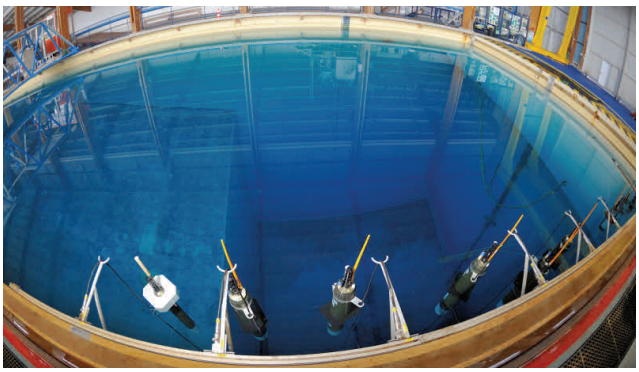
NAOS project newsletter

n° 2 - January 2013



Content

Observation of the global ocean - Preparation for the new decade of Argo

Editorial

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NAOS is in its most intensive development phase. Many activities are carried out in parallel to develop new versions of French Argo floats. The project team works hard and provides an outstanding job. The first tests at sea of deep float prototypes and floats with Argos-3 transmission have been successfully conducted. This second NAOS Newsletter testifies the intense activity of the project over the last six months. Enjoy reading!

Annual meeting

The 1st annual meeting was held on 21st and 22nd June 2012 at Ifremer, Brest. It was attended by about sixty participants with a good participation of project partners. Minitries (Higher Education and Research & Ecology, Sustainable Development and Energy) were represented. The meeting went well. A visit of Ifremer float test facilities and an exhibition of floats (biogeochemical Provor, 3 500 m deep float prototype) were organized.

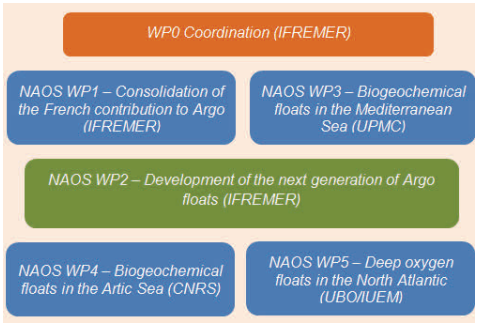
Project partners around the ProvBio float

Project and organization

NAOS has two main objectives:

- To consolidate the French contribution to Argo
- To develop the next generation of French Argo floats

The project was launched on 1st June 2011 and will end in December 2019. It is organized around five worpackages:



Prototype development will be carried out in WP2 from June 2011 to June 2014.

Purchases of floats for WP1, 3, 4 and 5 will be done from 2012 to 2016.

Workpackages news

WP1: Consolidation of the French contribution to Argo

Sylvie Pouliquen *sylvie.pouliquen@ifremer.fr*

The acceptance tests of the first NAOS floats were successfully performed and deployment preparation is underway.

- Processing chains and at sea monitoring tools have been improved.
- A special focus was done on Argo float trajectory data processing to derive better quality ocean currents.
- Jointly with WP3, an international workshop about Bio-Argo Data Management was held prior to the Argo Data Management meeting in India. The goal of this workshop was to prepare biogeochemical float processing and to define exchange formats and real time quality control procedures. This work will be continued in France by UPMC and Ifremer in the coming months.

WP2: Development of the next generation of French Argo floats

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In 2012, floats development activities were launched and several prototypes have been completed. Most of the human resources were mobilized for the project. Validation tests were conducted: functional tests on hardware and software, experiments at sea.

Argo profiles transmitted in fifteen minutes via Argos-3

Ifremer teams have been deeply involved in Argos-3 satellite transmission since the beginning of the project. In addition, the subcontractor SII helped us understanding a complex system and developing embedded software. The main objective is to transmit a complete profile on a single satellite pass and to remotely control the float. Two transmission types have been explored, the low and the high-rate:

- The interactive low-rate uses the same channel, flow rates and power transmission as Argos-2. An Arvor-A3 has been successfully deployed in October in the Bay of Biscay. The float is able to transmit 150 points data per profile (about 1.5 times a typical Argo profile) in a single Argos-3 satellite pass (less than fifteen minutes!) including margins (figures 1 and 2).
- The high-rate transmission uses GMSK modulation on a dedicated channel, with increased power and at a theoretical speed of 4 800 bits/s. The transmission test results suffer from high variability. The best passages satellites can transmit more than 1 000 points (ten times more than the content of a standard Argo profile), for the best cases to much less for the worst ones. This point is still under investigation.

