French National Report on Argo - 2018

By the Argo-France Management Board
G. Maze, C. Cabanes, T. Carval, H. Claustre, C. Coatanoan, F. D'Ortenzio, N. Kolodziejczyk, N. Lebreton, A. Poteau, S. Le Reste, C. Schmechtig, P.Y. Le Traon, N. Poffa, S. Pouliquen and V. Thierry

Background, organization and funding of the French Argo activities

Organization

Argo-France (http://www.argo-france.fr) gathers all the French activities related to Argo and its extension toward deep and biogeochemical measurements. Argo-France is the French contribution to the Euro-Argo European research infrastructure (ERIC) that organizes and federates European contributions to Argo.

All Argo-France activities are lead and coordinated by:

- a scientific committee shared with the CNRS/LEFE Group Mission Mercator Coriolis (GMMC),
- a steering team with: a national coordinator (G. Maze), scientific coordinators for the physical and bio-geochemical missions (N. Kolodziejczyk, F. D'Ortenzio, H. Claustre), technical coordinators for the physical and bio-geochemical missions (S. Pouliquen, F. D'Ortenzio), head of the data center (T. Carval), data center officer for BGC (C. Schmechtig) and heads of operational and infrastructure activities (N. Lebreton, N. Poffa, A. Poteau).

Argo-France is part of the Ministry of Research national roadmap on large research infrastructure (TGIR). Argo-France operational activities are organized through the Coriolis partnership (IFREMER, SHOM, INSU, IRD, Météo France, CEREMA, CNES and IPEV). Two research laboratories are leading the Argo-France scientific activities: the "Laboratoire d'Océanographie Physique et Spatiale" (LOPS, Brest, France) and the "Laboratoire d'Océanographie de Villefranche"/"Institut de la Mer de Villefranche" (IMEV/LOV, Villefranche-sur-Mer, France). Coriolis and Argo-France have strong links with Mercator Ocean International (the French operational ocean forecasting center).

Funding

Argo-France is mainly funded by the ministry of Research through Ifremer as part of the national roadmap on large scale infrastructures and contribution to Euro-Argo (TGIR). This is a long term commitment. Argo-France is also funded through Ifremer, SHOM (Ministry of Defense), CNRS/INSU and other French institutes involved in oceanography (CNES, IRD, Météo-France). At regional scale, Argo-France is supported by the IUEM OSU and funded by the Brittany and Provence Alpes-Cote d'Azur regions (CPER).

The French contribution to the Argo global array is at the level of 60 to 65 floats per year with funding from Ifremer (50 floats/year) and SHOM (about 10 to 15 floats/year).

Since 2000, around 1350 French floats have been deployed in a number of different geographic areas. Deployments have been focused on meeting specific French requirements while also contributing to the global array.

To complement Argo-France, the NAOS project (Novel Argo Ocean observing System, 2011-2019) has been funded by the Ministry of Research to consolidate and improve the French contribution to Argo and to prepare the next scientific challenges for Argo**.** The project provides an additional funding of 15 to 20 floats per year from 2012 to 2019, which allows Ifremer to increase its long-term contribution to Argo from 50 to 65-70 floats/year. NAOS also has developed the new generation of French Argo floats and set up pilot experiments for biogeochemical floats (Mediterranean Sea, Arctic), Under Ice BGC floats (baffin bay) and deep floats (North Atlantic).

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).

Year	Funding	**Man/Year**	***French floats***	***Co-funded EU floats***	***Total***
2000	300k€		*11*		*11*
2001	633k€	3	*12*		*12*
2002	980k€	6	*7*	*4*	*11*
2003	900k€	9	*34*	*20*	*54*
2004	1400k€	15	*85*	*18*	*103*
2005	450k€	15	*89*	*11*	*100*
2006	900k€	12	*51*	*14*	*65*
2007	900k€	12	*36*		*36*
2008	1200k€	12	*90*		*90*
2009	1200k€	12	*35*	*8*	*43*
2010	1400k€	12	*55*		*55*
2011	1400k€	12	*53*		*53*
2012	1400k€	12	*82*		*82*
2013	1400k€	12	*81*		*81*
2014	1400k€	12	*96*		*96*
2015	1400k€	14	*101*		*101*
2016	1400k€	14	58		*58*
2017	1400k€	14	65		65
2018	1400k€	14	95		95
Total (2000-2018)			*1136*		*1211*
2019	**1400k€**	**14**	83		

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 2018.

