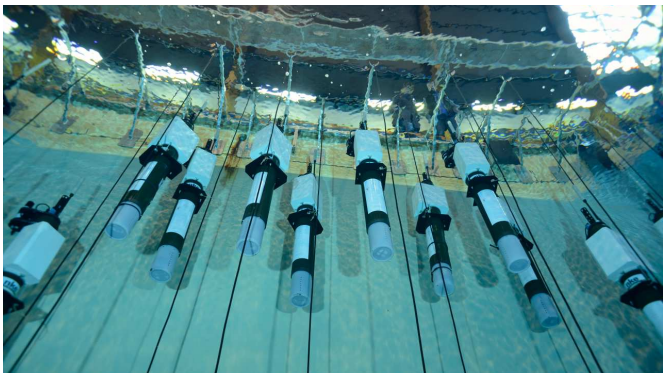
NAOS project Newsletter

n° 4 - February 2015



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NAOS — Novel Argo Ocean observing System: Observation of the global ocean - Preparation for the new decade of Argo

Editorial

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The NAOS newsletter aims to update the scientific community on the progress of the NAOS project and we are pleased to report that it has made excellent progress since it was launched over three years ago. Most of the prototyping activities are now completed. The Deep Arvor float went into production last year and we successfully deployed two industrially manufactured floats during the Geovide mission in 2014. The array of biogeochemical floats in the Mediterranean (WP3) is working very well indeed and has provided a unique set of data enabling us to study the biogeochemical cycles in the Mediterranean. The first series of biogeochemical floats (Pro Ice) for the Arctic (WP4) has been ordered thanks to the positive results of the Provor CTS-5 float tests.

The deployment of the Deep Arvor and Pro Ice floats series programmed for mid-2015 means that the project will soon enter a new scientific exploitation phase.

We hope you enjoy finding out about all these developments in this 4th issue of our Newsletter. Enjoy reading!

Work Package updates

WP1: Consolidation of the French contribution to Argo

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Following our call for tenders in 2014, the company NKE was selected to manufacture 40 Arvor floats. Our NAOS floats are now monitored more efficiently at sea using data that not only provide information on the array of floats as a whole but also on each individual float as well as displaying the necessary technical parameters that enable us to accurately diagnose and deal with any problems that may occur.

The processing of information from both biogeochemical and deep sea floats is now operational but exactly how it should be processed has been the subject of extensive talks among members of the international Argo data man-

WP2: Developing the next generation of French Argo floats

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Since the beginning of the NAOS project we have been working on improving our profiling floats and two new floats were deployed in 2014: the industrially manufactured version of the Arvor 4000m float and the Provor CTS5, which features a new electronic architecture for Arctic applications. Low rate Argos-3 satellite transmission is now fully functional and we now have two Provor floats equipped with Noss sensors.

T2.1 - Ensuring the reliability of Arvor

We have been focusing on improving the reliability of the current Arvor float in a number of ways: by simplifying the deployment procedure, consolidating self-tests, monitoring pressure variation more closely during certain critical phases etc., while minimizing any cost implications. We now have an additional “bi-mission” facility which enables each profiling float to have two life cycles. Two new floats tested in September 2014 highlighted a problem with the antenna that is about to be solved.

T2.2 - Argos-3 Satellite communications

The third generation of Argos satellite transmission involves a new modem, a specifically adapted antenna and software that manages the surface link and two-way transmission to the satellite. Two operating modes ("high-rate" and "low-rate") were tested as part of NAOS. Only the “low-rate” was finally selected and consolidated with security enhancements. These developments led to the deployment of an Arvor float in the West Mediterranean in May 2014 and the results are highly satisfactory: the profiling float completed 55 cycles at the end of January 2015, we were able to control it remotely and it transmits data regularly to the satellite in only a few minutes.

T2.3 - Deep Arvor

Ifremer was responsible for designing and developing “working models” that were tested at sea in 2012 and 2013. After further work to extend their operational depth to 4000m, these models went into production with NKE in early 2014 resulting in two prototypes which were deployed in May 2014 during the Geovide campaign. The first one has a 10 day cycle. It is being tested in the Iberian basin to allow us to verify the stability of the float during drift phases and the accuracy of measurements (32 cycles at 4000m were completed in 2014). The second cycles every two days in order to check the float’s cycle capacity and to assess energy consumption (90 cycles at 4000m were completed in 2014) (figure 1). To date there has been good reproducibility in the float’s behavior and energy consumption levels are very satisfactory.