Finally, a smaller Argo antenna was designed by CLS and University of Limoges. A prototype that could be fitted on a marine model will be developed.

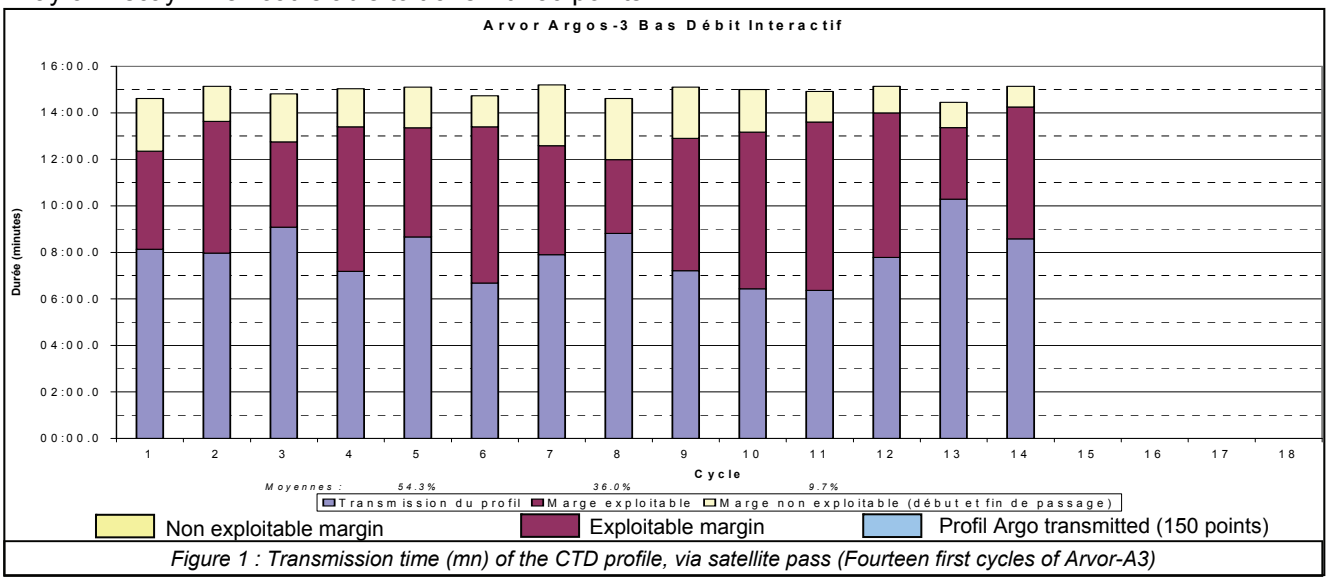


Figure 1 : Transmission time (mn) of the CTD profile, via satellite pass (Fourteen first cycles of Arvor-A3)

