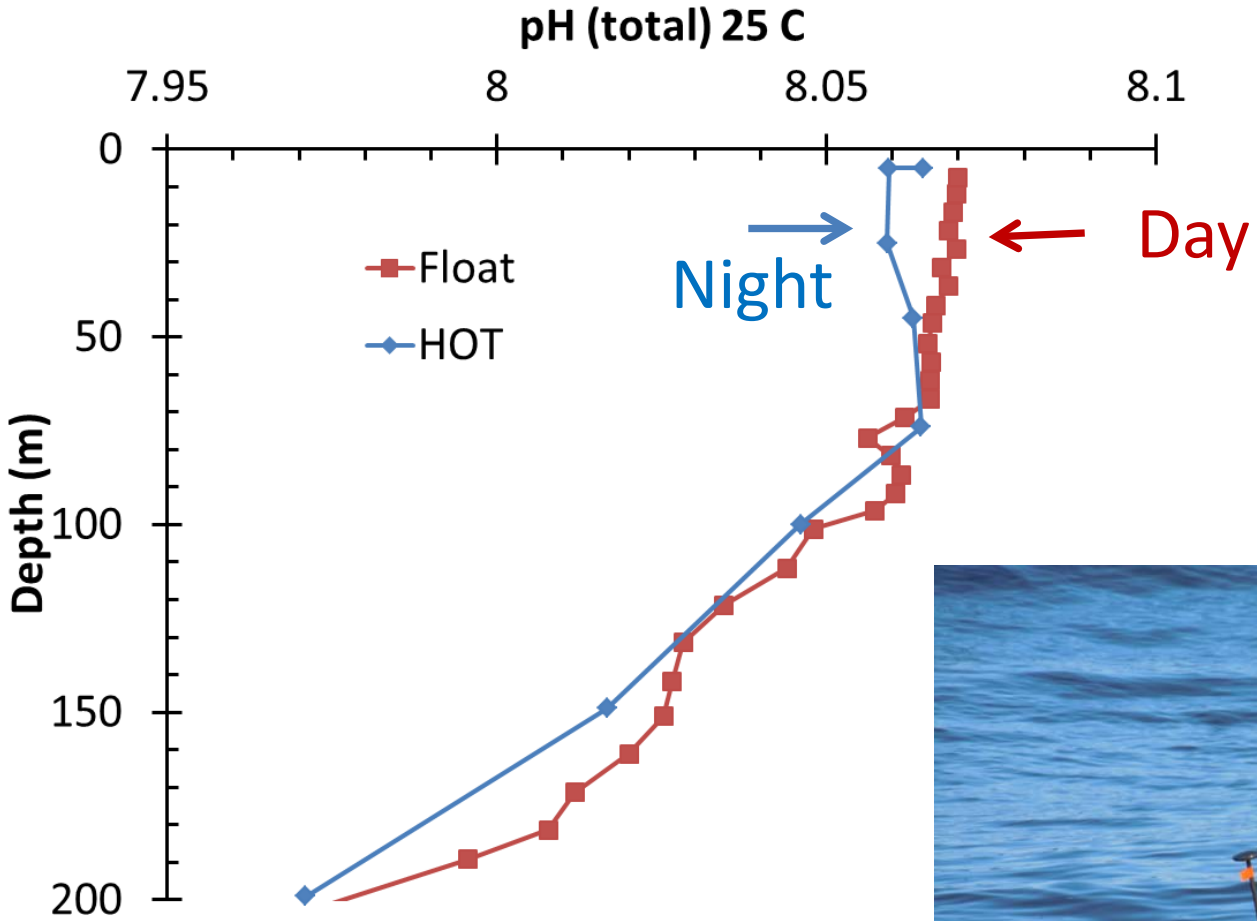


Courtesy of K. Johnson, MBARI



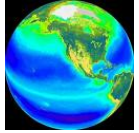
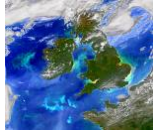
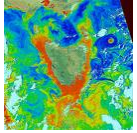
Deep-Sea DuraFET pH sensor built at MBARI & Honeywell, tested by SIO, integrated to float by UW, deployed by HOT (Hawaii Ocean Time-series)

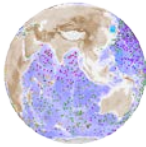
42 vertical profiles over 140 days. All data on FLOATVIZ web site in real time.