Following negotiations conducted by Ifremer, NKE has now been awarded a license to manufacture and commercialize the floats.

A contract for 12 Deep Arvor floats was drawn up in October for WP5.

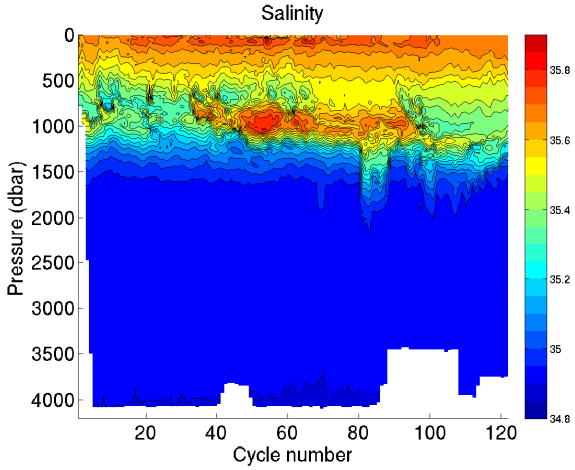


Figure 1: Salinity observed with the Deep Arvor in two-day cycling mode (90 cycles at 4000 m in 2014 and more than 120 cycles beginning of February 2015).

T2.4 - Float – Measurement architecture

The software embedded in the final version of the OSEAN acquisition card was validated at the beginning of last year. Consequently, an initial, stable version of the CTS5-OSEAN-equipped profiling float was completed in July 2014. This equipment was tested at sea as part of the ProVal project in which the float features specific sensors for validating satellite “ocean color” applications. After two weeks of successful deployment, we unfortunately had to recover the float because of a mechanical problem on one of the sensors. However, we were nonetheless able to confirm that the system functions successfully, allowing for Task 2.6 to be set in motion. We also conducted trials, in Villefranche Bay, in order to test feedback features from the measurement unit onto the unit in charge of the float navigation. As a result, the velocity and cycle of the profiling float were modified successfully by the measurement unit.

T2.5 - Provor float featuring the Noss density sensor

NKE has designed two new sensors which have been tested metrologically by the SHOM and under pressure at Ifremer. The results have been judged to be acceptable for use on floats. Two Provor profiling floats equipped with sensors were delivered and then were tested (in a hyperbaric chamber and in a tank). We plan to deploy the floats at sea and recover them after about one week in Spring 2015.

Figure 2 Provor NOSS tank trial

Figure 3: Pro-Ice Prototype

T2.6 - Bio Arctic

At the end of last year an initial prototype, equipped with a remA optic sensor, an acoustic altimeter and a shock sensor, was tested off the coast of Villefranche-sur-mer over one day. We were able to validate the configuration of the profiling float in “Bio-Arctic” mode (figure 3). Specifications were sent to NKE for the manufacture of five NAOS pro-Ice floats which were ordered in October and should be completed by the end of January.

Thanks to the CTD profile analysis carried out by Takuvik, a new ISA algorithm has been encoded specifically for the Arctic. Likewise for the altimeter algorithm. They have both been validated using a simulator.

Deep Arvor data analysis

Comparing the salinity data of the four Deep Arvor floats deployed from 2012 (figures 4 and 5) with the reference CTD data has revealed a slight under-estimation of the salinity level of between 0.01 and 0.02 psu which is not pressure dependent (figure 6). It has also become apparent that sampling from intermediate layers which contain too much variability hinders the detection of a bias of this amplitude with standard Argo floats (0-2000m) and therefore highlights the importance of extending the measurements beyond 2000m in order to improve the quality of the salinity data. Using previous data to correct the salinity measurements, the θ/S diagram matches perfectly the reference CTD data taken during deployment, demonstrating the high degree of reliability of these measurements.

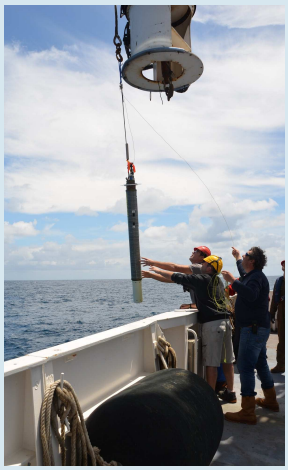


Figure 4: The deployment of a Deep Arvor float during the Geovide campaign.

