NAOS

NAOS Project Newsletter

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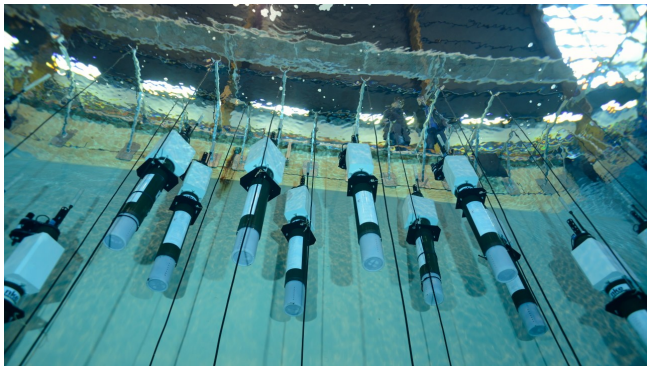

Content

NAOS Novel Argo Ocean observing System

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

Editorial

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This third Newsletter concludes a very intensive 2013 year for the project. The development and testing of the different float prototypes have continued. Tests at sea of deep float prototypes have been completed and industrialization phases are in progress. A new Provor prototype separating vector and measurement functions has been successfully tested. The first NAOS WP1 floats and WP3 floats have been deployed. New scientific results have already been obtained in the framework of WP3, which has implemented for the first time a network of biogeochemical floats at the scale of an ocean basin. Enjoy reading and see you on June 16-17 at Ifremer Brest during the third NAOS annual meeting!

Workpackages news

WP1: Consolidation of the French contribution to Argo

Sylvie Pouliquen *sylvie.pouliquen@ifremer.fr*

Delivered in 2012, WP1 floats have been mostly deployed in 2013. The second version of the "at sea monitoring" online tool has been updated. The tool is able to provide more synoptic information on float operation. An annual report of the operation of floats deployed in 2013 has been produced. Processing chains have been updated to improve decoding of the transmitted float data, especially those acquired when the float is drifting. This will allow the generation of more accurate velocity fields from Argo data. Together with WP3 and WP5, the quality control procedures for oxygen and chlorophyll have been defined by scientists and implemented at Coriolis data center.

WP2: Development of the next generation of the French Argo floats

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T2.1 - Reliability of the Arvor and new Arvor-NT float

The selected developments on the vector were implemented by NKE. Software upgrades will be made on five Arvor floats in early 2014. This concerns, in particular, additional self-tests, the simplification of deployment protocol, as well as securing the vector, the feedback of technical data and the support for decoding data. New features also include the improvements required by users, especially the mode enabling to connect two missions with different parameters. The Arvor-NT development is focused on finding solutions combining performance and cost reduction. This led to the creation of a new pump unit, the definition of a composite solution for the tube and the evolution of the Seabird cap.

T2.2 - Argos-3 communications

Results of high data rate tests conducted on test bench have shown poor performances that were confirmed by CNES. However, decision was made to proceed with a demonstration at sea and a float was deployed south of the Azores in August 2013. The first sessions enabled providing four profiles of high resolution (1000 CTD samples) in less than 10 minutes, even though the experiment was cut down due to the failure of the transmission. The feasibility of high data rate transmission has thus been demonstrated but the operational limits of the system are an obstacle to its general use. Regarding the low data rate transmission, the prototype deployed (figure 1) a year ago, has obtained very good results. It made about 140 cycles by synchronizing its arrival at surface on Argos-3 satellite pass and transmitting Argo profiles (100 CTD samples) in 10 minutes. Energy consumption is divided by five compared to an Argos-2 transmission, the transmission cost is reduced and the battery life is increased by 25%.

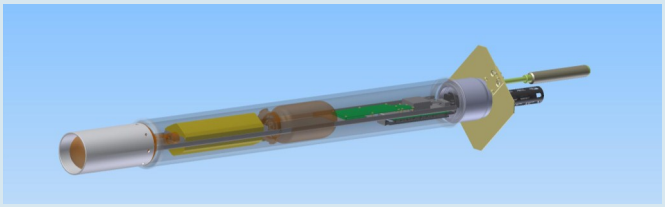
Figure 1: Deployment of a low data rate Arvor Argos-3 in Bay of Biscay.