Long term evolution of Argo

At the national level, the proposal for Argo-France is in two phases:

- 2011-2016: Core Argo mission (temperature and salinity – 0 to 2000m) and pilot experiments on the new phase of Argo (notably via the NAOS project).
- 2017-2020: Continuation of the core Argo mission with the addition of an extended mission.

For the upcoming phase 2017-2020, France will conduct an over-fitting strategy of a 66 floats/year sustained fleet with:

- 15 deep floats
- 7 with biogeochemical sensors including O2 sensors for 4 of them
- 11 with oxygen sensors
- 33 core T/S.

Core T/S, deep floats and oxygen sensors are fully funded until 2020 (CPER Brittany region), the biogeochemical mission is partially funded (CPER PACA and Brittany regions until 2020) and thus requires new sources of funding that are being requested for the 2018-2023 period as part of the Research Infrastructure second phase (PIA3).
Argo-France strategy will be adjusted according to international recommendations with regard to the deep and Bio-Argo extensions. Euro-Argo has published a long term roadmap for the next phase of Argo and as part of the ERIC Euro-Argo countries will work on the implementation of a new sustained phase for Argo in Europe.

Float development

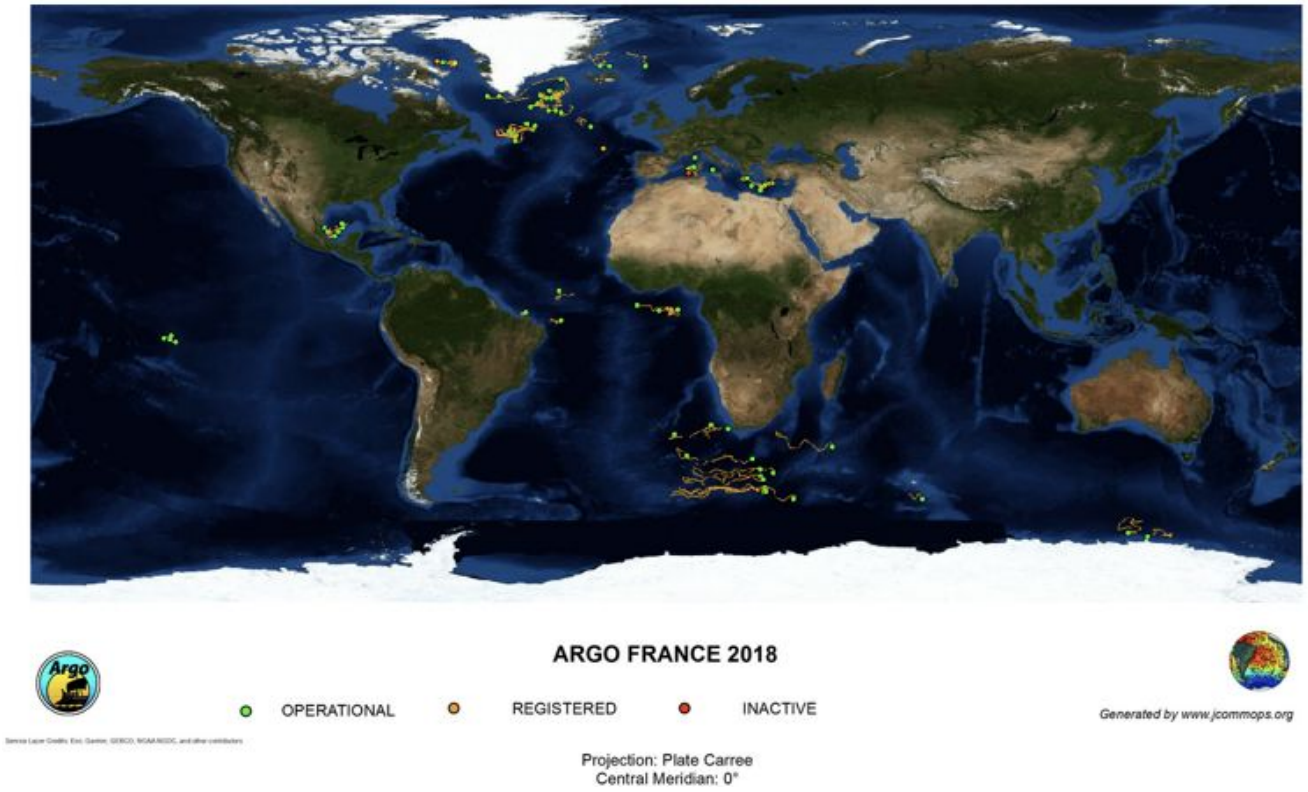
Development of a Deep-Arvor equipped with 3 CTDS: the SBE41CP, SBE61 and deep RBRargo is achieved and preliminary test at sea in preparation. Within the EA-RISE 2019-2022 H2020 project, another 3-CTDs Deep-Arvor will be assembled as well as two other floats with 2-CTDs (the RBRargoDeep|OEM and the SBE61). These floats should be deployed in 2020.