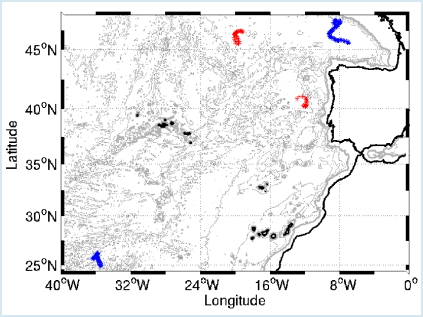


Figure 5: The positions of the four Deep Arvor floats. The first two Deep Arvor working models deployed in 2012 and in 2013 are shown in blue. The two industrial prototypes deployed in 2014 during the Geovide campaign are shown in red.

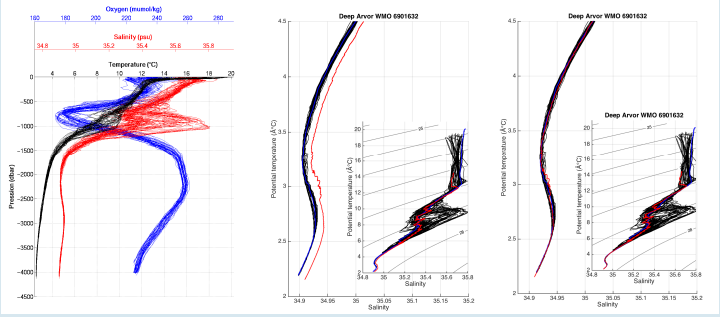


Figure 6: Data from the Deep Arvor float 6901632 deployed in 2014.

Temperature potential (in black), salinity (in red) and dissolved oxygen concentration (in blue) versus pressure.

ϑ/S diagram of all the float profiles (black contours) and of the closest (blue contour) to the control profile (red contour) measured at the moment of deployment.

The same data as the middle graph, corrected for salinity.

CTS5-ProVal first deployment

Works carried out in Task 2.4 led to the CTS5-ProVal profiling float which took its first measurements at sea last summer (see figure 7). The CTS5-ProVal is a new float which takes high quality radiometric measurements with a view to validating satellite "ocean color" measurements. The float is equipped with two fixed arms with instruments mounted on both extremities that prevent self-shadowing and allow data redundancy. It provides irradiance and radiance measurements on seven wavelengths (see figure 9). The ProVal also features sensors that measure tilt and orientation (compass) as well as fluorescence (chlorophyll). It is based on the same structure as the Pro Ice profiling float for application in the Arctic (Task 2.6 and WP4) and consists of the latest version of the Provor float (CTS5, NKE) combined with the new acquisition board which has been developed as part of the NAOS project (by the subcontractor OSEAN). Information is exchanged between the two boards using a protocol that has been validated on a laboratory simulator. The ProVal float thus has the advantage of featuring both the flexible, high rate transmission of the CTS5 as well as the data acquisition capacity of the OSEAN acquisition card. The successful running of the ProVal float during these trials also enabled the data acquisition components of the Pro Ice float to be validated.

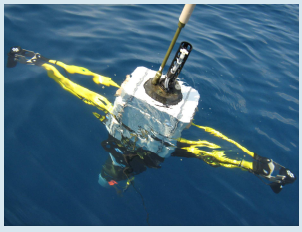


Figure 7: CTS5-ProVal float during its deployment near BOUSSOLE.

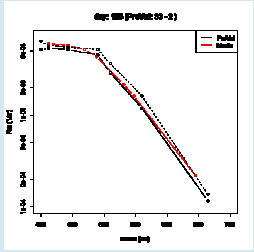
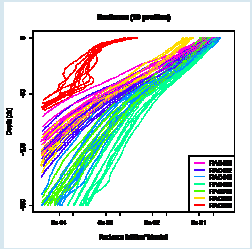


Figure 8: Match up of the reflectance measurements taken by the satellite sensor Modis (Nasa) and by ProVal (14/7/14).