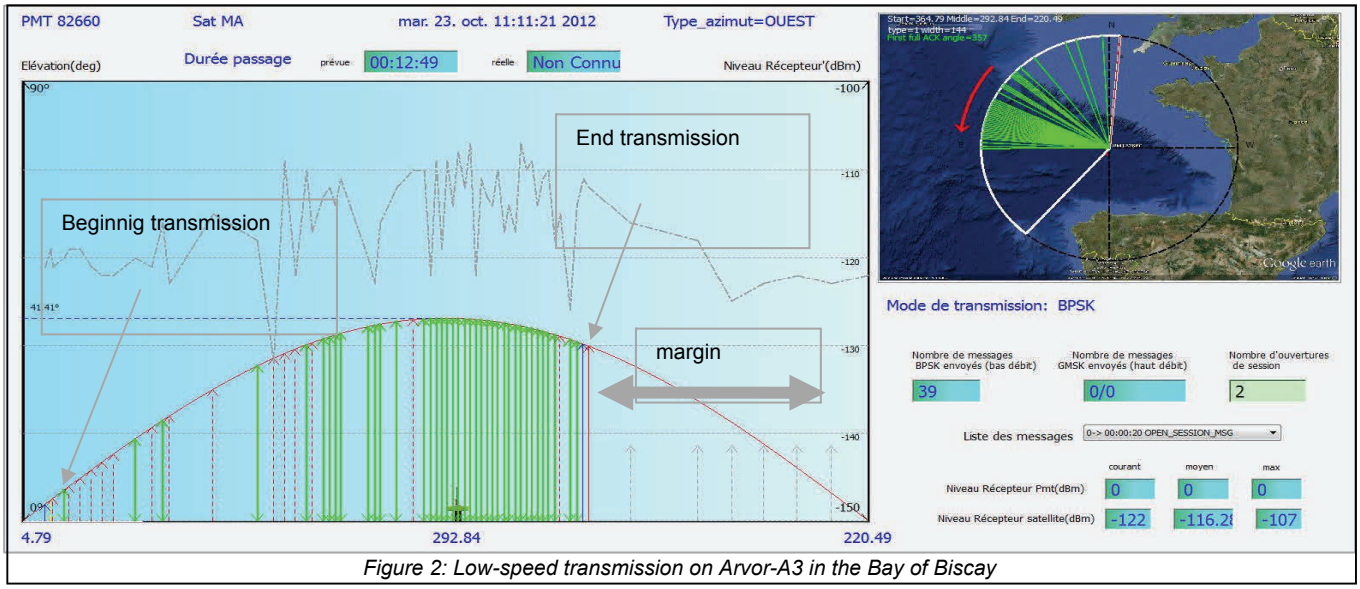


Figure 2: Low-speed transmission on Arvor-A3 in the Bay of Biscay

Deep Arvor cycles 3 500 m deep

The deep Arvor model was successfully deployed during the Strasse campaign in August 2012 in the middle of the Atlantic Ocean. This was the last step of a work started in 2009 by Ifremer. This extension to Argo capabilities is needed to monitor deep water masses that play a key role in climate change studies.

The targeted “depth” was achieved thanks to the use of composite materials that have the advantages of being light and cheap, the adaptation of engine technology and the evolution of the CTD sensor. This deep-Arvor float is also equipped with an optode sensor and an Iridium satellite transmission in “sbd” mode. The on-board energy package is dimensioned to realize 150 cycles $CTD0_2$. Since its launch, the deep-Arvor reached sixty cycles at 3 500 m depth (figure 3) and transmitted both standard Argo sampling profiles and high resolution profiles (1000 points) (figures 4 and 5).

This is the first time an Argo float has been regularly cycling at such a depth. The achievement and maintaining a cycling Argo float at 3 500 m depth is a performance.

Deep-Arvor deployment

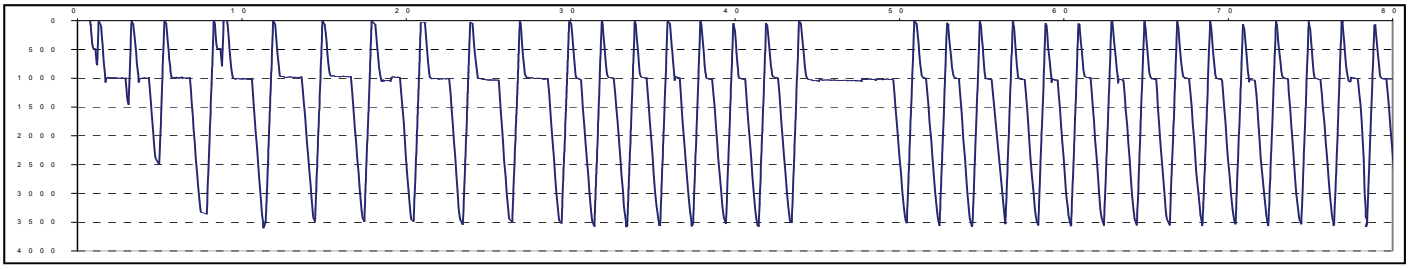


Figure 3: « Deep Arvor » cycles during the first eighty days of the misision (Time in days)