In 2018, the deep RBRargo was tested during the OVIDE 2018 cruise in the North-Atlantic. Intercomparison of pressure, temperature and conductivity/salinity with the rosette SBE911 and bottle measurements is still ongoing. Preliminary results show a systematic pressure bias very close to that obtained during the RREX17 test, but within the manufacturer specification. Temperature shows a median warm bias of 0.0011degC or 0.0006degC with corrected pressure. This is satisfactory and within the bounds of the manufacturer specification and Argo-Deep requirements. Conductivity and salinity are still ongoing analysis.

The status of implementation

Floats deployed and their performance

86 floats have been deployed by France in 2018 (56 T/S Core, 7 T/S/O2, 15 BGC, 8 DEEP). The deployment areas are chosen to meet French requirements in terms of research and operational activities but also to contribute to establishing the global array (especially in the Southern Ocean) using AIC tools/map.



Technical problems encountered and solved

No technical problems specific to Argo-France were encountered in 2018 with regard to operational T/S floats. Seabird batch of drifting CTDs is being assessed and monitored.

Status of contributions to Argo data management

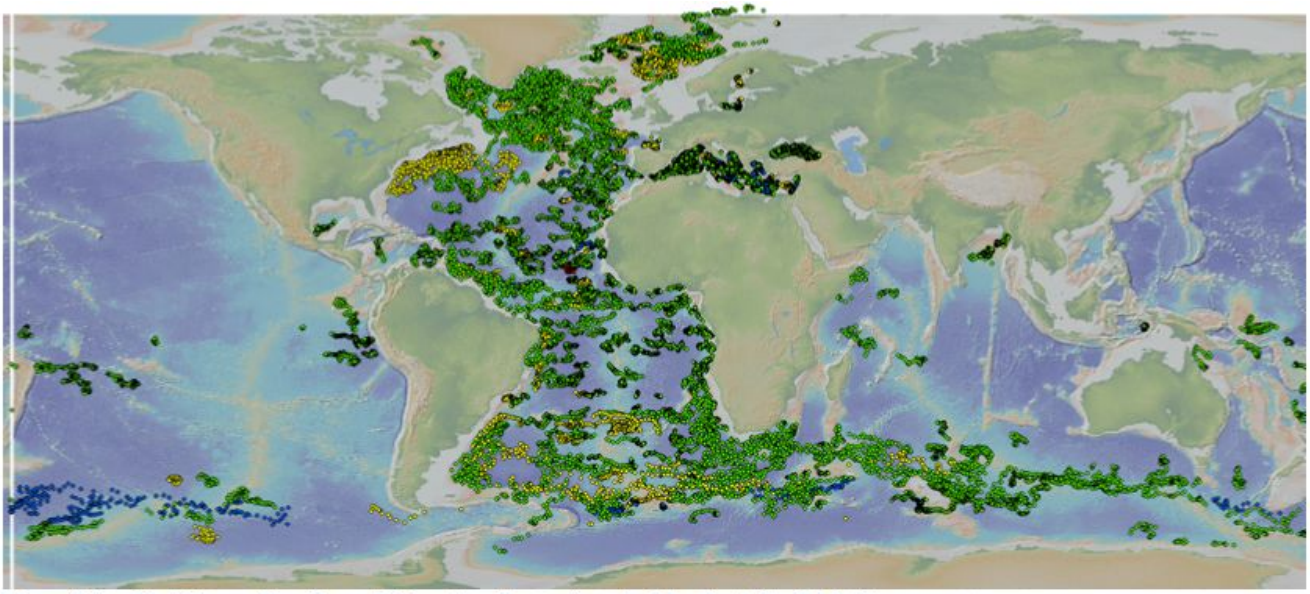
Within Argo-France, data management is undertaken by Coriolis, which play three roles: Data Assembly Centre, Global Data Centre, and leader of the North Atlantic Argo Regional Centre. Coriolis is located within Ifremer-Brest and is operated by Ifremer with support of SHOM. Since 2016, the BGC floats processing chain have been fully operational and integrated within the Coriolis data management stream.

