French National report on Argo – 2010
12th Argo Steering Team meeting
March 2011

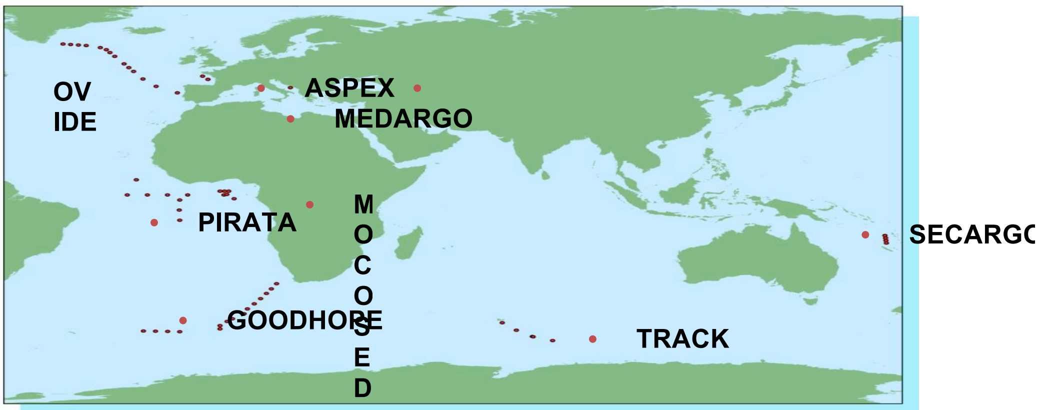
1. Organization of the Argo France program

Argo France gathers all the French activities related to Argo and its extension toward biogeochemical measurements. Argo France is the French contribution to the Euro-Argo European research infrastructure that organizes and federates European contribution to Argo. Euro-Argo will evolve in 2011 into a sustained long-term European organization and legal structure (Euro-Argo ERIC) that will be hosted by France. Euro-Argo and its French component (Argo France) is part of the Ministry of Research national roadmap on large research infrastructures (TGIR). To complement Argo France and Euro-Argo ERIC, the NAOS project has been recently funded by the Ministry of Research to consolidate and improve the French contribution to Argo and to prepare the next scientific challenges for Argo. At national level, Argo France is organized through the Coriolis partnership (CNES, Ifremer, INSU, IPEV, IRD, Météo-France et SHOM) and has been recognized in January 2011 as a long-term research observatory. The agreement is valid for 10 years. At regional scale, Argo France is supported by the IUEM Observatory and funded by the Brittany region. A European Research Council (ERC) advanced grant has also been recently obtained by LOV to work on the development of a biogeochemical component for Argo.

2. The status of implementation (major achievements and problems in 2010)

- **floats deployed and their performance**

59 floats have been deployed in 2010. The current position of the French floats deployed in 2010 and of the French active floats are displayed Figure 1.



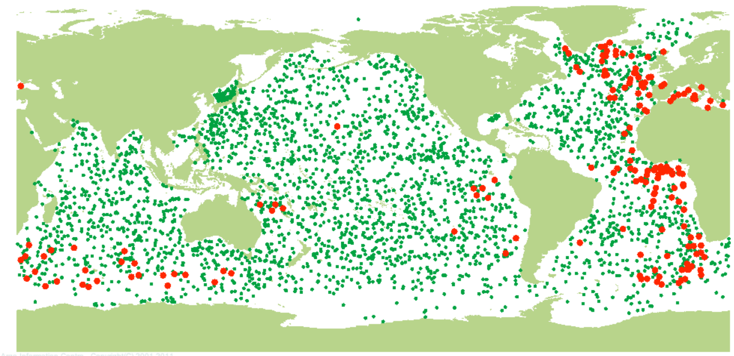


Figure 1: Floats deployed in 2010 and french active floats (red dots).