Diel cycle at HOT "as much as 0.01 in pH" (Dore et al. 2009)

Courtesy of K. Johnson, MBARI



Other variables on their way to become mature

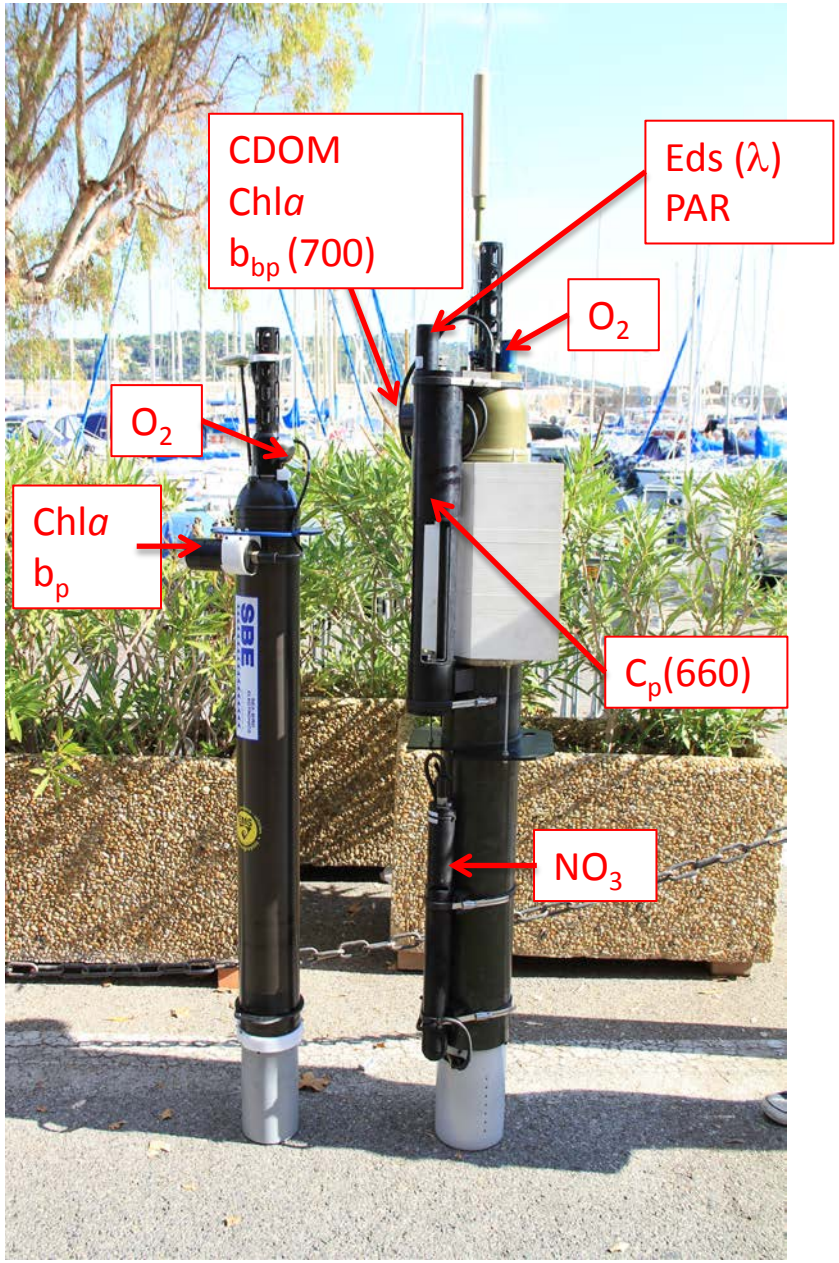
- ❑ pH: Great potential for a global array

- ❑ Radiometry
  - PAR: Photosynthetically Available Radiation (400-700 nm). Photosynthesis (euphotic zone). Heat deposition (?)
  - Downwelling irradiance (Eds) => derive Kds robust products (e.g. insensitive to drift) to refine retrieval of Chla and CDOM. Great potential for CAL-VAL activities (OCR).