All Argo data management details are in the Coriolis DAC and GDAC 2018 annual report (english) : https://doi.org/10.13155/58109

Data Assembly Center

Coriolis processes in Real Time and Delayed Mode float data deployed by France and 7 European countries (Germany, Spain, Netherlands, Norway, Italy, Greece, Bulgaria).

These last 12 months (nov17-oct18), 30 434 profiles from 794 active floats were collected, controlled and distributed. Compared to 2017, the number of profiles is stable (+0.2%), the number of floats increased by 1%. These figures show a fair stability in Coriolis DAC activity. The 794 floats managed during that period had 57 versions of data formats.

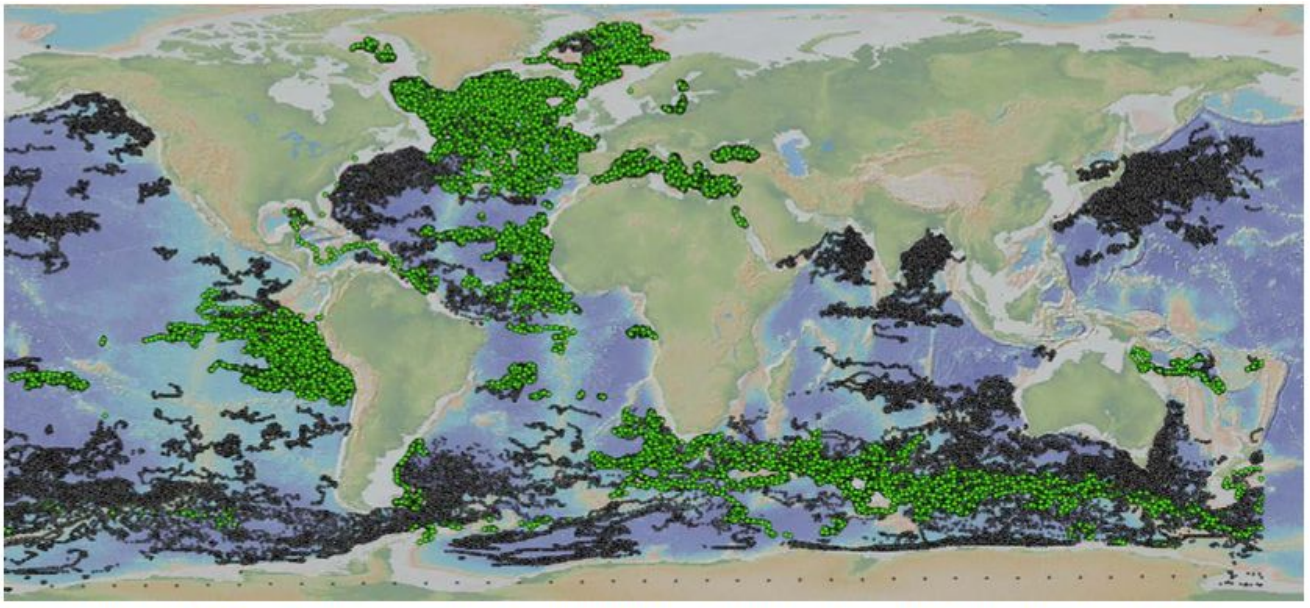


Map of the 30.434 profiles from 794 active floats decoded by Coriolis DAC this current year
Apex Navis Nova Provor

The data processing chain based on Matlab to manage data and metadata from Coriolis BGC-floats is continuously improved. These are advanced types of floats performing bio-geo-chemical (BGC) measurements.