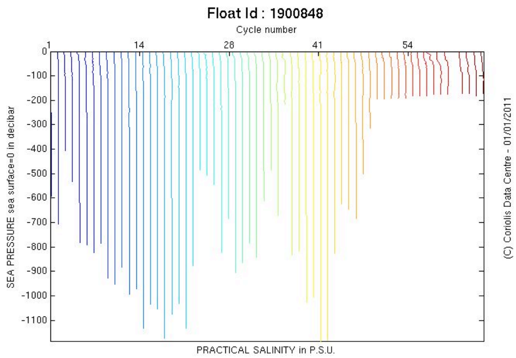
- **technical problems encountered and solved**

<u>At Sea Monitoring Tool:</u> A monitoring tool has been set up to follow PROVOR and ARVOR performances while at sea. This tool provides alert on monthly basis and one person is in charge of the analysis of those alerts. This person is also in charge of understanding premature float death to help improve PROVOR and ARVOR lifetime.

<u>ARVOR-I floats:</u> A first Arvor float (6900794) has been fitted with an Iridium modem coupled with a GPS receiver and a high pressure antenna, for Argo marginal seas requirements:

- Extra information about the behavior of the float is sent
- A last CTD raw data is acquired before stopping the CTD pump at the end of the rising profile (useful for the knowledge of the surface properties)
- Improved vertical resolution (2 dbars), improved power balance
- Remote control available during operation (modification of cycling period, parking depth, profile depth)
- Capability to manage seabed stationing proven at sea.

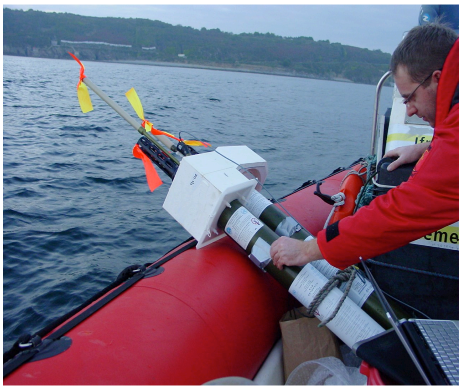
A 2nd Arvor-I (WMO 1900848) was launched in Adriatic sea by OGS team (Feb. 2010). Initially, the float was programmed to cycle every 5 days, drifting at 350m and profiling from700m depth. Every 10 cycles it was programmed to dive at 1100m depth.
Several remote commands have been sent to the float in order to modify the cycling period and the profile depth. At the end of the year, the float has drifted northward, moving away from the south Adriatic Basin. In December, in order to reverse this drift, the parking and starting profile depths have been reprogrammed to respectively 150m and 200m. This float is cycling in an area where depth changes very often from shallow to deep scheme. The float "follows" the ground and samples all the water column, proving its good capability to manage very frequent grounding behavior (53 on 66 cycles). In early 2011, this float has done 66 cycles.



A third <u>Arvor-I (WMO6900800 then 1901203)</u> has been bought by OGS and deployed in the Ligurian sea in July 2010. Several remote commands have been sent to the float in order to modify the cycling period and the profile depth. Particularly, the float has been recovered 2 times and redeployed thanks to a new specific remote command allowing the float to stay at surface at the end of a cycle.

The three ARVOR-I floats are able to better sample the water column. They have been programmed to transmit 240 PTS (pressure, temperature, salinity) triplets between 2000m depth and surface, instead of 100 triplets for standard Argo float. Particularly, the upper area is sampled every 2m. When the float has reached the surface, only 3 minutes are needed to transmit the profile. The total time at surface is approximatively 30 minutes, including the time to increase the buoyancy for good satellite transmission, and afterwards to reduce buoyancy to start a new cycle. This performance has to be compared to more than 8 hours with Argos2.

ARVOR with Argos-3 satellite transmission: Argos 3rd generation transmission is being embedded on Arvor. It is intended to use the interactive mode capability (low data rate) of the MetopA satellite, using its prediction pass tables to make a meeting point at surface. Argos2 standard communication is maintained in case of interactive mode failure. The issue of the double band antenna has been resolved and the new design has been successfully tested in our pressure tank. Two floats have been assembled and tested in pressure tank and in seawater pool. Then, satellite transmission has been tested at sea, near Ifremer institute, in order to get results in real environmental conditions (sea water, buoyancy, satellite visibility,…) in October 2010. Some trouble on the electronic PCB of the float (Eeprom default), and a default on one antenna (RF wire solder) have been detected and corrected. The two Arvor A3 floats are now ready to be deployed at sea for a real mission. This will be done by OGS in Mediterranean Sea when an opportunity vessel will be found. After deployment, we will have to analyze all the data transmitted by the floats, including specific statistic messages that are generated by the float to assess the quality and performance of the transmission.



