General objective of the Bio-Argo workshop: why are we here?
Miniaturisation and diversification of biogeochemical sensor makes global monitoring of biogeochemical and ecosystem properties possible.
The “Bio-Argo” community is becoming progressively organized.

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 at the ADMT meeting (2011)
The core ecosystem and biogeochemical variables: which ones?

“For biogeochemical time-series, the list of potential measurements is nearly endless and justifying inclusion / exclusion is difficult. Decisions as to what measure, as well as how to measure, are never trivial. The list of “essential” measurements for time-series can grow to the point that sustainability of the entire enterprise is put at risk”. from U. Send, OceanObs09

- Observation valid for any kind of observation platform (including Argo)
- Mandatory: selection (labeling) of core variables of the future system
- Readiness of the variable to be included in the system
  - Scientific relevance
  - Routinely and autonomously measurable by a variety of platforms (sensors)
  - Data quality: agreement between established (discrete) and developing (sensor) technologies; fits with the standard requirement of the users (operational / scientists)

- At the moment, potential core variables over the vertical are: O$_2$, NO$_3$, Chla, POC. Their progressive implementation in the integrated system is possible.

- Variables of the CO2 system operational for surface (ship-based underway, drifting buoys) or fixed depth (moorings). Not vertically resolved (but see later)

- Progressive implementation / labeling of additional variables with the maturation of sensor technology
Beside O2, the biogeochemical community has identified the first variables ready to be implemented on Argo

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

- **Nitrate**: New production (build up of organic material); remineralization; biogeochemical modeling

- **Chlorophyll a**: Proxy of phytoplankton biomass, photosynthesis

- **Particulate scattering**: Stock of particulate matter (detrital and living). Proxy of Particulate Carbon (POC) and Suspended Particulate Matter (SPM)

*Selection of these variables through an international consensus: IOCCG Working group “Bio-optical sensors on Argo floats Argo”, OceanObs09*
Some BGC float examples

NAVIS

PROVOR

CDOM

Chl $\alpha$

$b_{bp} (700)$

Eds ($\lambda$)

PAR

O$_2$

Chl $\alpha$

$b_p$

O$_2$

NO$_3$

C$_p(660)$

APEX

CDOM

$b_{bp} (\lambda)$

$b_{bp} (\lambda)$

Eds ($\lambda$)

O$_2$

C$_p(660)$

Chl $\alpha$

$b_{bp} (700)$

$b_{bp} (\lambda)$

Lus ($\lambda$)
Some coming playgrounds
Some coming playgrounds (?)

Proposal: PI J. Sarmiento: 200 biogeochemical floats

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.
The key to success: “Bio”-data management #1
(slides presented at OceanObs09)

- 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 “revolution” 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
  - Real-time delivery with real-time QC (operational data)
  - Delayed mode QC delivery after data reprocessing (scientific, climatic-trend value): real issue of climatologies for biology / biogeochemistry.
  - Generation of derived products
The management of “bio” data is likely a more complicated task than for physical variables because of the diversity of ways of measuring the variables.

For example, [Chla], the “universal” proxy of phytoplankton can be measured (see presentation on specificity of (“Bio-data”):

- from space;
- In situ, non intrusively by sensors: (spectro)fluorescence, absorption (676 nm);
- In situ, from filtered water samples: HPLC, (spectro)fluorometry, spectrophotometry;
- In fine, [Chla] should represent the same “bio” product regardless of the method of acquisition. (Imagine modelers who visit databases…)

It is thus mandatory to develop a unified format and language which is essential for streamline and interfacing datasets.

Upstream of data management, QC and unified format, it will be essential to

- Needs to clearly know instrument specification (e.g. ex / em for fluorescence)
- Establish reference material.
- Support regular international intercomparison exercises.
- Develop internationally agreed calibration centers.
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
- .....
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.**
<table>
<thead>
<tr>
<th>Time</th>
<th>Session</th>
</tr>
</thead>
<tbody>
<tr>
<td>8:30</td>
<td>Welcome; practical issues</td>
</tr>
<tr>
<td>8:40</td>
<td>Hervé Claustre: General objectives of this meeting</td>
</tr>
<tr>
<td>8:55</td>
<td>Sylvie Pouliquen: Argo Data management: history and objectives</td>
</tr>
<tr>
<td>9:40</td>
<td>Sylvie Pouliquen: Argo Data management: history and objectives</td>
</tr>
<tr>
<td>10:00</td>
<td>Virginie Thierry: What has been achieved for Argo-O2?</td>
</tr>
<tr>
<td>10:20</td>
<td>Hervé Claustre: The nature of bio-optical measurements: Common an uncommon traits with T and S data management with Argo</td>
</tr>
<tr>
<td>10:50</td>
<td>Antoine Poteau: sensors calibration and intercalibration</td>
</tr>
<tr>
<td>11:20</td>
<td>Discussions</td>
</tr>
<tr>
<td>12:00</td>
<td>Lunch</td>
</tr>
<tr>
<td>13:30</td>
<td>Fabrizio D’Ortenzio: real-time QC</td>
</tr>
<tr>
<td>15:30</td>
<td>Fabrizio D’Ortenzio: delayed mode QC (conceptual)</td>
</tr>
<tr>
<td>17:30</td>
<td>Catherine Schmechtig: meta data; data format</td>
</tr>
<tr>
<td>8:30</td>
<td>Emmanuel Boss: real-time QC</td>
</tr>
<tr>
<td>10:00</td>
<td>Emmanuel Boss: real-time QC</td>
</tr>
<tr>
<td>10:20</td>
<td>Emmanuel Boss: delayed-mode QC</td>
</tr>
<tr>
<td>11:20</td>
<td>Catherine Schmechtig: meta data; data format</td>
</tr>
<tr>
<td>13:05</td>
<td>Sensor calibration and intercalibration</td>
</tr>
<tr>
<td>13:35</td>
<td>Real-time QC</td>
</tr>
<tr>
<td>14:35</td>
<td>Delayed-mode QC</td>
</tr>
<tr>
<td>15:35</td>
<td>Catherine Schmechtig: meta data; data format; type of data to be transmitted</td>
</tr>
<tr>
<td>15:50</td>
<td>Hervé Claustre: real-time QC; delayed-mode QC</td>
</tr>
<tr>
<td>16:50</td>
<td>Catherine Schmechtig: meta data; data format</td>
</tr>
<tr>
<td>17:05</td>
<td>Review of actions to be undertaken : Catherine Schmechtig</td>
</tr>
</tbody>
</table>