2.3 - Deep Arvor

The second deep Arvor prototype deployed in October 2012 was recovered in February 2013 after presenting an intermittent communication failure due to a manufacturing defect on the Iridium antenna. The expertise of the float showed good general condition and allowed us to improve the hydraulic motor. The profiler was reintegrated and then redeployed in November. Mid-February, it had made about 40 cycles at 3,500 m. After transferring the technical file to NKE at end of 2012, the decision was also made to increase the operational immersion of the deep Arvor to a depth of 4,000 m. This required calculations and additional tests on different subsets that were successfully conducted. This step also allowed us to incorporate technical modifications taking based on the results from the two prototypes. It is planned to deliver industrial prototypes in the first quarter of 2014. The expected performance is at least 150 cycles to 4,000 m in depth.

Deep Arvor industrialization phase

Industrialization conducted by NKE and Ifremer teams will provide soon tow deep float prototypes. In addition to the next production preparation, this project phase helped us to improve some profiler components. Masses of the upper cap and the antenna have been lowered, thereby enhancing the stability of the surface float. The frame was simplified and consolidated to facilitate the integration.



T2.4 - Vector - measure architecture

The new NKE CTS5 float was validated at sea during a deployment of five weeks off Nice. This float, even without the OSEAN acquisition card worked perfectly well during this test. Meanwhile the OSEAN company, according to the specifications defined by LOV, developed a second version of the acquisition board. A feedback protocol, based on a set of commands interpretable by the CTS5 profiler, was jointly developed by the LOV and NKE. This protocol was validated on a simulator (figure 2) and will be tested in early 2014 on an actual float.

Figure 2 : Environment simulator used in Villefranche-sur-Mer for the new vector measurement architecture's validation.

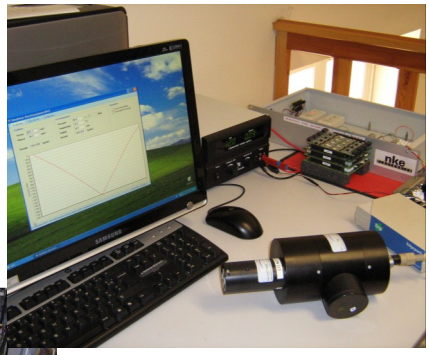


Figure 3 : NOSS sensor tested in an hyperbaric chamber.

T2.5 - Provor float with the NOSS density sensor

NKE modified the NOSS density sensor in particular by using stronger materials (titanium) to meet the constraints of rigidity. Tests were conducted according to an environmental qualification plan (Ifremer) and calibrations were held (NKE and SHOM) followed by measurement controls in pressure with the Ifremer hyperbaric chamber (figure 3). The NOSS sensor hardware and software's design resulting in the refractive index is considered as correct. It was decided to implement the NOSS sensor on a Provor float already equipped with a Seabird CTD sensor.

T2.6 - Bio Arctic

Two ProIce prototypes were delivered in May 2013. These prototypes include a software and hardware adaptation able to store data obtained under ice until the next communication. A fiberglass tubular structure was also added to protect the antenna from possible shocks with sea ice. A very useful option for changing mission without remote control (on date criteria) was also added. The feedback mechanism ISA type (Ice Sensing Algorithm) has been implemented on the OSEAN card and validated on physical simulator (figure 2).