Arvor fitted with Argos3 satellite transmission during tests at sea in October 2010

- status of contributions to Argo data management

Within Argo-France, Coriolis plays three roles in the Argo data management organization: Argo Data Assembly Centre, Global Data Centre, and leader of the North Atlantic Argo Regional Centre.

As Argo Data Assembly Center, Coriolis processes in Real Time and Delayed Mode float data deployed by France, by 5 European countries (Germany, Spain, Netherlands, Norway, Italy) and by 3 non European countries (Chili, Costa Rica, Mexico). Coriolis data center processes data coming from 1246 floats (562 Provor, 554 Apex, 119 Nemo and 11 Metocean floats) including 376 active floats in February 2011 (151 Provor, 204 Apex and 21 Nemo floats). Some floats are deployed as part of scientific projects. Data are processed and distributed according to Argo recommendations.

Coriolis also coordinates the North-Atlantic ARC activities and in particular the float deployment in Atlantic. France has taken the lead in establishing the NA-ARC, which is a collaborative effort between Germany (IFM-HH, BSH), Spain (IEO), Italy (OGS), Netherlands (KNMI), UK (NOCS, UKHO), Ireland (IMR), Norway (IMR), Canada (DFO), and USA (AOML). Work has concentrated on acquiring recent CTD data to improve the reference data set for the North Atlantic Ocean needed for scientific QC of the float data and setting up the delayed mode processing in the different institutes. Work on consistency of the Argo dataset over the basin has started and it's promising and will be finalized within EURO-ARGO. Collaboration with the Southern Ocean and South Atlantic Ocean ARCs is also performed.

- status of delayed mode quality control process

Statistics on all delayed mode data loaded in the Coriolis database for beginning of February (02/08/2011) are presented on Figure 2. 71244 delayed mode profiles are present in the Coriolis DAC that represents about 72% of the total number of profiles available at the Coriolis DAC.

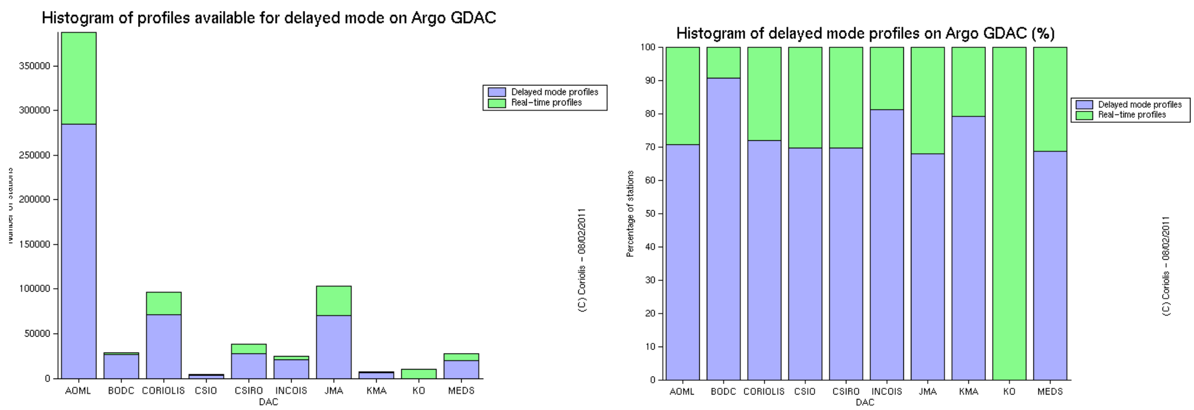


Figure 2: Histogram of profiles available for delayed-mode on Argo GDAC. (Left) Number of pofiles; (Right) percentage.

Figure 3 presents the status of the Coriolis floats. 72% of the floats have been processed, while less than 15% of the floats cannot be processed for various reasons (problem with floats which need to be review by decoding, floats too young, etc.). Among the remaining floats that must be controlled in delayed mode, 13% of the floats are currently under consideration by the PIs and should be processed in delayed mode very soon.