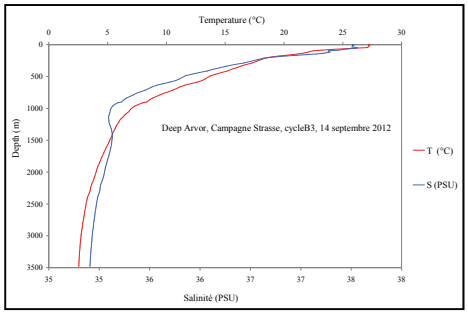


Figure 4: T& S, B3 cycle, September 14, 2012

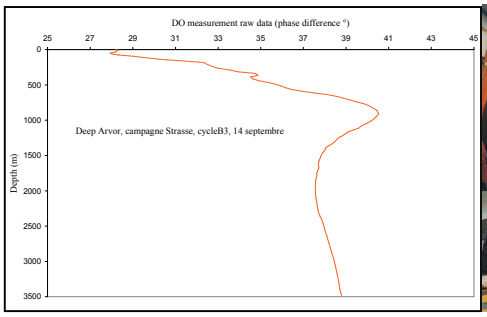
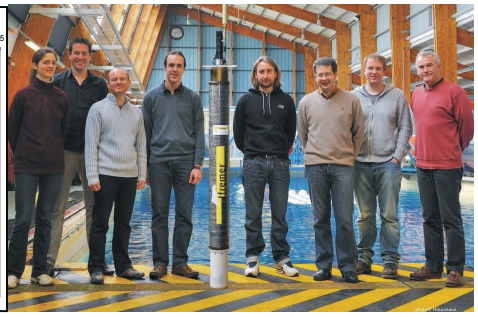


Figure 5: Oxygen, B3 cycle, September 14, 2012



Ifremer NAOS WP2 team

Reliability, NOSS and APMT

Work on the float reliability was realized by NKE and Ifremer to draft a set of measures to be implemented to control manufacturing and to improve the robustness of embedded software and deployment safety.

To reduce Arvor production costs, the float design was re-evaluated: a new Argos antenna has been designed, a composite hull has been proposed and a new engine is studied.

Work on the optical sensor (NKE, Ifremer, SHOM) resulted in the design of the NOSS-v2 sensor that was tested by the SHOM during the summer campaign “Proteus”. The results are promising. However, some improvements need to be done to embed the sensor on a Provor float in 2013.

The LOV, together with NKE developed a new Provor prototype separating the vector and the measurements functions. A measurement unit will be able to process complex in-situ signals (such as ice detection) and change the vector behaviour accordingly. On the float, a controller unit (APMT) is able to link the elementary navigation phases and execute cycles more complex than the standard Argo mission. In the past couple of months a Provor APMT equipped with Bio-optical sensors was successfully tested in the Bay of Villefranche.

The specifications (ProIce) of the Provor APMT Arctic evolution dedicated to bio-geochemical experiments in the Arctic Ocean have been finalized (NKE, LOV, Takuvik).

WP3 : Biogeochemical floats in the Mediterranean Sea

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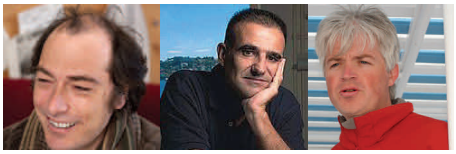

In November 2012, the first biogeochemical NAOS-WP3 float (MED_NWE_NOA) has been successfully deployed in the Mediterranean Sea between the French coast and the Corsica Island (BOUSSOLE cruise, see figure 1).

