

French National Report on Argo - 2017



<http://www.argo-france.fr>

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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[i] European research infrastructure (ERIC) that organizes and federates European contribution to Argo.

Argo-France is coordinated by 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).

Euro-Argo and its french component (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[ii] partnership (IFREMER, SHOM, INSU, IRD, Météo France, CNES and IPEV) and its governance bodies. Two research laboratories are leading the Argo France scientific activities: the "Laboratoire d'Océanographie Physique et Spatiale[iii]" (LOPS, Brest, France) and the "Laboratoire d'Océanographie de Villefranche[iv]" (LOV, Villefranche, France). Coriolis and Argo France have strong links with Mercator Ocean[v] (the French ocean forecasting center).

Funding

Argo France is mainly funded by the ministry of Research through Ifremer as part of 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[i] and funded by the Brittany and Provence Alpes-Cote d'Azures regions (through 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 1160 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^[ii] 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 10 to 15 floats per year from 2012 to 2019, which allows Ifremer to increase its long-term contribution to Argo from 50 to 60-65 floats/year. NAOS also develops the new generation of French Argo floats and set up pilot experiments for biogeochemical floats (Mediterranean Sea, Arctic) 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€		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
<i>Total (2000-2017)</i>			1041		1116
2018	1400k€	14	88		88

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.

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

Since 2011, Ifremer together with NKE and CNRS has been working on PROVOR/ARVOR floats improvement in order to develop, validate and deploy the next generation of French Argo profiling floats. The new float capabilities include: longer life-time, more efficient design of the vehicle, improved transmission rates, integration of biogeochemical sensors, deeper measurements and under ice operations in the polar seas. In 2016, prototype designs were industrialised by NKE and some deployed by Operational Center. More informations on technological float developments can be found in the NAOS project webpage (<http://www.naos-equipex.fr/>) and its last newsletter ([Feb 2018, French version.pdf](#)).

The developed Arvor float behaves quite well at sea. 212 Arvor floats have been deployed in 2017 (48, about 25%, by France) and 198 are still active (93%).

Deep Arvor floats have been deployed since 2015 (36 in total). The general behaviour of the float is satisfactory and performances are improving. The Deep-Arvor technology was described in Le Reste et al (JAOT, 2016, <http://dx.doi.org/10.1175/JTECH-D-15-0214.1>)

Development of a Deep-Arvor equipped with the SBE41CP, SBE61 and deep RBRconcerto is on going. This float should be deployed in summer 2018. Such an experiment will contribute to determine which CTD is the best suited for the 0-4000db profiling Deep-Arvor.

In 2017, the deep RBRconcerto was tested during 120 stations of the RREX2017 cruise in the North-Atlantic. Preliminary analysis of the data are encouraging for the ability of the RBRconcerto to meet the core Argo mission accuracy. Even though differences against bottles and SBE911 measurements were found out of specs, biases look systematic and pressure dependant in a correctable way. So, clearly more work is still needed to meet the Deep-Argo expectations. The deep RBRconcerto preliminary evaluation will be reported on at the AST19.