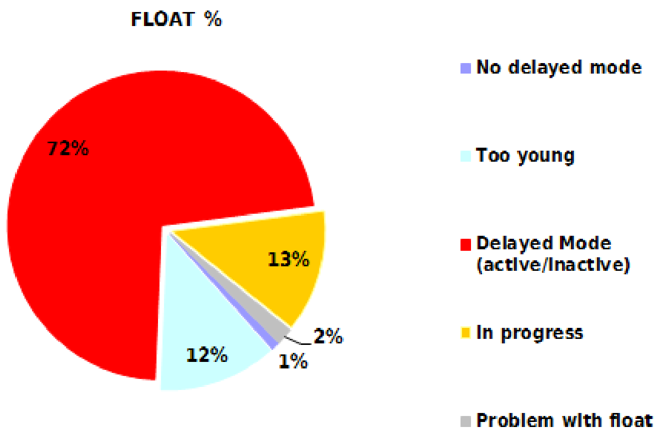


Figure 3: Status of the delayed mode process at the Coriolis DAC.

In terms of project, some of them are well updated and others have needed complementary studies (location studies of the various front) to provide delayed mode data, especially those that deployed floats in the southern ocean. Even if the OW's method has now an option to take into account the subarctic Front, sometimes we do not have enough data to provide significant results with the method.
The delayed mode profiles for some floats should be available in the next months. The method has been run on some of them and now we are waiting for the PI's answer.
In others projects (as that was done for the Ovide project), some reports are available and contain a complete overview of the behavior of the float, of the changes on real-time flags, as well as information about the correction applied to the data.
Those reports should be available on the new Argo web site. The reports for the OVIDE floats are available on the following Web page:
http://www.ifremer.fr/lpo/ovide/data/argo_profiling_floats.htm.

Some corrections have also been done by BSH for different countries, not only Germany. Those corrections correspond to a large account of DM profiles since they have some floats in the DAC Coriolis (Figure 6).

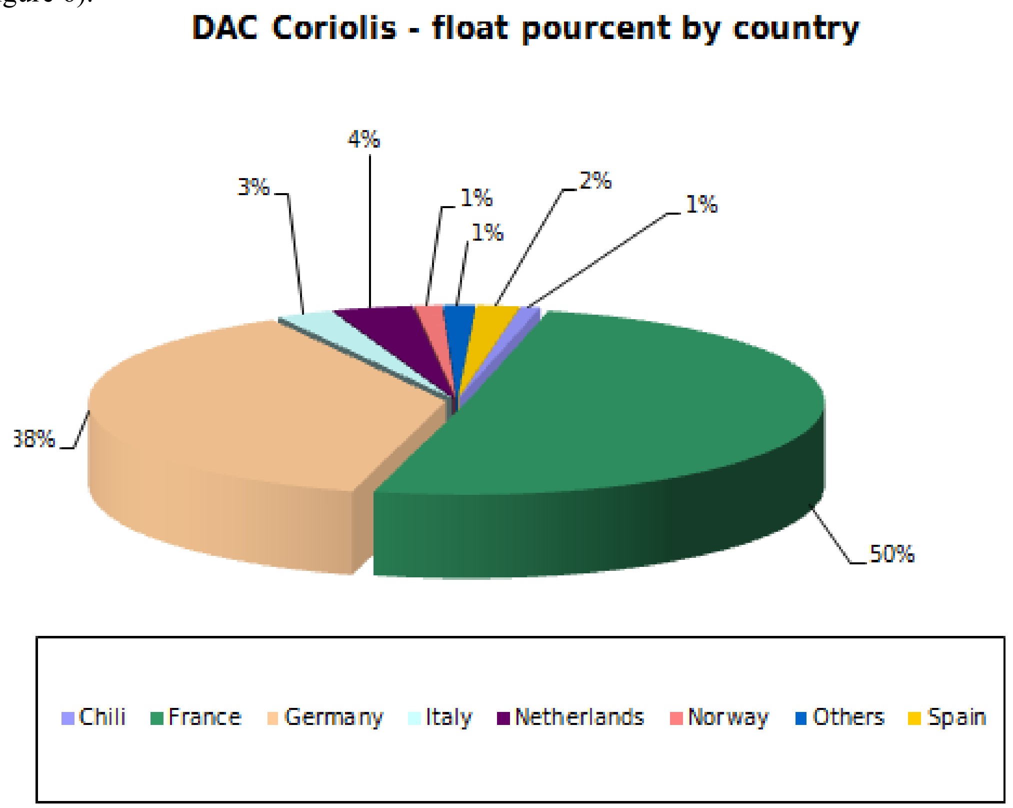


Figure 4: Percentage of float by country.