Coriolis DAC manages 409 BGC-Argo floats from 5 families and 57 instrument versions. They performed 53.509 cycles. The data processing chain is freely available:

- Coriolis Argo floats data processing chain, http://doi.org/10.17882/45589



Map of the 409 BGC-Argo floats managed by Coriolis DAC (grey dots: the others DACs bio-Argo floats). They measure parameters such as oxygen, chlorophyll, turbidity, CDOM, back-scattering, UV, nitrate, bisulfide, pH, radiance, irradiance, PAR.

Global Argo Data Centre

Coriolis hosts one of the two global data assembly centres (GDAC) for Argo that contains the whole official Argo dataset. The Argo GDAC ftp server is actively monitored by a Nagios agent (see http://en.wikipedia.org/wiki/Nagios). Every 5 minutes, a download test is performed. The

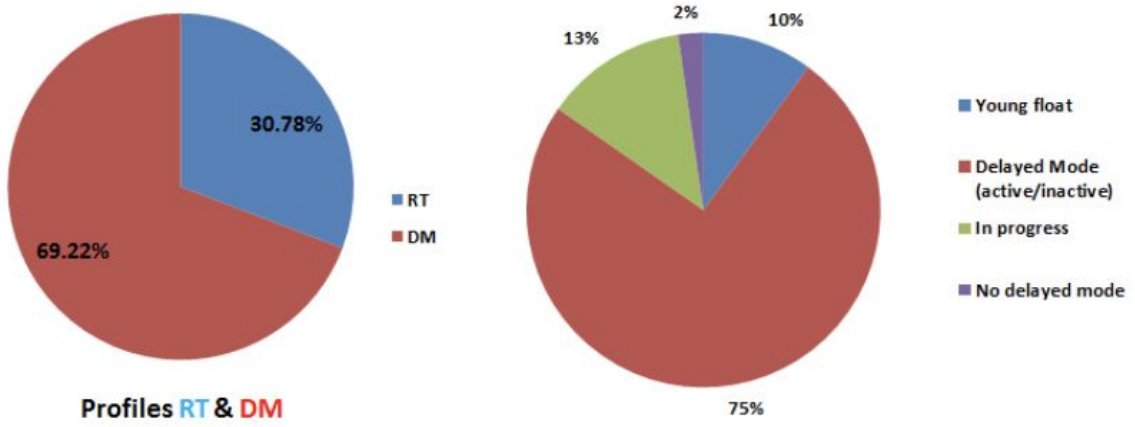
success/failure of the test and the response time are recorded. There is a monthly average of 561 unique visitors, performing 4302 sessions and downloading 5.9 terabytes of data files.

North Atlantic Argo Regional Centre

See section 5.4

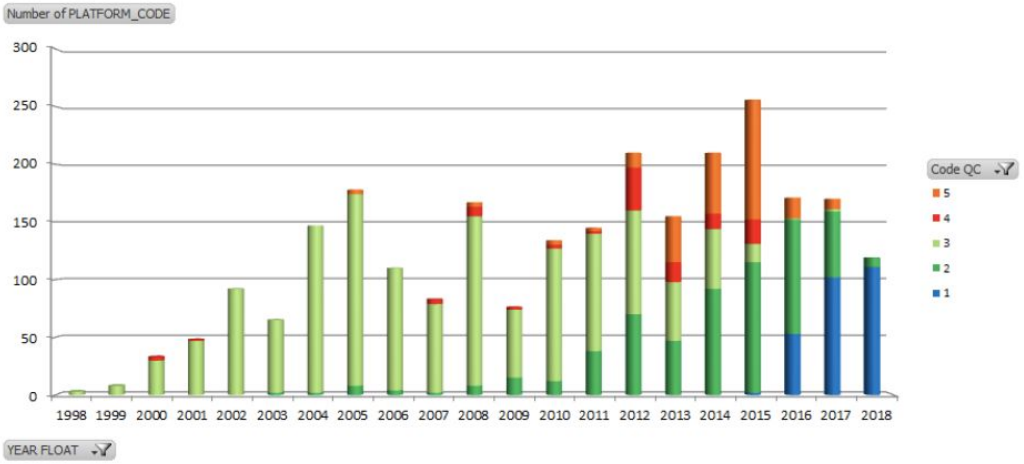
Status of delayed mode quality control process