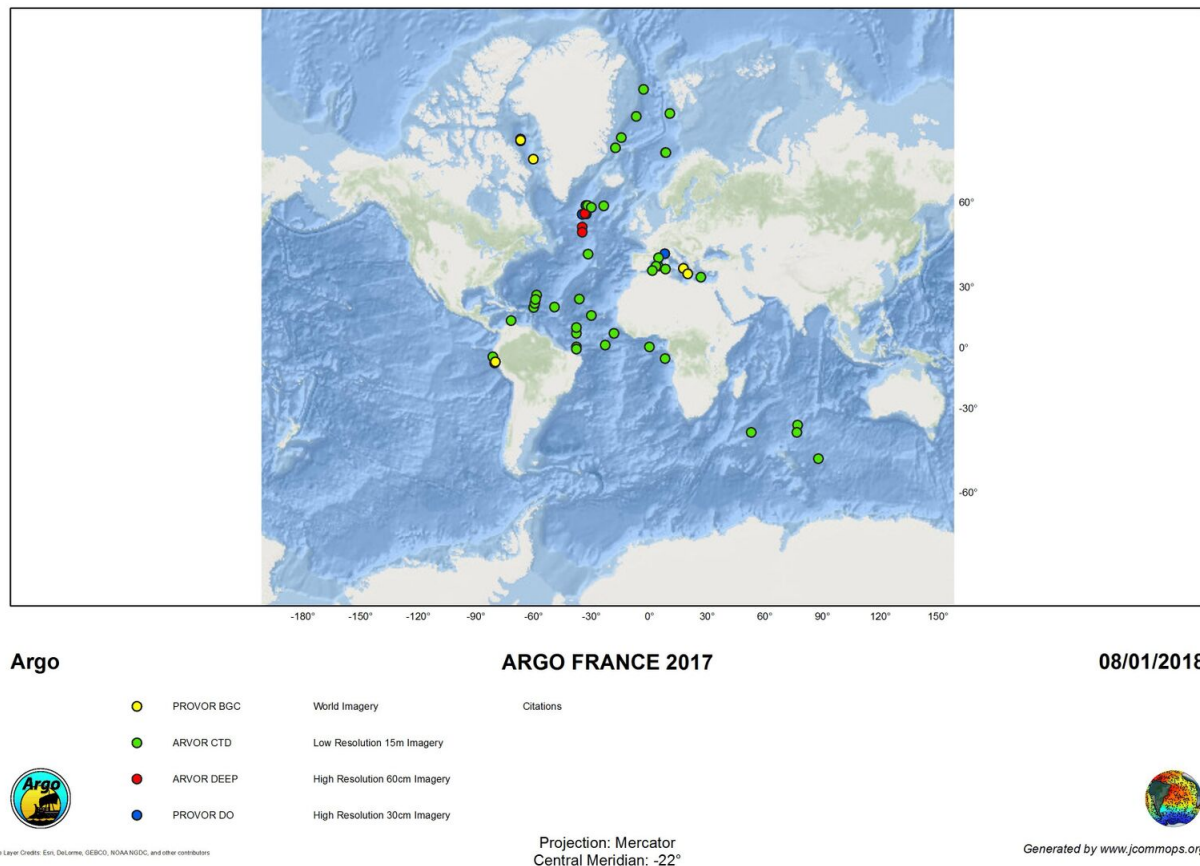


Setting on the LOPS-Ifremer rosette for the test of the deep RBRconcerto CTD (equipped with 2 RBR Optode 2 oxygen sensors). The RBR ctd is mounted near the SBE911.

The status of implementation

Floats deployed and their performance

65 T/S floats (3 BGC) have been deployed by France in 2017. 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.



2017 Argo-France 65 deployments

Technical problems encountered and solved

No particular technical problems were encountered in 2017 with regard to operational T/S floats.

Status of contributions to Argo data management

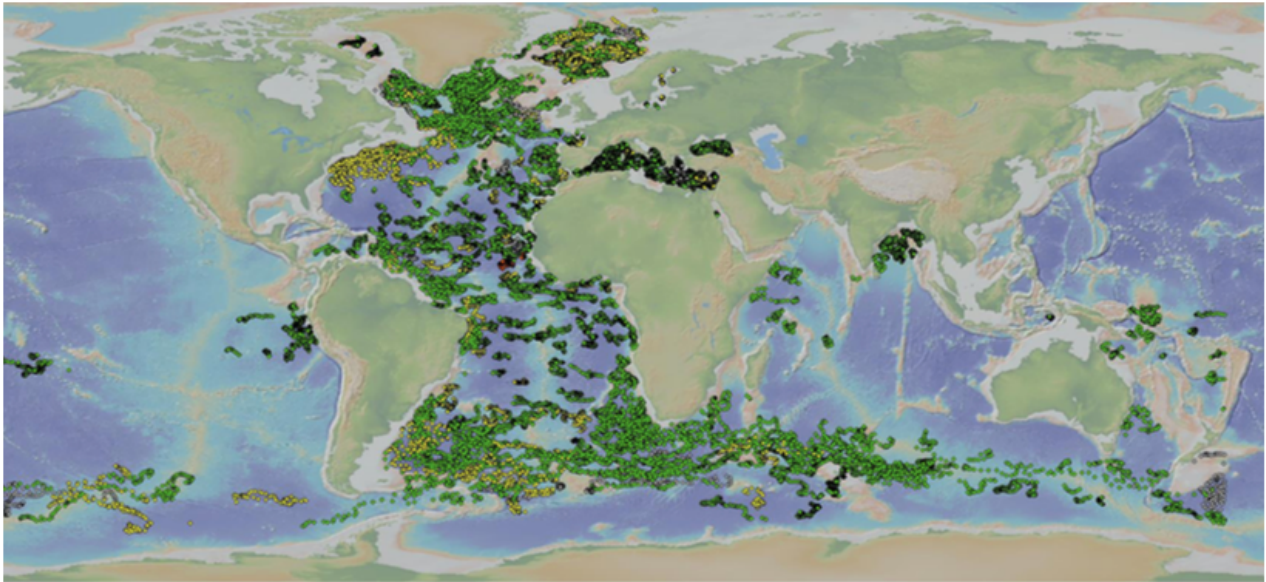
Within Argo-France, data management is undertaken by Coriolis, which play three roles: Data Assembly Centre, Global Data Centre, and leader of the North Atlantic Argo Regional Centre. Coriolis is located within Ifremer-Brest and is operated by Ifremer with support of SHOM. Since 2016, the BGC floats 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 2017 annual report (english) : <http://archimer.ifremer.fr/doc/00411/52199/>