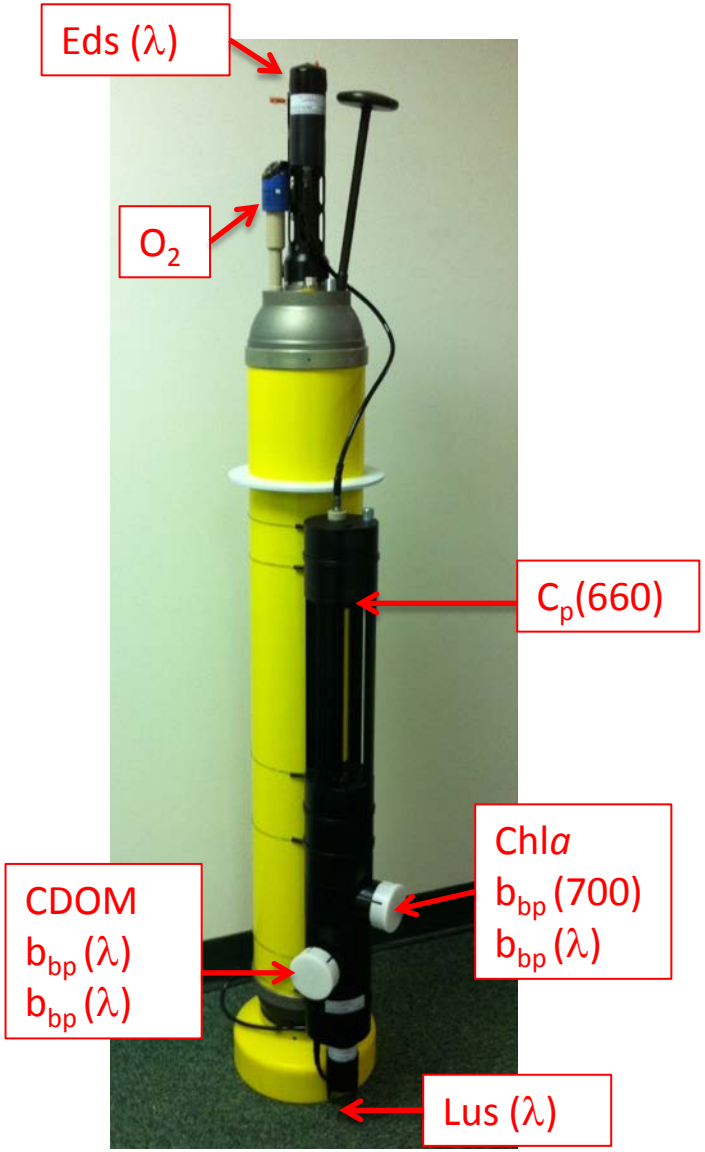
- ❑ Transmissiometry cp : Proxy of phytoplankton biomass, Precise measurement useful for flux (primary production, exportation at depth) estimata.

- ❑ CDOM: Water mass tracer (coastal, melting ice). CAL-VAL of OCR

Some BGC float exemples



NAVIS PROVOR



APEX

Regional vs global

- Rather than dispersing resources in a « scattered » Bio-Argo global array, the community prefer to **target first regional hotspots** (expecting a large return in term science for a restricted number of floats)
- These targeted areas have been identified/ chosen (not only by the Bio-Argo community but also by the biogeochemical community) because their are **climate-change hotspots** (take the pulse in key areas)
- When this regional approach will have been proven to be valid at the regional scale and with less expensive sensors (the manufacturers can do it), it might become the time of thinking and implementing global.