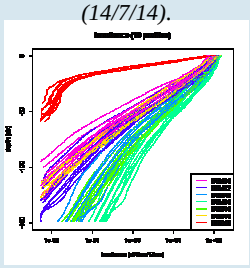


Figure 9 : Irradiance and radiance profiles on seven wavelengths near BOUSSOLE

Ten high quality radiometric profiles (figure 9) were obtained during the deployment of ProVal (out of a total of 20). These data have enabled us to study light propagation within the water column with unprecedented detail. We can now calculate in situ marine reflectance and compare it with the same measurements taken by satellite (figure 8). Marine reflectance provides a base measurement for "ocean color" satellites, so comparing in situ readings with spatial and temporal coverage of the Argo floats gives us a better understanding of the satellite data. Following this trial period, Pro Val will be deployed over a longer period as part of WP3 in order to research bio-optical anomalies in the Mediterranean. The ProVal project is funded by the CNES (TOSCA).

WP3: Biogeochemical floats in the Mediterranean Sea

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WP3 has mainly focused on the consolidation of the Mediterranean array of floats and a comprehensive scientific analysis of its data. The first set of floats has been deployed: nine are up and running, four have been recovered and are being re-fitted and only one has been lost. By December 2014, 1329 profiles had been collected and stored on the Coriolis database and on LOV. Two papers and a thesis Phd have presented the uses of these data and three more studies are to be published soon. Meanwhile, the second series of floats (12 floats) has been purchased, prepared and finalized. Their deployment will take place in May 2015 during the Bio-Argo-Med campaign (PI F. D'Ortenzio). Lastly, real time quality control of chlorophyll and nitrates has been finalized, in accordance with (and in conjunction with) the international Argo authority's Bio Argo working group. The delayed mode quality control for these two parameters is currently under analysis, notably by the subcontractor ACRI.

WP4: Biogeochemical floats in the Arctic

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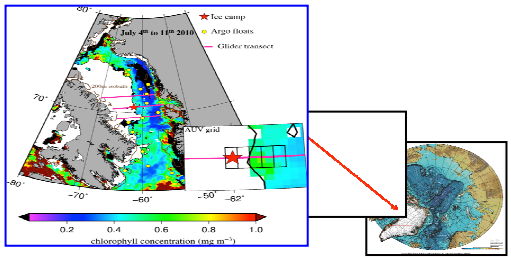
The first WP4 PRO-ICE biogeochemical floats are ready to be deployed using the icebreaker Amundsen in the summer of 2015. Baffin Bay has been selected as WP4's preferred area for studying ice-edge phytoplankton blooms. The deployment will be part of the Green-Edge scientific project whose main campaign will take place in 2016.

Icebreaker Amundsen



Chlorophyll a concentration Baffin Bay (IBCAO)

In 2014, the work of Takuvik focused mainly on the detection of ice using ISA and optical detection methods. We had to adapt the temperature algorithm (ISA) to the area under study using a considerable amount of CTD data and ice concentration data correlated with these profiles.

Optical ice detection uses the light depolarizing properties of sea ice. The first miniaturized prototype was tested in May 2014 under the floe at Qikiqtarjuaq with the sailing ship Vagabond as basecamp. It has enabled us to discriminate between different layers of ice.

WP5: Deep oxygen floats in the North Atlantic

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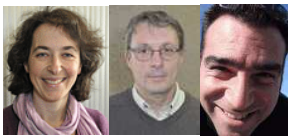

Working in collaboration with WP2, we have been analyzing the data from the four Deep-Arvor floats deployed as part of the NAOS project (see box). Our deployment of nine floats equipped with oxygen sensors during the Geovide campaign has also helped us to maintain the pilot network of oxygen floats in the North Atlantic. We have also developed a method of validating the oxygen data with respect to weather conditions or to a baseline profile. This method has been used to adjust the data from the four Deep-Arvor floats and to generate an improved Argo-O2 database for the North Atlantic which is now being analyzed.

Meetings and events

- 2nd Annual Meeting of E-AIMS, 27th-28th January 2015, UNESCO, Paris.
- 13th Meeting of the NAOS Steering Committee, 3rd February 2015, Ifremer, Brest.
- E-AIMS Technical Review, 5th February 2015, REA, Bruxelles.
- 6th meeting of the NAOS board of directors , 10th February 2015, Ifremer, Issy-les-Moulineaux.
- Euro-Argo Users Workshop & International Argo Steering Team meeting,16th-20th March 2015, Ifremer, Brest.
- 4th Annual NAOS Meeting, 21st-22nd September 2015, Ifremer, Brest.

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NAOS
Novel Argo Ocean observing System

Convention ANR-10-EXPQ-40-01

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