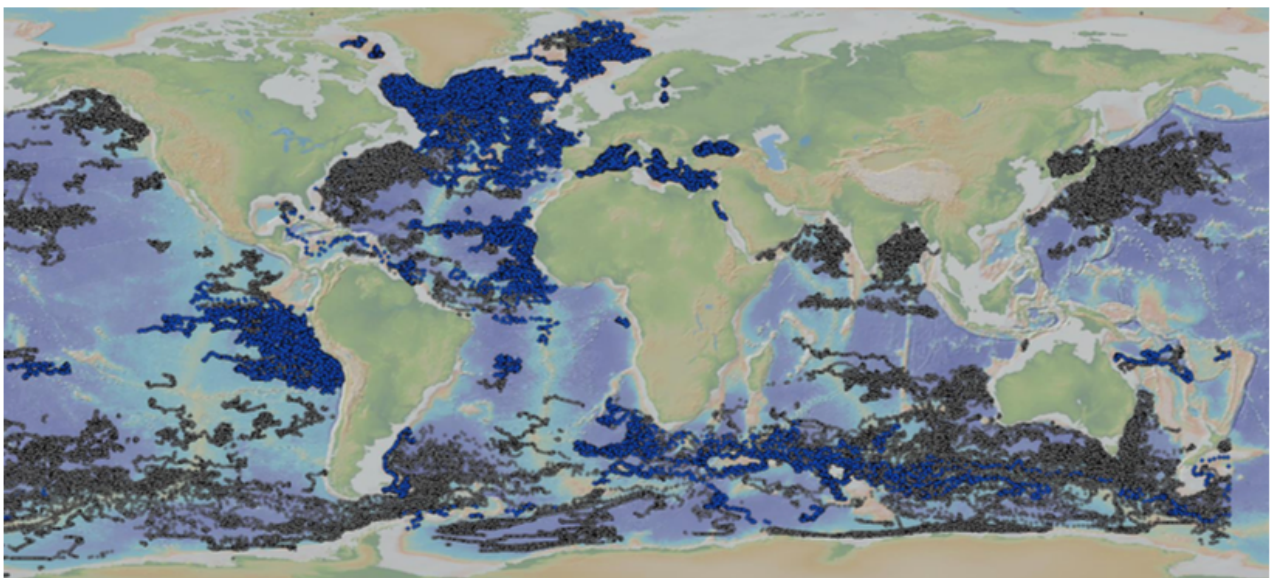
Data Assembly Center

Coriolis processes in Real Time and Delayed Mode float data deployed by France and 7 European countries (Germany, Spain, Netherlands, Norway, Italy, Greece, Bulgaria). Details information can be found the 2017 Coriolis DAC / GDAC data management report (<http://archimer.ifremer.fr/doc/00411/52199/>).