Bio-Argo HOTSPOTS

- **Arabian Sea** (INCOIS): OMZ
- **North Atlantic** (remOcean, NAOS): AMOC and CO2 drawdown
- **Mediterranean Sea** (LOV, OGS) => miniature Ocean with shorter time scale for the thermohaline circulation
- **Austral Ocean** (SOBOM): CO2 drawdown, experimental for coupled model-observation
- **North Pacific** Kuroshio (UW, MBARI): CO2 drawdown.

Sampling strategy and Argo label

- Most of the floats will be Argo compliant
  - Every 10 (5) days, 1000m drift, 2000-0 profile every 3 (6) cycles
- Few floats will be more process study research-oriented and not Argo compliant.
  - Diel cycles and flux measurements which impose intermediate drift at sub-surface (200-400 m).
  - Note some of these floats are amenable to be recovered

The competition for resources….the three concerns and the actions

- The float procurement
- The cost linked to additional sensors
  - Energy cost (life-time reduced)
  - Iridium cost
- The human resources with respect to data management and QC (the DAC needs to be reinforced).

- Bio-Argo has to find additional resources (e.g. space agencies) to enhance the system
- In each country, scientist interested in Bio-Argo should contribute to identify where additional resources can be seek for
- “Capacity building”is required with this new iridium floats to “educate” and attract more biogeochemical oceanographers.

Some principles to set up BIO-Argo DM

Prerequisite: We should follow as much as possible what has been defined by Argo, and that is working fine for T and S.
«*Do not reinvent the wheel…*»

However: specificities of some Bio-data might require some minimal «flexibility» and «adaptation»

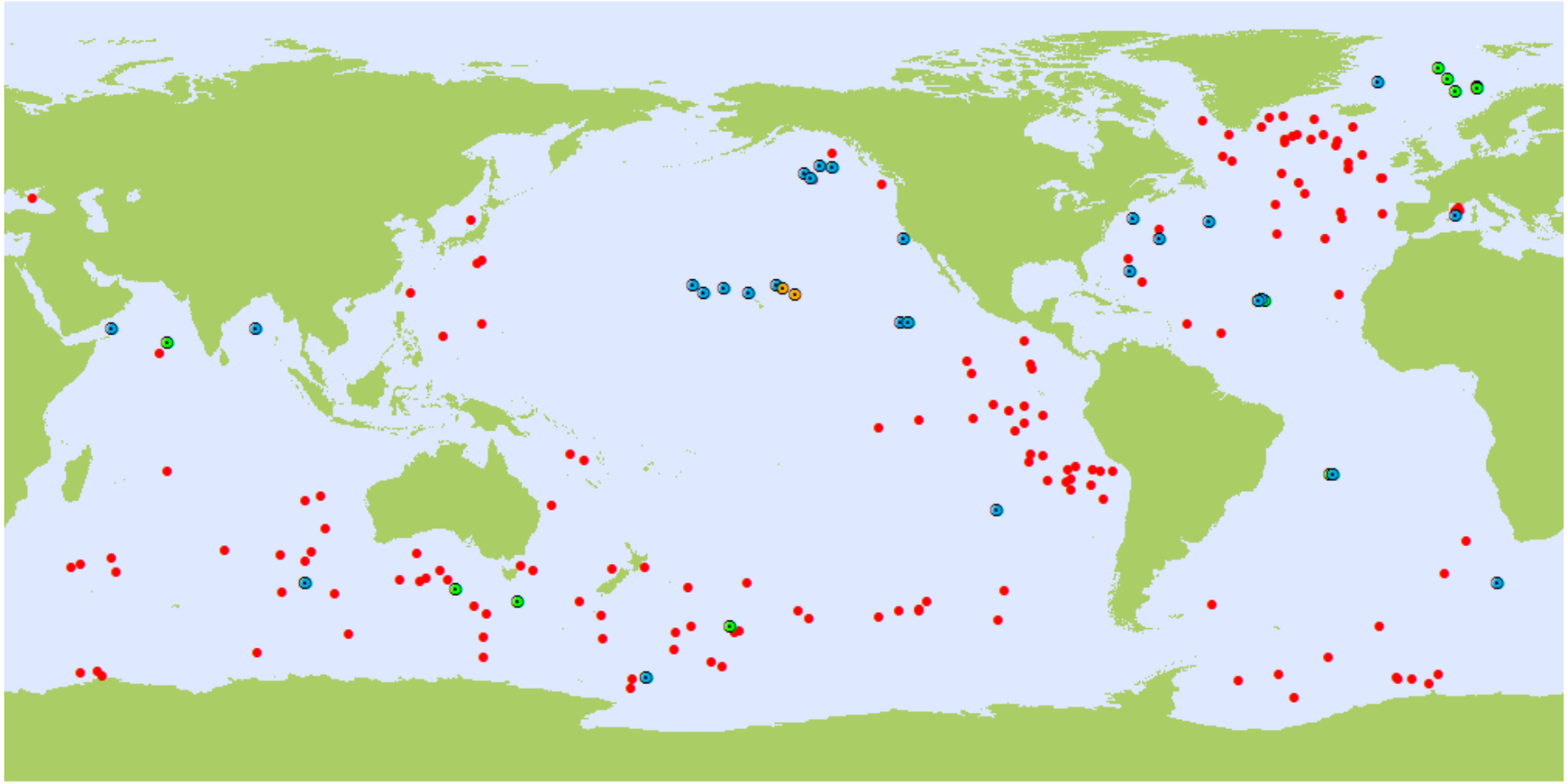
=> add a new (spectral) dimension for managing NO3