APEX Pressure correction:

Some corrections have been revisited and updated by BSH to take into account recommendations of the ADMT/AST. Others corrections have also been done by OGS for the Mediterranean floats.

Corrections of the French APEX floats deployed by SHOM are underway as well as those of the Spanish floats. Pressure of the Coriolis APEX fleet should be corrected before end of August 2011.

3. Present level of and future prospects for national funding for Argo including a summary of the level of human resources devoted to Argo

Since 2000, France has provided a significant contribution to the growing Argo array. 509 French floats and 68 floats co-funded by European Union have been deployed in different geographic areas. The deployments meet specific French requirements but they also contribute to the global array

Year	Man/Year	French floats	Co-funded EU floats	Total
2000		11		11
2001	3	12		12
2002	6	7	4	11
2003	9	34	20	54
2004	15	85	18	103
2005	15	89	11	100
2006	12	51	14	65
2007	12	36		36
2008	12	90		90
2009	12	35		35
2010	12	59		
Total(2000-2010)		***509***	***63***	**572**
2010	**12**	**60**		

Tableau 1: (*Man/year* column) Man power dedicated to Argo for coordination activities, float preparation, deployment and data management activities (GDAC,DAC, NAARC, DMQC) within Argo-France. (*French floats* column) French floats contributing to Argo deployed by year. (*Co-funded EU floats* column) EU floats are the additional floats co-funded by European Union within the Gyroscope, Mersea and MFSTEP projects. Estimated value is given for 2010.

The French Argo Project is funded by the ministry of Research and by local administrations (Britanny region, Finistère department, city of Brest) mostly through Ifremer but also through other french institutes involved in oceanography (CNES, IRD, INSU, Météo-France) and in a lesser proportion by the ministry of Defense through SHOM. Until now, the French contribution to the Argo global array was at the level of about 65 floats per year with funding from Ifremer (about 50 floats/year) and SHOM (about 15 floats/year). A new funding of 15 floats per year from 2011 to 2019 was recently accepted within the scope of the EQUIPEX call for proposal (NAOS proposal). This will allow Ifremer to increase its long term contribution to Argo from 50 to 65 floats/year.

As part of the Euro-Argo preparatory phase, Ifremer (for the Argo-France project) works with its funding ministry (mainly research ministry) to agree on a long-term funding level and commitment. Together with its European partners, Ifremer also works with the European commission to set up a long term EC funding to Argo.
In parallel to the Euro-Argo initiatives and to sustain the commitments of France in Argo, a proposal has been submitted to the French agencies to identify Argo-France project as a research observatory. The agreement has been obtained in January 2011. It is valid for 10 years.

Overall the level of support, additional to float purchase, is as indicated in Tableau 1 (man power for coordination activities, float preparation, deployment and data management activities).

4. Summary of deployment plans (level of commitment, areas of float deployment) and other commitments to Argo (data management) for the upcoming year and beyond where possible.

According to the current deployment plan, 60 floats will be deployed in 2011. Deployments plans of few floats are already known and shown Figure 5.