These last 12 months (sep16-aug17), 30 367 profiles from 788 active floats were collected, controlled and distributed. Compared to 2016, the number of profiles increased by 1%, the number of floats increased by 2%. These figures show a fair stability in Coriolis DAC activity. The 788 floats managed during that period had 56 versions of data formats. Coriolis DAC provides data for 357 BGC-Argo floats from 5 families and 51 instrument versions. They performed 46 460 cycles.



Map of the 30.367 profiles from 788 active floats decoded by Coriolis DAC this current year
Apex Navis Nemo Nova Provor

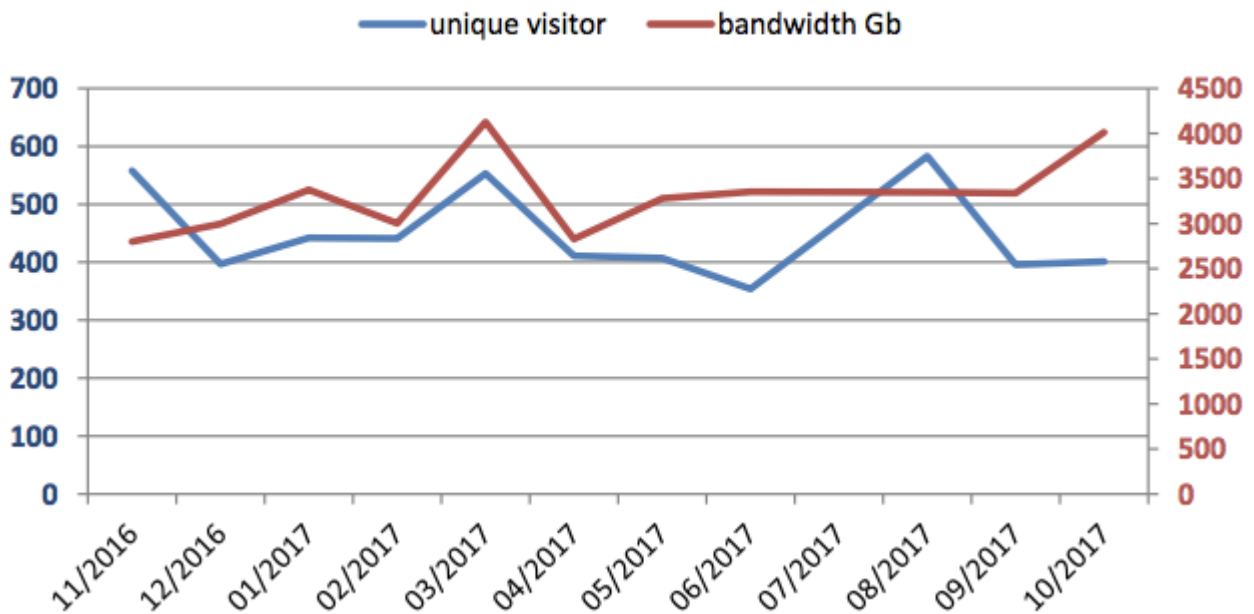


Map of the 357 bio-Argo floats managed by Coriolis DAC (grey dots: the others DACs bio-Argo floats). They measure parameters such as chlorophyll, turbidity, CDOM, back-scattering, UV, nitrate, bisulfide, pH, radiance, irradiance, PAR.

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 (see Figure). There is a monthly average of 449 unique visitors, performing 4552 sessions and downloading 3.3To of data files.