ADMT Bio-Argo list of actions

Action	WHAT	Who
#1	Write the minute of the meeting	Hervé, Catherine
#2	Contact seadata net for variable names (and close the action 45 of ADMT)	Catherine, Justin
#3	Write the document "Processing Argo Chla data at the DAC level" (e.g. similar document produced by V. Thierry et al. for Argo-O2)	Catherine
#4	Write the Chla QC document	Catherine
#5	Database harmonization: producing reference matériel => interaction with manufacturers	Tom & Antoine
#6	Propose a Quenching test for Chla	Xiaogang & Clare
#7	Propose a depth correction for Chla	Antoine, Haili, Xiaogang
#8	Propose a spike test	Xiaogang, Hervé, Sandy
#9	Write the document "Processing Argo backscattering data at the DAC level" (e.g. similar document produced by V. Thierry et al. for Argo-O2)	Emmanuel, Catherine
#10	Writing the backscatering QC document	Emmanuel, Catherine
#11	Write the document "Processing Argo NO3 data at the DAC level" (e.g. similar document produced by V. Thierry et al. for Argo-O2)	Ken, Catherine
#12	NO3: review the RT test for Argo identify the usefull, define new ones	Ken, Fabrizio
#13	Writing the NO3 QC document	Ken, Catherine
#14	Evaluation of the need for two Chlas: e.g. operational, blended synthetic Chla vs science Chla (action AST?)	Fabrizio, Hervé, Tom, Emmanuel, Sandy
#15	Interact with IOCCG / maintain the link with spatial agency (e.g. yearly summary of Bio-Argo progress on their web site) (Action AST)	Hervé

Outline

- The organization of the BGc- and BIO-Argo community
- The ADMT 14
- The future deployment (and procurement) plans for BGC- and BIO-Argo floats