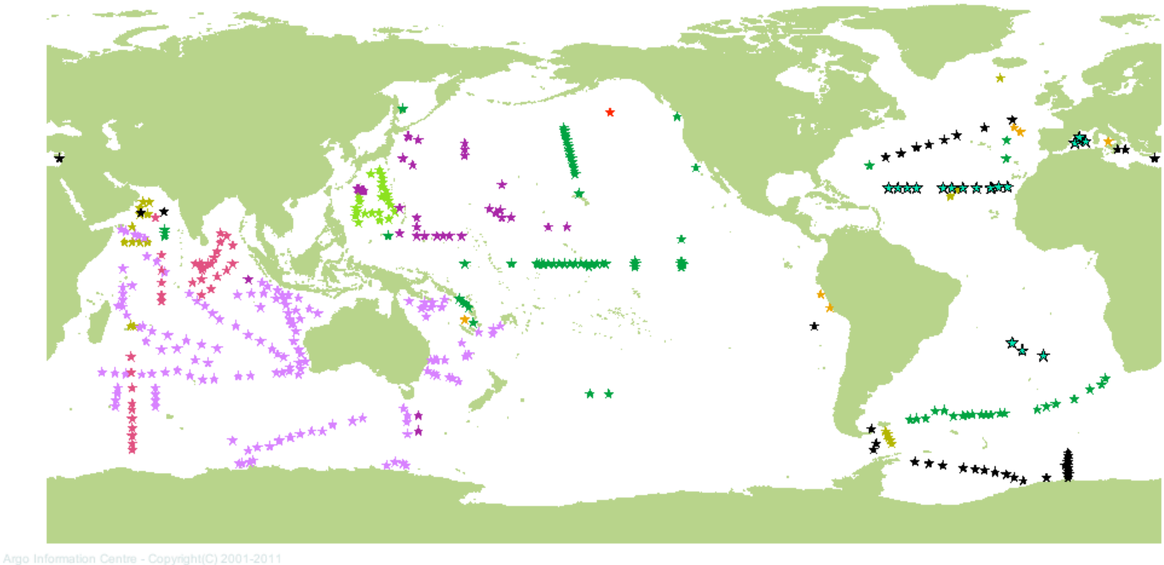


Figure 5: Deployment plan. The orange stars represent the French deployment plan for 2010.

Coriolis will continue to run the Coriolis Dac and the European GDAC as well as coordinating the North Atlantic Arc activities. Within the Euro-Argo project development will be carried out to improve anomalies detection at GDAC both in RT and DM, to monitor in real time the behaviour of the European fleet and to improve data consistency check within NA-ARC.

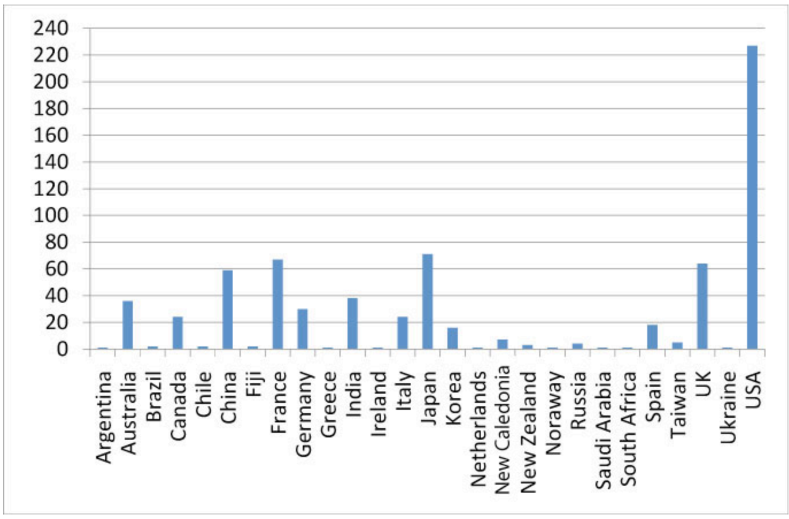
France also contributes to the funding of the AIC.

5. Summary of national research and operational uses of Argo data as well as contributions to Argo Regional Centers

Operational ocean forecasting. All Argo data (alongside with other in-situ and remotely sensed ocean data) are routinely assimilated into the MERCATOR operational ocean forecasting system run by the MERCATOR-Ocean structure.

Ocean science. Argo data are being used by many researchers in France to improve the understanding of ocean properties (e.g. circulation, heat storage and budget, and mixing), climate monitoring and on how they are applied in ocean models (e.g. improved salinity assimilation, …). List of scientific publications is available trough the Argo web site (http://www-argo.ucsd.edu/FrBibliography.html)

The French Argo Users' Group provides a forum for engagement between these scientists and the French Argo program. More than 60 peer-reviewed papers using Argo-data have a leading author based in a French laboratory.



Argo France coordinates the North-Atlantic Argo Regional Center. Besides coordinating deployment in the North-Atlantic, Argo France is working on method to improve data consistency check in the North-Atlantic and to detect TNPD Apex floats with large negative pressure sensor drift.