The first results of NAOS biogeochemical floats in the Mediterranean Sea

F. D'Ortenzio & V. Taillandier

From November 2012 to July 2013, 11 biogeochemical PROVBIO-II (NKE) floats were deployed in different regions of Mediterranean Sea (Figure 4), on the basis of the existing knowledge of the basin biogeography. They collected 749 profiles of Temperature, Salinity, Chlorophyll concentration (CHL), Backscattering, CDOM and Irradiance (on 25/02/14). For some floats (SN016/017/018/039/042, indicated in green in the figure 4), Nitrate concentration (NO_3) and oxygen are also sampled (344 profiles with NO_3 on 25/02/14). In the following, we will discuss only the data of the North Western Mediterranean region, as for the other floats/bioregions, a complete annual cycle is still not achieved. Profiles of CHL for the two floats in the bioregion (SN017, SN035) are checked using the LOV RT-QC data processing chain. They are then plotted versus time (Figure 5). Mixed layer, nitracline and euphotic depths are also plotted. Time series of total Chlorophyll (nCHLtot, i.e. integrating each profile from surface to depth) and of the surface Chlorophyll (nCHLsurf), both normalized by the annual maxima, are also plotted (Figure 6). Climatological time series of normalized satellite surface Chlorophyll (nCHLsat) time series, calculated for the bioregion "Bloom", is also plotted for comparison.

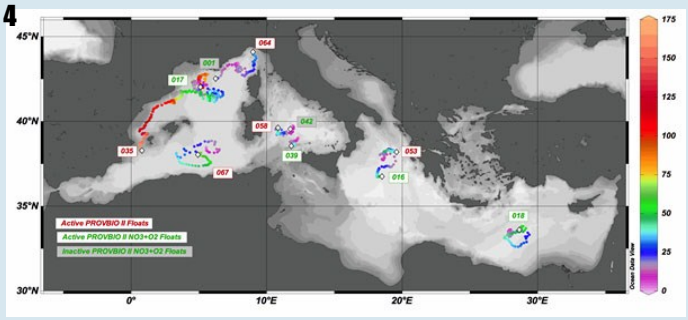
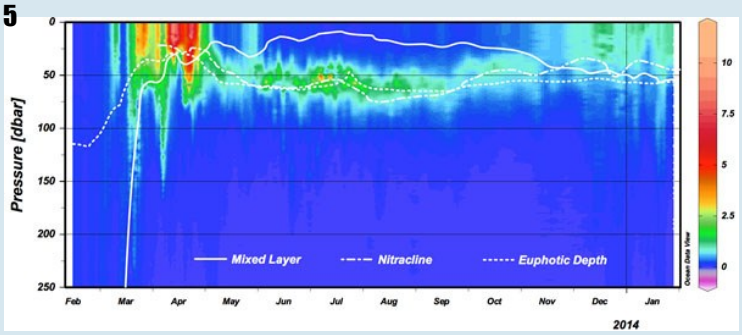
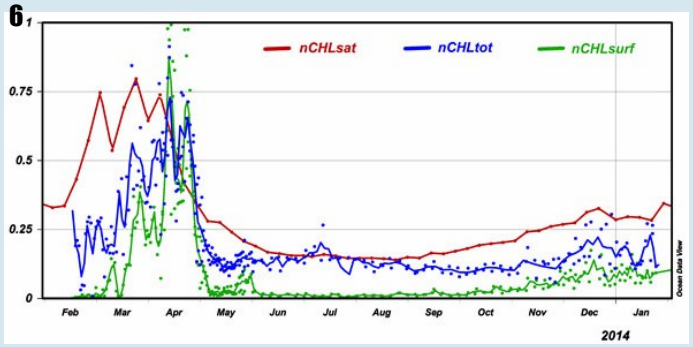


Figure 4: NAOS WP3 float trajectories (surface positions). Boxes indicate the serial number, status and instrumental configuration of float. Colorbar indicates the number of profiles achieved for each float.

Figure 5: Profiles of chlorophyll concentration (CHL) versus time for the SN017 and SN035 NAOS WP3 floats. White continuous line indicates mixed layer depth; dotted line, euphotic depth; dot dash line Nitracline depth.

Figure 6: Time series of nCHLtot (blue line and points) and nCHLsurf (green line and points) calculated from SN035 and SN017 NAOS WP3 floats. Red line indicates the climatological nCHLsat calculated on the "Bloom" bioregion.