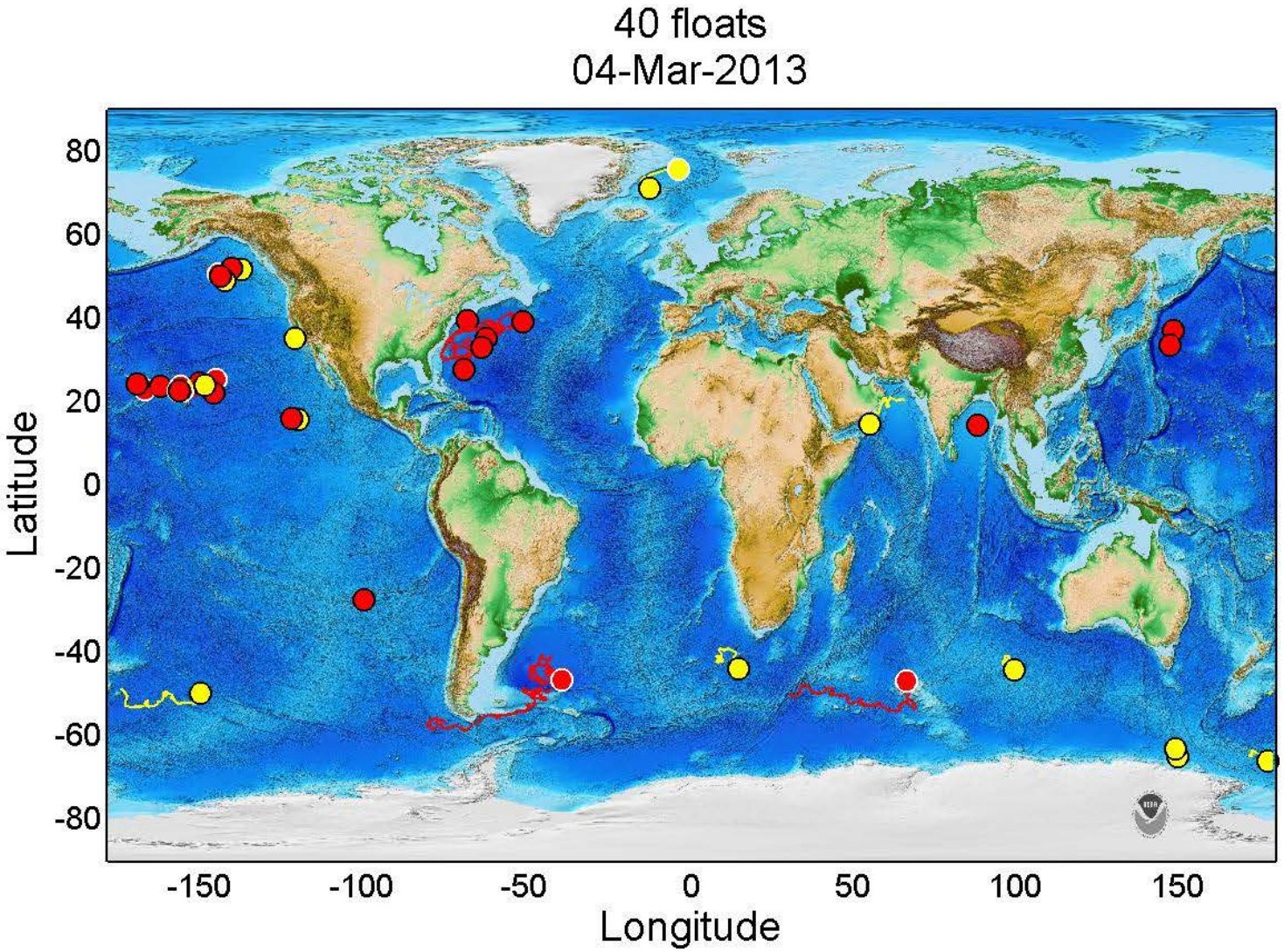
Bio-Argo (194)

- Dissolved Oxygen (193)
- Bio-optics (18)
- Nitrate (27)
- pH (2)

February 2013

jcommops

Argo equivalent floats in UW/MBARI array. All floats have nitrate/oxygen. Yellow symbols also have biooptics (Wetlabs FLBB). One pH float is also operating.



