



# French National Report on Argo - 2021 AST 23

**By the Argo-France Management Board :**

*X.André, C. Cabanes, T. Carval, H. Claustre, C. Coatanoan,  
F. D'Ortenzio, N. Kolodziejczyk, N. Lebreton, A. Poteau, R.  
Sauzède, C. Schmechtig, P.Y. Le Traon, N. Poffa, S.  
Pouliquen and V. Thierry*

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## Bibliography

How has COVID-19 impacted your National Program's ability to implement Argo in the past year?

Argo France program

Purchases and tests

Deployments at sea

DAC/GDAC and data management

Does your National Program have any deployment plans for RBR floats in the next couple years?

# Background, organization and funding of the French Argo activities

## Organization

Argo-France (<https://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 led and coordinated by:

- a scientific committee shared with the CNRS/LEFE Group Mission Mercator Coriolis (GMMC),
- a [steering team](#) with: a national coordinator (V. Thierry), scientific coordinators for the physical and biogeochemical missions (N. Kolodziejczyk, F. D'Ortenzio, H. Claustre), technical coordinators for the physical and biogeochemical 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) and heads of quality control activities (C. Cabanes and R. Sauzède).

Argo-France is part of the Ministry of Research national roadmap on large research infrastructure (IR\*). 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 "[Laboratory for Ocean Physics and Satellite remote sensing](#)" (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 (IR\*). 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), and by the Brittany and Provence Alpes-Côte d'Azur régions ([CPER projects](#)). The National Observation Services (SNO) Argo-France is supported by CNRS/INSU and the IUEM institute at University of Brest OSU (Observatory). The French contribution to the Argo global array is at the level of 60 to 65 floats per year with funding from Ifremer (50 to 55 floats/year) and SHOM (about 10 floats/year).

Since 2000, around 1450 French floats have been deployed in different geographic areas. Deployments 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) was 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 provided an additional funding of 15 to 20 floats per year from 2012 to 2019, which allowed Ifremer to increase its long-term contribution to Argo from 50 to 65-70 floats/year. NAOS also 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).

As follow up of this project:

-the [Ifremer PIANO project](#) (2021-2025) will consolidate and improve the French contribution to BGC-Argo (funding of 15 BGC floats) and develop the next generation french of deep-Argo floats (6000m), and BGC-ECO floats (BGC float with ecological sensors).

-the [Argo2030 project](#) (2021-2028) has been recently accepted and funded by the Ministry of research to consolidate and improve the French contribution to BGC-Argo (funding of 15 BGC floats), and to test the next generation of french deep-Argo-6000 floats (funding of 22 floats), and of BGC-ECO floats (funding of 14 BGC-ECO float).

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

<b>Year</b>	<b>Funding</b>	<b>Man/Year</b>	<b>French floats</b>	<b>Co-funded EU floats</b>	<b>Total</b>
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	59		59
2011	1400k€	12	64		64
2012	1400k€	12	105		105
2013	1400k€	12	89		89
2014	1400k€	12	108		108
2015	1400k€	14	131		131
2016	1400k€	14	57		57
2017	1400k€	14	69		69
2018	1400k€	14	86		86
2019	1400k€	14	71		71
2020	1400k€	15	45		45
2021	1400k€	15	90		90

Total (2000-2020)			1424		1423
<b>2022</b>	<b>1400k€</b>	<b>15</b>	<b>80</b>		

Tableau 1: (*Man/year* column) Manpower 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 the European Union within the Gyroscope, Mersea and MFSTEP projects. Estimated value is given for 2022.

## Long term evolution of Argo

At the national level, Argo-France will contribute to the new phase of Argo with about 69 floats/year with the following repartition:

- 30 core Argo floats /year
- 15 core Argo floats with O2 sensor /year
- 15 Deep-Argo-4000 floats /year (+ 22 Deep-Argo-6000 floats)
- 9 BGC-Argo floats /year (+ 14 BGC-ECO floats)

Core T/S, deep floats and oxygen sensors will be funded until 2027 (National Research Infrastructure IR\* Euro-Argo France and [CPER Brittany region](#)), the biogeochemical mission is funded through different projects (CPER PACA and Brittany regions, ERC Refine, Argo-2030 and PIANO projects).

Argo-France strategy will be adjusted according to international recommendations with regard to the deep and BGC 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

As part of the [EA-RISE 2019-2022 H2020 project](#):

- An Arvor model equipped with the RBR CTD has been developed and deployed in December 2020. Analyses are on-going.
- Two Deep-Arvor equipped with 2-CTDs (the RBRargoDeep|OEM and the SBE61) and two Deep-Arvor equipped with 3-CTDs (the RBRargoDeep|OEM, the SBE41 and the SBE61) were developed. Due to delay in sensor provisioning, the two 2-head floats will be deployed in 2022. After first deployments in 2020, a 3-head float will with the new design of the RBRargoDeep|OEM sensor will be deployed in 2022.
- Two Provor floats with SUNA + OPUS + O2 + EcoTriplet and with OC4 + RAMSES + O2 + EcoTriplet are developed, tested in the Mediterranean Sea and will be deployed in the Baltic.