ARGO GDAC, FTP statistics 2017



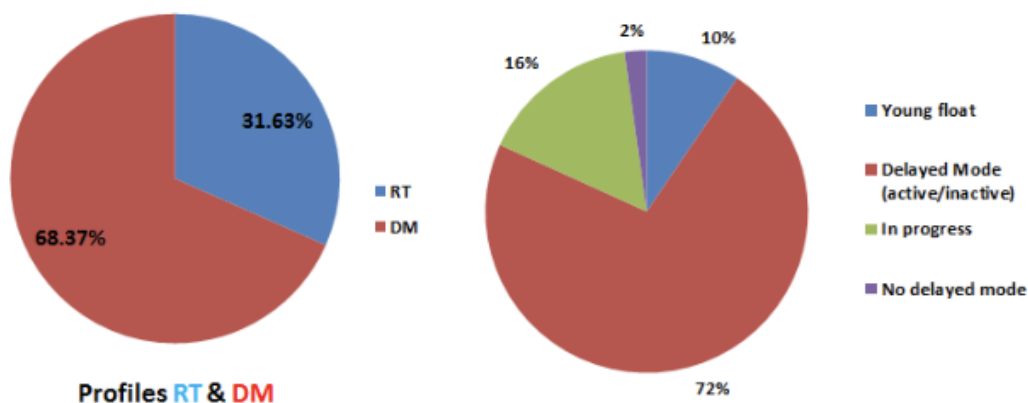
In November 2017, 131 308 BGC Argo profiles from 863 floats were available on Argo GDAC. This is a strong increase compared to 2016 : +65% more profiles and +54% more floats.

North Atlantic Argo Regional Centre

See section 5.4

Status of delayed mode quality control process

During the last year (from Oct. 2016 to Nov. 2017), 49 125 new delayed mode profiles were produced and validated by PIs. A total of 178 763 delayed mode profiles were produced and validated since 2005. In February 2018, 72% of the floats and 68.37% of the profiles processed by the Coriolis DAC were in delayed mode (see Figure below).

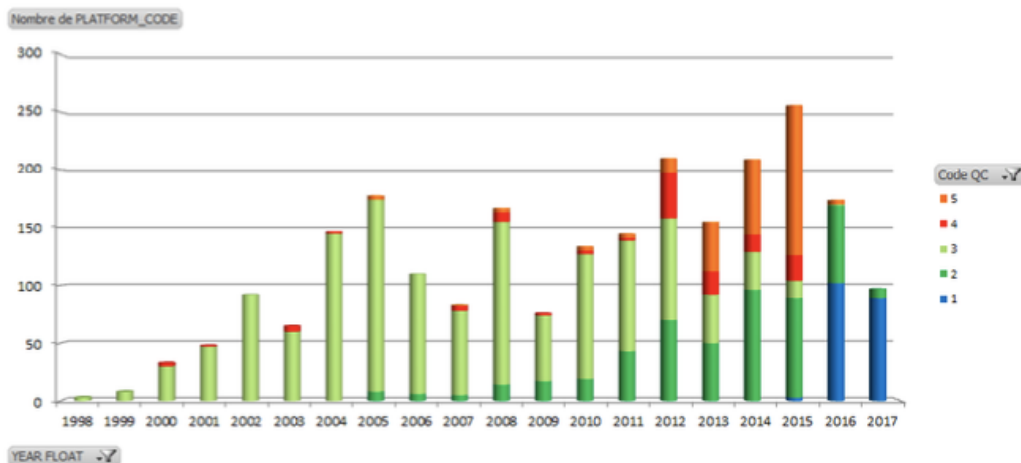


Status of the floats processed by Coriolis DAC.

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 (2016-2017), 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.