(presently known) activities/future plans for BGD/Bio-Argo

- UW (Steve Riser Steve Emerson) just deployed an array of 12 floats with highly calibrated dual oxygen sensors in the Kuroshio Extension region off Japan
- UW now has several floats that carry three O2 sensors (Aanderaa 3830 & 4330, and SBE 63) in order to evaluate performance of each sensor.
- UW/MBARI (S. Riser / K. Johnson) has now 40 floats with NO3. New floats are in the Bay of Bengal, Kuroshio Extension, California Current, and South Pacific.
- UC Bekerley (J. Bishop) : 2 Solo (?) floats with PIC sensors deployed at Papa
- U. Maine (E. Boss). 4 floats with Bio-optics. HOT, Mediterranean Sea
- MBARI (K. Johnson): The Deep-Sea Durafet pH sensor is operating extremely well (HOT). Pending proposal to continue the development

(presently known) activities/future plans for BGD/Bio-Argo

CENTER FOR SOUTHERN OCEAN BIOGEOCHEMICAL OBSERVATIONS AND MODELING

Proposal: PI J. Sarmiento: 200 biogeochemical floats

SEARCH C-SOBOM | WHO WE ARE | PROGRAMS | KNOWLEDGE TRANSFER | NSF SITE VISIT | RESOURCES | MEMBERS

Programs

- Theme 1: Observations
- Theme 2: Modeling
- Theme 3: Education/Diversity/Outreach

PROGRAMS

Theme 1: Observations

To develop a new observing system for carbon, nutrients, and oxygen that will complement and expand on the existing observing system for heat and freshwater, the observations team will deploy a large array (150-200) of profiling floats (shown at right) with biogeochemical sensors throughout the Southern Ocean. This robotic float observing system will be complemented by shipboard measurements, instrument and sensor development, and data analysis, including state estimation in conjunction with the modeling program. Deployment opportunities have already been identified through discussions with international partners.

Principal responsibility for development and deployment of the observing system will be in the hands of the Scripps Institution of Oceanography (Theme 1 Lead Lynne Talley), in partnership with the University of Washington (Co-Lead Steve Riser) and Monterey Bay Aquarium Research Institute (Associate Director Ken Johnson (in photo with cap)), who together will design and build the floats and participate in analysis of the data.

(presently known) activities/future plans for BGD/Bio-Argo

- India (INCOIS, M. Ravichadran): 50 floats (10 per year) over the next 5 years: bb (POC), Chla, O2, NO3(?). Arabian Sea, Indian sector of the Austral Ocean
- Japan (Jamstec, Univ. Tokyo, Fishery Research agency): 3 floats: Chla, O2
  - ✓ Argo plans (including BGC) for the next 10 years in discussion.
- South-Africa (CSIR, Sandy Thomalla): 3 floats: bb, Chla, O2, transmissiometry. Atlantic Sector of the Austral Ocean
- Australia (Univ. Tasmania). 3 floats: bb, Chla, O2. Southern Ocean Time Serie;
  - ✓ pending proposal for 8 floats

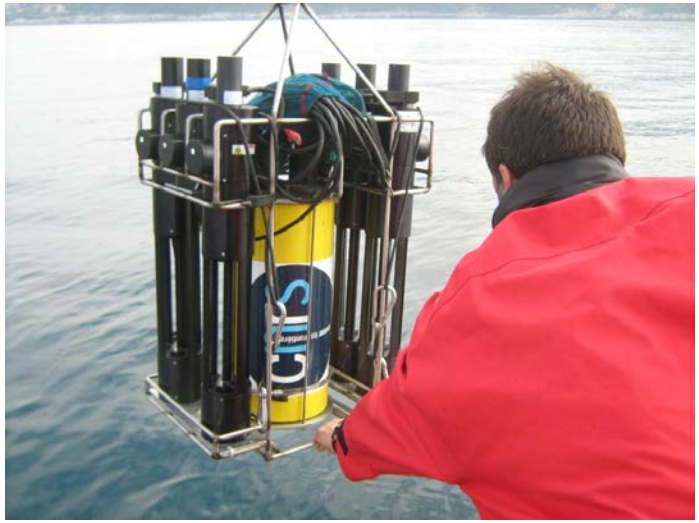
(presently known) activities/future plans for BGD/Bio-Argo