6. Issues that your country wishes to be considered and resolved by the Argo Steering Team regarding the international operation of Argo. These might include tasks performed by the AIC, the coordination of activities at an international level and the performance of the Argo data system. If you have specific comments, please include them in your national report

One of the Argo project priority is data quality. Ensuring a good decoding is the first step to guarantee data quality but some decoding errors have already been discovered in profile, trajectory and technical files. One problem is that the decoding is not straightforward because of subtle encoding, because some floats manuals are not complete or up to date and because the number of float version keeps growing. We are particularly aware that decoding PROVOR floats is rather complex. What could be the solutions ?

- To keep raw Argos data in case of a new decoding is required (maybe such recommendation has already been done).
- To limit the number of float version and to stabilize the "regular" one.
- To keep somewhere a database on the floats functioning with manuals, decoders, etc.. This probably requires a float "referee" (a person or maybe a DAC). This referee could be the reference for decoding a float type and could be, for instance, the one who propose a name for the associated technical variables.

Ann Thresher has done a huge work on the issue of technical variables names but there is still no guarantee that there is consistency between DACs on the way names are attributed. I'm not sure we find the same name for the same parameter for the same float in two different DACS. Indeed, few months have been necessary to provide a simple table that summarizes the way each float managed the surface pressure data and to define a name of the surface pressure variable that corresponds to each different case. This work has been done for one technical parameter only and should be done for the 50 (or more) other technical parameters.

7. To continue improving the number of CTD cruise data being added to the reference database by Argo PIs, it is requested that you include the number and location of CTD cruise data uploaded by PIs within your country to the CCHDO website in the past year. These cruises could be used for Argo calibration purposes only or could be cruises that are open to the public as well

The number of CTD cruise data uploaded by PIs within France in 2010 to the CCHDO website is not known.
No feedback from the CCHDO has been provided to Coriolis to update the reference database.

8. List of publications in which a french scientist is involved.

Peer reviewed publications in 2010 and 2011 (in bold publications that are not in the Argo Bibliography available on Argo web site)

2011

Delcroix,T., G. Alory, S. Cravatte, T. Corrège, and M. McPhaden, 2011. A gridded sea surface salinity data set for the tropical Pacific with sample applications (1950-2008). Deep Sea Res., 58, 38-48 doi:10.1016/j.dsr.2010.11.002.

2010

Bindoff, N.L., D. Stammer, P.Y. Le Traon, K. Trenberth, C. Mauritzen, J.A. Church, N. Smith, T. Malone, T. Suga, J. Tintoré and S. Wilson, 2010. Capabilities of Global Ocean Programmes to Inform Climate Services, World Climate Conference-3, Procedia Environmental Sciences, Volume 1, 2010, Pages 342-353.

Claustre, H. and co-authors, 2010: Bio-optical Profiling Floats as New Observational Tools for Biogeochemical and Ecosystem Studies. *Proceedings of OceanObs'09: Sustained Ocean Observations and Information for Society* J. Hall, D. E. Harrison, and D. Stammer, Eds., ESA Publication.

Church, J.A., D. Roemmich, C. M. Domingues, J. K. Willis, N. J. White, J. E. Gilson, D. Stammer, A. Köhl, D. P. Chambers, F. W. Landerer, J. Marotzke, J. Gregory, T. Suzuki, A. Cazenave, and P.Y. Le Traon, 2010. Ocean Temperature and Salinity Contributions to Global and Regional Sea-Level Change, 143-168, in Understanding sea level rise and variability, Editors J.A. Church, P.L. Woodworth, T. Aarup and W.S. Wilson.

de Boisseson, E., V. Thierry, H. Mercier, and G. Caniaux, 2010: Mixed layer heat budget in the Iceland Basin from Argo. *J. Geophys. Res.*, **115,** C10055.

Dobricic, S., N. Pinardi, P. Testor, and U. Send, 2010: Impact of data assimilation of glider observations in the Ionian Sea (Eastern Mediterranean). *Dynamics of Atmospheres and Oceans*, **50,** 78-92.

Foltz, G. R., J. Vialard, B. Praveen Kumar, and M. J. McPhaden, 2010: Seasonal Mixed Layer Heat Balance of the Southwestern Tropical Indian Ocean. *Journal of Climate*, **23,** 947-965.