It is equipped with the complete biogeochemical suite of the standard NAOS-WP3 floats: Chlorophyll and CDOM fluorometers, Nitrate UV sensor, three wavelength irradiance-meters, oxygen concentration sensor, Photosynthetically Available Radiation sensor. The float was initially programmed for a one day cycle frequency and for a parking depth of 1 000 m (the standard protocol for LOV biogeochemical floats). After five free error profiles, the float was remotely reprogrammed for a five days cycle frequency. Positions and data are available online (http://www.oao.obs-vlfr.fr/carto/NAOS.html). Before its deployment, the MED_NWE_NOA float has been "adopted" by a school class of the region (figure 2), and it will be followed by the scholars during its life-time (www.monoceanetmoi.com).

The thirteen others NAOS-WP3 floats will be deployed in the coming months, in the framework of oceanographic cruises organized in a national (MERMEX cruises) and international context (Italian OGS, Spanish-IMEDEA, Cyprus-UOC, see figure 3). The deployment and the sampling strategies have been concerted with the scientists involved in the deployments, and a scientific roadmap has been prepared (http://en.naos-equipex.fr/content/download/65498/877444/file/Roadmap_Bio_Argo_NAOS_dec2012-1.pdf). Three floats will be deployed in the Ligurian Sea in February, four floats in the Southern Adriatic and in the Ionian in March, and six floats in the Algerian, Tyrrhenian and Levantine basins in June.

In parallel, the QC processing chain of the NAOS-WP3 floats is developed, through a strong collaboration with the Coriolis data centre and in the framework of the Argo Data Management Team (ADMT), which includes now a Bio-Argo representative.

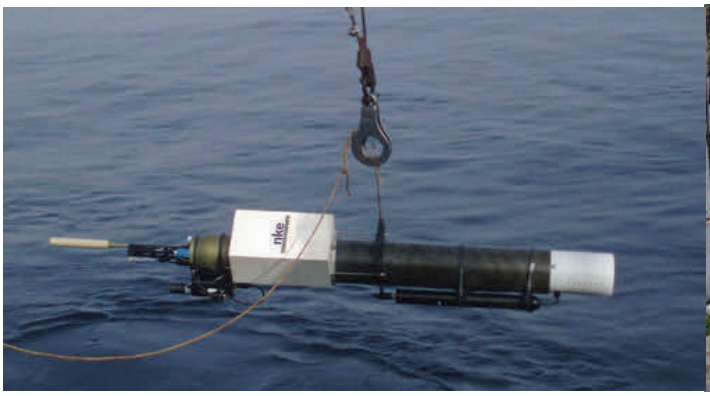

Figure 1: The MED_NWE_NOA NAOS-WP3 float deployment on the BOUSSOLE site

Figure 2: The MED_NWE_NOA during its "adoption" by a French class

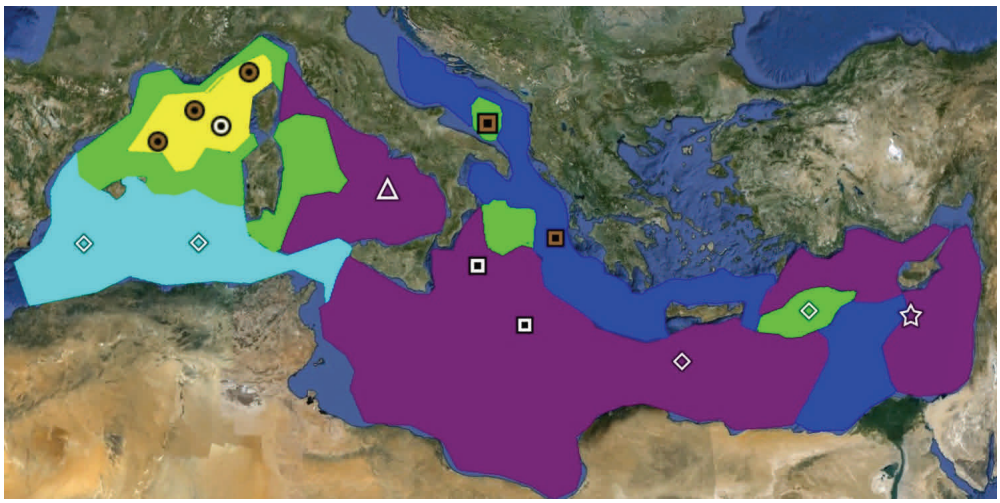

Figure 3:

The present deployment plan of the NAOS-WP3 Mediterranean biogeochemical floats.