Last year, 60,598 new delayed mode profiles where produced, validated by PIs and sent to GDACs. A total of 198,769 delayed mode profiles where produced and validated since 2005. In February 2019, 75% of the floats and 69% of the profiles processed by the Coriolis DAC were in delayed mode (see Figure below).



Status of the floats processed by Coriolis DAC.
Left: in terms of profile percent and right: in terms of float percent (DM : delayed mode – RT : real time).

The status of the quality control done on the Coriolis floats is presented in the following plot. For the two last years (2017- 2018), most of the floats are still too young (code 1) to be performed in delayed mode. For the years 2012-2013-2014, we are still working on the DMQC of some floats. The codes 2 and 3 show the delayed mode profiles for respectively active and dead floats.



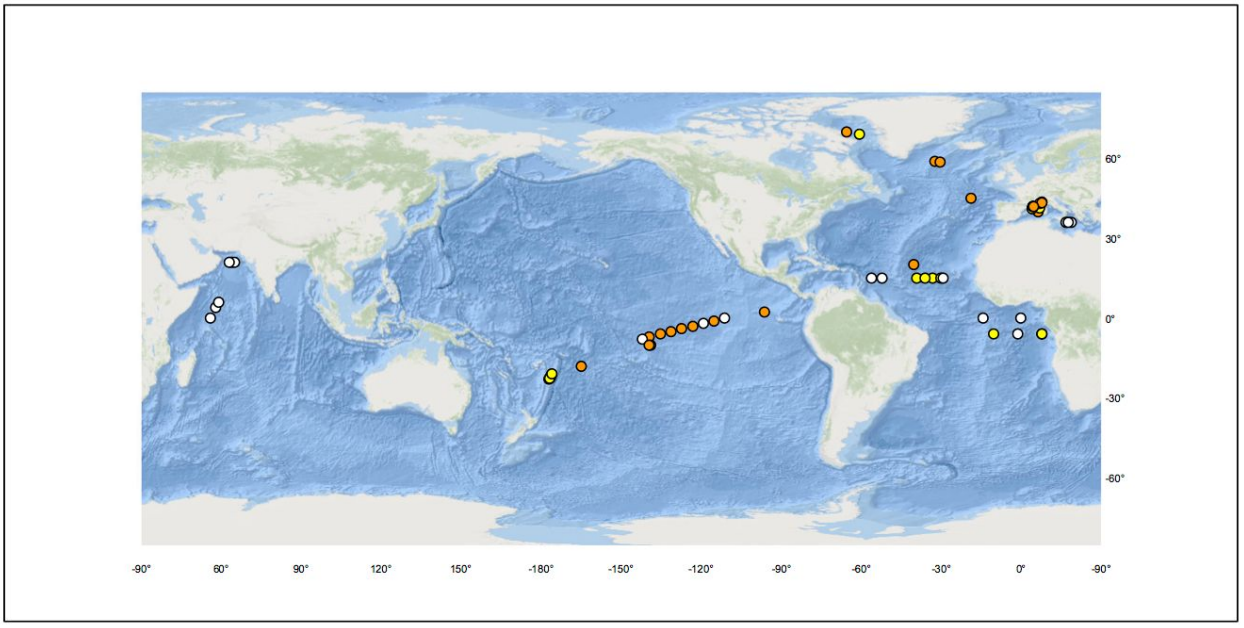
Status of the quality control done on profiles sorted by launch's year, code 1: young float, code 2: active float, DM done, code 3 : dead float, DM done; code 4 : DM in progress, code 5 : waiting for DM, code 6 : problems with float.

Summary of deployment plans and other commitments to Argo for the upcoming year and beyond where possible

According to the current deployment plan, 83 floats are scheduled to be deployed in 2019 (with 60 T/S, 18 BGC, 5 DEEP), see map below.