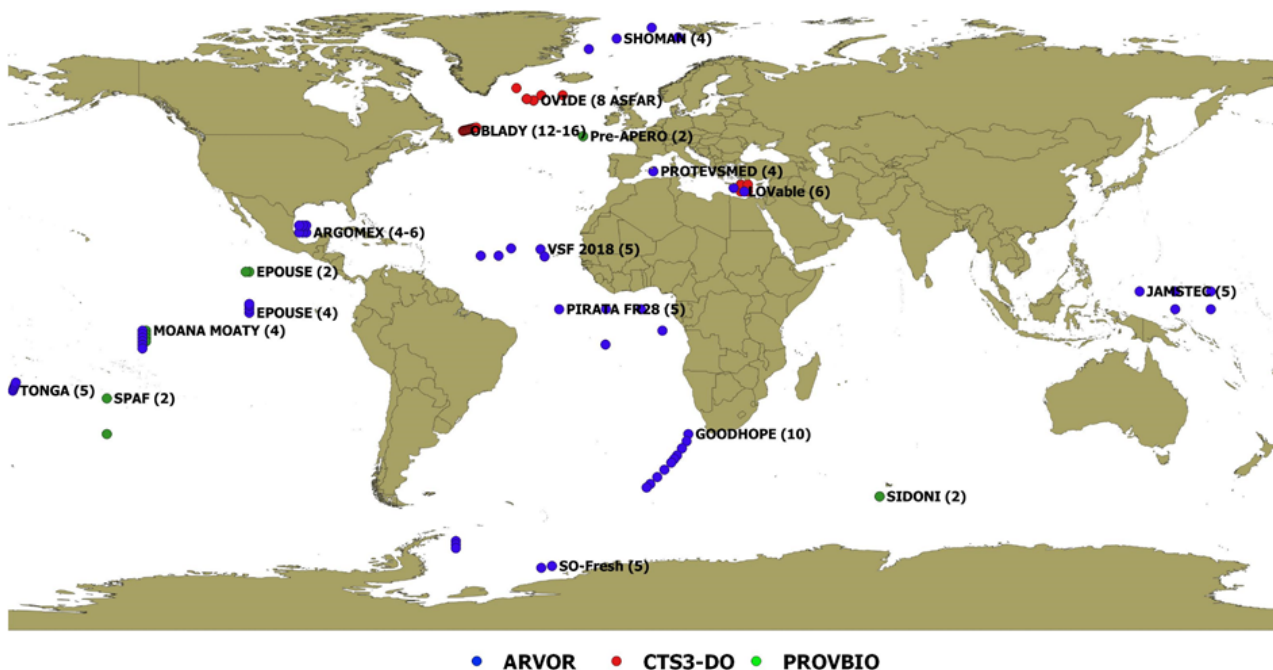
Status of the quality control done on profiles sorted by launch's year, code 1: young float, code 2: active float, DM done, code 3 : dead float, DM done; code 4 : DM in progress, code 5 : waiting for DM, code 6 : problems with float.

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

According to the current deployment plan, 88 floats are scheduled to be deployed in 2018 (with 11 DO, 21 BGC and 7 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 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.



2018 Argo-France planned deployments

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 tender. Its task is to support the Mercator and Coriolis scientific activities and to participate in product validation. The call for tender proposes to the community "standard" Argo floats as well as floats equipped with oxygen and biogeochemical sensors. These new opportunities strengthen ties 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 storage and budget, and mixing), climate monitoring and on how they are applied in ocean models (e.g. improved salinity assimilation, ...).

In 2017, an update of the ISAS product, an objective analysis of delayed mode Argo data, has been published. The new interpolated 3D fields now cover the periods 2002-2015, as monthly means. A version based only on Argo data and another version also using MEMO (Marine Mammals), ITP (Arctic) and moorings from TAO-TRITON-PIRATA-RAMA are available. All fields and standardized data are freely available to the community: Kolodziejczyk Nicolas, Prigent-Mazella Annaig, Gaillard Fabienne (2017). ISAS-15 temperature and salinity gridded fields. SEANOE. <http://doi.org/10.17882/52367>.

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.

The NA-ARC website provides information about float data and status in the North-Atlantic Ocean. NA-ARC also provides a web API to access metadata about Argo profiles in the North Atlantic region (<http://api.ifremer.fr/naarc/v1>).

All the floats that have been processed in delayed time in the North Atlantic ARC, north of 30°S, were checked again using a modified OW method that has been published by Cabanes et al

(<http://dx.doi.org/10.1016/j.dsr.2016.05.007>). Among the 1682 floats checked, we found 10 floats for which it may be necessary to revise the original DM correction. Reports have been sent to the PIs.

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.

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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.

The last version CTD_for_DMQC_2017V01 has been provided in January 2017, this is an updated version (correction of bugs in some boxes) of the CTD_for_DMQC_2016V01 dataset provided in September 2016 which takes into account new CTD provided by the CCHDO API (following figure), CTD from scientists as well as feedbacks from users on quality of some profiles. Concerning the CCHDO API, all cruises have been imported but only 30% have been kept after duplicates check with data in Coriolis database. A new version should be published in early 2018.

Bibliography

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

In 2017, at least 75 articles with a scientist affiliated in France as a coauthor have been published in peer reviewed journals. The list is reported hereafter. 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 360 articles have been listed.

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