Colours indicate Mediterranean bioregions.

Locations of the float's deployments are indicated by circles (French cruises), squares and triangles (Italian cruises), diamonds (Spanish cruise) and star (Cyprus cruise).

WP4 : Biogeochemical floats in the Arctic Sea

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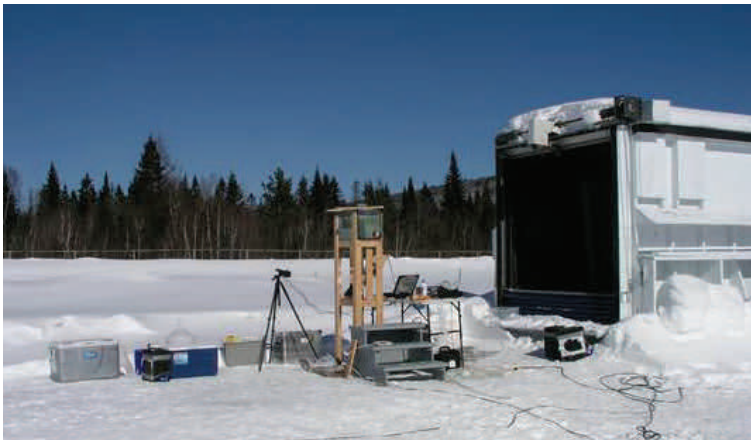
The WP4 is dedicated to the deployment of biogeochemical floats in the Arctic Ocean to study the dynamics of ice-edge spring phytoplankton blooms. The selected study area will be the Baffin Bay where spring blooms occur systematically. The strategies for deployment (choice of characteristics of profiling cycles, deployment locations and tactical patterns for profiling) will be optimized using high-resolution hydrodynamic modeling studies and lagrangian calculations. These deployments will be performed in 2014 and 2015.

Currently, WP4's activities go on, linked to WP2 (in close collaboration with LOV); they are dedicated to the implementation of selected sea-ice detection techniques on floats. Takuvik wrote a white paper detailing the problem of the use of platforms, Argo float particularly, in Arctic marginal areas.

Researches have been conducted on sensors for ice detection (Optical, methods, acoustic passive or active), as well as algorithms detection. The Takuvik team is leading the development of an optical sensor for ice-detection (depolarizing signature of sea-ice) in collaboration with two institutes for optics, based in Québec city.



Review of an ice detection device by Lidar (copyright Gilles Roy, RDDC)

WP5 : Deep oxygen floats in the North Atlantic

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In preparation for the deployment of deep Argo floats equipped with oxygen sensors carried in the WP5, an engineer was hired to work on the establishment of Arvor 3 500 m pre-deployment validation procedure. This pre-deployment validation procedure details the tests to be performed on the float prior to deployment to minimize the risk of float failure after deployment.
In parallel, we established the real time quality control checks to be applied to the oxygen data acquired by the regular Argo floats (0 - 2 000 m). Next step is to verify the validity of these tests for the deep oxygen data (2 000 m - 3 500 m).

Meetings and next events

- 4th Argo Science Workshop, September 27-29, 2012, Venice, Italy.
- 13th Argo Data Management and 1st Bio Argo workshop, November 12-16, 2012, Hyderabad, India.
- 5th Steering Committee meeting, October 18, 2012, Ifremer, Issy-les-Moulineaux.
- Meetings Euro-Argo in Brest (Euro-Argo Management Board, annual meeting SIDERI, kick-off of the european project E-AIMS) January 14-17, 2013, Ifremer, Brest.
- 6th NAOS Steering Committee meeting January 24, 2013, Ifremer, Issy-les-Moulineaux.
- 3rd NAOS governing board meeting, March 14, 2012, Ifremer, Issy-les-Moulineaux.
- 4th User meeting Euro-Argo, June 18-20, 2013, Southampton, U.K..

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Convention ANR-10-EXPQ-40-01

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