Freeland, H. J. and co-authors, 2010: Argo - A Decade of Progress. *Proceedings of OceanObs'09: Sustained Ocean Observations and Information for Society*, J. Hall, D. E. Harrison, and D. Stammer, Eds., ESA Publications.

Ganachaud, A., A. Vega, M. Rodier, C. Dupouy, C. Maes, P. Marchesiello, G. Eldin, K. Ridgway, and R. Le Borgne, 2010: Observed impact of upwelling events on water properties and biological activity off the southwest coast of New Caledonia. *Marine Pollution Bulletin*, **61,** 449-464.

Henocq, C., J. Boutin, F. Petitcolin, G. Reverdin, S. Arnault, and P. Lattes, 2010: Vertical Variability of Near-Surface Salinity in the Tropics: Consequences for L-Band Radiometer Calibration and Validation. *Journal of Atmospheric and Oceanic Technology*, **27,** 192-209.

Koch-Larrouy, A., R. Morrow, T. Penduff, and M. Juza, 2010: Origin and mechanism of Subantarctic Mode Water formation and transformation in the Southern Indian Ocean. *Ocean Dynamics*.

Le Traon, P. Y. and co-authors, 2010: GODAE OceanView: From an Experiment Towards a Long-term Ocean Analysis and Forecasting International Program. *Proceedings of OceanObs'09: Sustained Ocean Observations and Information for Society*, J. Hall, D. E. Harrison, and D. Stammer, Eds., ESA Publication.

Lee, T., T. Awaji, M. Balmaseda, N. Ferry, Y. Fujii, I. Fukumori, B. Giese, P. Heimbach, A. Kohl, S. Masina, E. Remy, A. Rosati, M. Schodlok, D. Stammer, and A. Weaver, 2010: Consistency and fidelity of Indonesian-throughflow total volume transport estimated by 14 ocean data assimilation products. *Dynamics of Atmospheres and Oceans*, **50,** 201-223.

Llovel, W., S. Guinehut, and A. Cazenave, 2010: Regional and interannual variability in sea level over 2002Ð2009 based on satellite altimetry, Argo float data and GRACE ocean mass. *Ocean Dynamics*, 1-12.

Morel, A., Claustre, H., and B. Gentili (2010) The most oligotrophic subtropical zones of the global ocean: similarities and differences in terms of chlorophyll and yellow substance. *Biogeosciences, 7, 3139–3151,*doi:10.5194/bg-7-3139-2010

Pouliquen, S. and co-authors, 2010: Argo Data Management. *Proceedings of OceanObs'09: Sustained Ocean Observations and Information for Society*, J. Hall, D. E. Harrison, and D. Stammer, Eds., ESA Publication.

Roemmich, D., L. Boehme, H. Claustre, H. J. Freeland, G. Fukasawa, G. J. Goni, J. Gould, N. Gruber, M. Hood, E. Kent, R. Lumpkin, S. Smith, and P. Testor, 2010: Integrating the ocean observing system: Mobile platforms.

Swart, S., S. Speich, I. J. Ansorge, and J. R. E. Lutjeharms, 2010: An altimetry-based gravest empirical mode south of Africa: 1. Development and validation. *J. Geophys. Res.*, **115,** C03002.

Taillandier, V., S. Dobricic, P. Testor, N. Pinardi, A. Griffa, L. Mortier, and G. P. Gasparini, 2010: Integration of Argo trajectories in the Mediterranean Forecasting System and impact on the regional analysis of the western Mediterranean circulation. *Journal of Geophysical Research-Oceans*, **115,** 17.

Tanguy, Y., S. Arnault, and P. Lattes, 2010: Isothermal, mixed, and barrier layers in the subtropical and tropical Atlantic Ocean during the ARAMIS experiment. *Deep-Sea Research Part I-Oceanographic Research Papers*, **57,** 501-517.

Vivier, F., D. Iudicone, F. Busdraghi, and Y.-H. Park, 2010: Dynamics of sea-surface temperature anomalies in the Southern Ocean diagnosed from a 2D mixed-layer model. *Climate Dynamics*, **34,** 153-184.