Coriolis will continue to run the Coriolis DAC and the European GDAC as well as coordinating the North Atlantic ARC activities. Within Euro-Argo, 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 will continue to contribute to the funding of the AIC.



Argo **Plan Argo-France 2019** **04/03/2019**

PROBABLE REGISTERED

CONFIRMED

Service Layer Credits: Esri, Garmin, GEBCO, NOAA NGDC, and other contributors

Projection: Plate Carree
Central Meridian: -150°

Generated by www.jcommops.org

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. MERCATOR also operates the Global component of the European Copernicus Marine Environment Monitoring Service (CMEMS).

Support to the Mercator and Coriolis scientific activities

Coriolis has developed together with MERCATOR (The French operational oceanography forecast center) a strong connection with the French research community via the Mercator-Coriolis Mission Group (GMMC). It consists of about one hundred researchers (with some turnover each year)

following a scientific announcement of opportunities and call for scientific proposal. Its task is to support the Mercator and Coriolis scientific activities and to participate in product validation. The call for scientific proposals proposes to the community "standard" Argo floats as well as floats equipped with oxygen and biogeochemical sensors. These new opportunities strengthen link between the French scientific community and Coriolis with regard to the development of qualification procedures for "Argo extensions" floats.

National Research

Argo data are being used by many researchers in France to improve the understanding of ocean properties (e.g. circulation, heat and freshwater storage and budget, and mixing), climate monitoring and on how they are applied in ocean models (e.g. improved salinity assimilation, …).

A list of France bibliography is available at the end of this report.

Argo-Regional Center: North Atlantic

France leads 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), Greece (HCMR) and Bulgaria (IOBAS). Coriolis coordinates the North-Atlantic ARC activities and in particular the float deployment in Atlantic.

1903 floats that have been processed in delayed time in the North Atlantic ARC, north of 20°S, with a check made using a modified OW method that has been published by Cabanes et al (http://dx.doi.org/10.1016/j.dsr.2016.05.007). Floats for which it may be necessary to revise the original DM correction are reported to PIs. The list is available online at:
http://www.umr-lops.fr/en/SNO-Argo/Activities/NAARC/Consistency-checks-of-DM-salinity-corrections

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.

-

CTD cruise data in the reference database

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.

In beginning of 2017, a new version 2017V01 has been provided with some updates on a few boxes, following the feedback sent by some scientists. Since March 2018, a new version 2018V01 including OCL updates, CTD from PI, correction from feedbacks is available on the ftp site.

This version is divided in smaller tar balls, one by wmo box area (1-3-5-7): for instance, CTD_for_DMQC_2018V01_1.tar.gz for all boxes starting with wmo 1, then we will have 4 tar files.

New works are in progress and a new version (2018V02) should be delivered by the end of this year. This version will take into account CTD from the GO-SHIP program (data from 2016 to 2018) and downloaded from the CCHDO Website, as well as a few CTD from scientists.

Bibliography

List of publications in which a scientist from a french laboratory is involved

In 2018, at least 46 articles with a scientist affiliated in France as a coauthor have been published in peer reviewed journals. Note that the list of all publications in which a scientist from a French laboratory is involved is available on the Argo France website and on the Argo Bibliography webpage. To date, around 350 articles have been listed.

http://www.argo-france.fr/references

Argo-France: http://www.argo-france.fr
French bibliography: *http://www.argo-france.fr/publications*
Argo PhD list: http://www.argo.ucsd.edu/argo_thesis.html
NA-ARC data mining website: http://www.ifremer.fr/lpo/naarc
Coriolis FTP: http://www.coriolis.eu.org/Data-Services-Products/View-Download/Download-via-FTP
Coriolis DAC: http://www.coriolis.eu.org/Observing-the-ocean/Observing-system-networks/Argo
IUEM OSU: http://www-iuem.univ-brest.fr/observatoire
NAOS project: http://www.naos-equipex.fr
Euro-Argo: http://www.euro-argo.eu
Coriolis: http://www.coriolis.eu.org
Laboratoire d'Océanographie Physique et Spatiale: http://www.umr-lops.fr/
Laboratoire d'Océanographie de Villefranche: http://www.obs-vlfr.fr/LOV
Mercator: http://www.mercator-ocean.fr