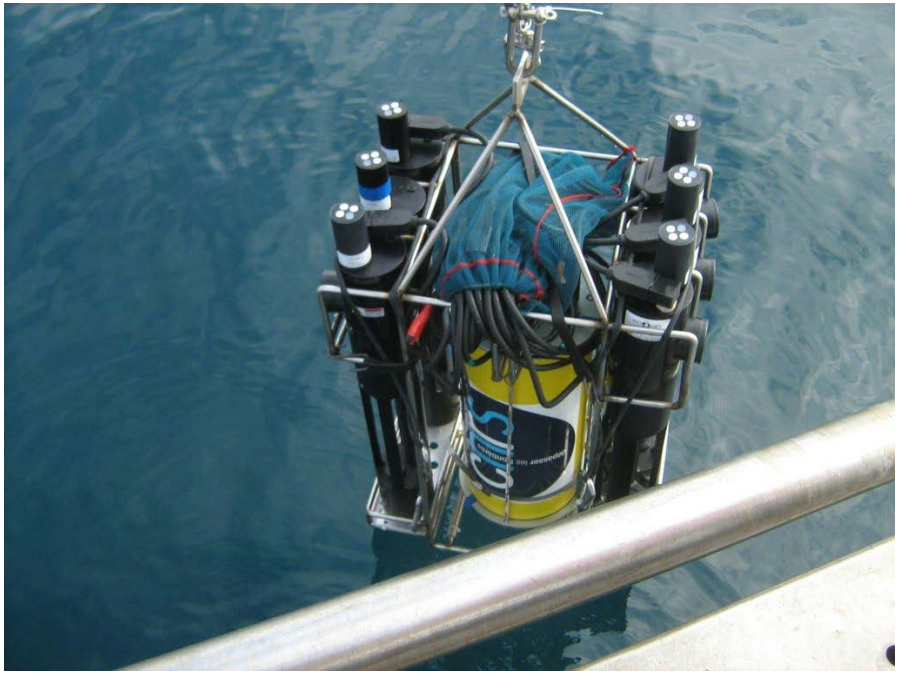
- Italia (OGS, P.M. Poulain): 7 floats : bb, Chla, O2, CDOM, radiometry NO3 (2 floats). Mediterranean Sea
- Bulgaria (USOF, -E-AIMS program): 2 floats: bb, Chla, O2, CDOM, radiometry. Black Sea
- UK (University of Plymouth-Giorgio D'Allomo-E-AIMS program): 2 floats: bb, Chla, O2, CDOM, radiometry. North Atlantic sub-tropical Gyre.
- Norway (Institute of Marine Research-Mork Kjell Arne-E-AIMS program): 2 floats: bb, Chla, O2, CDOM, radiometry. Norway Sea

(presently known) activities/future plans for BGD/Bio-Argo

- Canada (Univ. Laval, Marcel Babin) : 26 floats : bb, Chla, O2, CDOM, radiometry, NO3. Arctic (starting in 2014 over two years)
- France (LOV, NAOS & remOcean projects, Fabrizio D'ortenzio & Hervé Claustre): Chla, bb, O2, CDOM, radiometry, (NO3)
  - ✓ 6 floats: North and South Atlantic sub-tropical gyres.
  - ✓ 14 floats: Mediterranean Sea
  - ✓ 21 floats: North Atlantic sub-polar gyre (Labrador, Irminger, Iceland)
  - ✓ 8 floats waiting for deployment opportunity
- France (Argo-France + CNES): 4-5 floats per year distributed to the national community through an open call (3 new labs recently appplied)

BGD sensors cross calibration





Thanks…..