The two floats deployed in the North Western Mediterranean (NWM) region ("Napoléon", SN035 deployed in February 2013; "Mortier", SN017, in April 2013, with NO3 sensor) are still operational (February 2014) and no severe hardware nor software issues have been detected. Floats sampled a large bloom (April 2013), occurring after the extreme mixing event observed in February 2013, which injected large amount of NO3 into surface layers (see nitracline depth on Figure 5). After the bloom (from May to October, 2013), oligotrophic conditions are observed, with a deepening of the nitracline and the onset of a deep CHL maximum, positioned at the same depth of nitracline. In November the slow deepening of mixed layer induced an uplift of nitracline and a consequent augmentation of biomass.

Comparing nCHLsurf with the nCHLsat of the "Bloom" bioregion (Figure 6), we observed a general correspondence between the time series. The timing of the onset of oligotrophic conditions, as well as their temporal duration, are relatively close: occurring the first in May, and spanning, the second, up to October. The timing of the peak (indicating the period of blooming conditions) are slightly different. The observed differences certainly result from different time periods considered (climatology for the satellite analysis and year 2013 for the NAOS floats).

The SN017 ("Mortier") and SN035 ("Napoleon") WP3 NAOS PROVBIO-II floats completed their first annual cycle of observations in the NWM. They observed the biogeochemical behavior of the area providing invaluable tool to explain connections between the physical/biogeochemical components of the Mediterranean ecosystems. Further work is on going, in particular to exploit the other parameters measured on the PROVBIO-II (i.e. irradiance, backscattering), which could open up a new scope for our understanding of the Mediterranean ecosystem functioning.

WP3: Biogeochemical floats in the Mediterranean Sea

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The 2013 year has been a key year for WP3, as the first phase of Mediterranean network deployment was successfully achieved. Almost the whole group (11 of 14) of floats acquired in 2012 was deployed. Overall, the network situation is very satisfactory. Presently, eight floats work perfectly, two floats experienced technical issues and were recovered through a dedicated campaign at sea (August 2013). The analysis of these recovered two floats is underway and it already provided the identification of some minor technical problems. Three floats were deployed in the framework of a major action of oceanographic researches in the Ligurian Sea (DEWEX, Mediterranean INSU chantier). The real-time processing of data, which includes quality control methods, is almost completed. The delayed time quality control methods have been defined and are under validation in an international context. In February 2014, 749 profiles were acquired over the whole Mediterranean region providing an unprecedented dataset on a couple geophysical dynamics. The NAOS WP3 observations consist then in an unprecedented data set on the coupled physical biogeochemical dynamics. A preliminary analysis of the profiles in the Ligurian Sea (Lavigne et al., JGR, 2013) indicates that Bio-Argo observations provide a better characterization of the relationship between mixed layer and algal response, including the identification of key events of the ocean ecosystems (i.e. start and duration of phytoplankton blooms). See page 3.

WP4: Biogeochemical floats in the Arctic Sea

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Since the start of the project, WP4 has been working closely with WP2. Takuvik focuses its work on ice detection by optical measurement (not funded by NAOS). Two projects based on depolarizing characteristics of sea ice are conducted with local partners. Takuvik also gathered many CTD profiles collected under ice in the Arctic in order to make the best adjustment to the thresholds algorithm ISA to the Arctic.

WP5: Deep oxygen floats in the North Atlantic

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Actions have been undertaken to prepare the WP5 float deployment. The manual describing the oxygen data management process has been updated. Automatic real-time tests to control oxygen data quality were implemented in the data center. A software has also been developed to facilitate float programming and to facilitate report on acceptance tests in automatically downloading results of the tests and summarizing them in a pdf file.

Meetings and next events

- E-AIMS 1st annual and review meetings, January 21-22 2014, BELSPO AISBL, Brussels.
- 5th Euro-Argo Management board meeting, January 22-23 2014, BELSPO AISBL, Brussels.
- 10th NAOS Steering Committee meeting, April 3 2014, Ifremer, Brest.
- 5th NAOS Governing Board meeting, April 8 2014, Ifremer, Issy-les-Moulineaux.
- 3rd NAOS annual meeting, June 16-17 2014, Ifremer, Brest.

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Convention ANR-10-EXPQ-40-01

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