As part of the new [ERC REFINE project](#) (see details in the National research section) technological developments are expected to provide:

- Extended battery packs for longer mission
- New electronic for targeted exploration and adaptative sampling
- New sensors for particles and zooplankton characterization

As part of the new [lfremer PIANO project](#) the expected technological developments are :

- New T/S and BGC sensors (optical sensors, sonar, chemical sensor)
- improvement of Deep-Argo 4000 and development of new Deep-Argo 6000 m
- Improve float technology (communications and electronics)
- Test of a Deep-Arvor float with two oxygen sensors: Aanderaa optode and RINKO sensor.

## The status of implementation

### Floats deployed and their performance

90 floats have been deployed by France in 2021 (51 T/S Core, 7 T/S/O<sub>2</sub>, 10 BGC, 22 DEEP). We deployed those floats from French RVs Atalante, Thalassa, Marion Dufresne and Beautemps Beupre, international RVs Sonne, Amundsen and Sarmiento de Gamba but also from ships of opportunity (commercial ship, fishing vessels and sailing yachts Tara and Iris). The deployment areas are chosen to meet French requirements in terms of research and operational activities and also to contribute in establishing the global array (especially in the Southern Ocean) using OceanOPS tools. Note that due to COVID19 pandemic, ship opportunities from the French Scientific fleet previously scheduled in 2020 have been deployed in 2021.



Deployment locations of Argo-France floats in 2021 by float types.

### Technical problems encountered and solved

#### Technical problems.

- 2 DEEP disappeared prematurely: Unidentified problems
- 1 CTS4 End of life mode after deployment (deployed off Peruvian shelf)
- 1 CTS3-DO disappeared after grounding on the Gulf of Lion shelf

#### Seabird batch of drifting CTDs is being assessed and monitored.

Since 2014, a larger than expected percentage of SBE conductivity sensors have drifted prematurely, eventually to an uncorrectable state (Abrupt Salty Drift - ASD). To monitor this issue, floats affected are listed in a spreadsheet that is concatenated at the international level and updated regularly:

<https://docs.google.com/spreadsheets/d/1TA7SAnTiUvCK7AyGtSTUq3gu9QFbVdONj9M9zAq8CJU/e/dit#gid=0>

- So far, 38 French Floats are listed as having a moderate or severe drift, this represents about 6% of the french float affected by this failure.

## Status of contributions to Argo data management

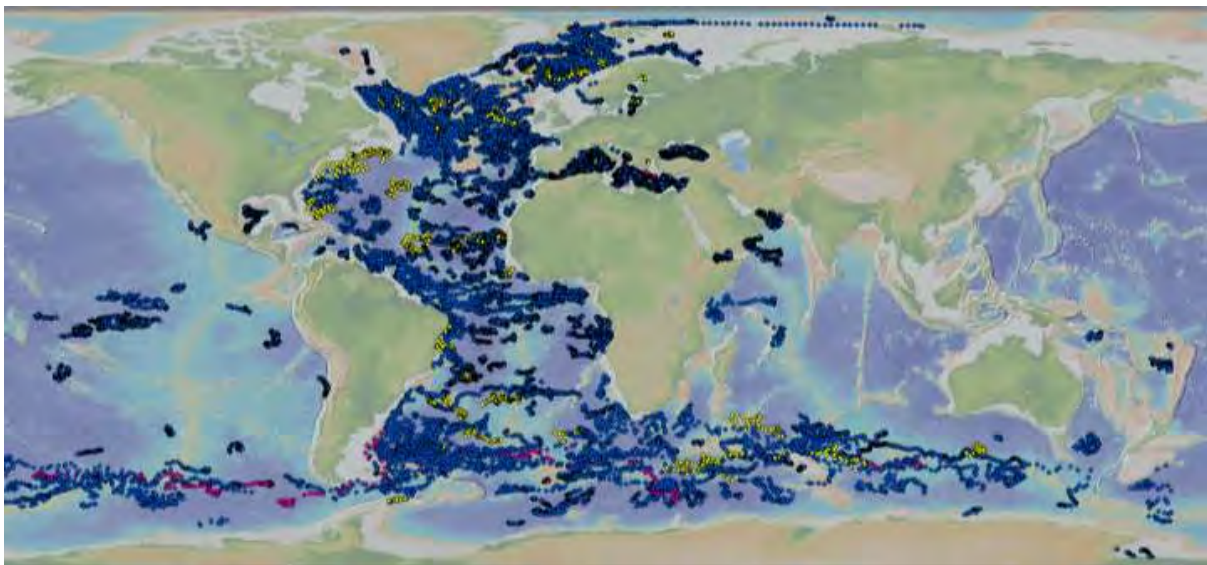
Within Argo-France, data management is undertaken by Coriolis, which plays three roles: Data Assembly Centre, Global Data Centre, and leader of the North Atlantic Argo Regional Centre. Coriolis is located within Ifremer-Brest and is operated by Ifremer with support of SHOM. Since 2016, the BGC floats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

All Argo data management details are in the Coriolis DAC and GDAC 2021 annual report (english) : <https://archimer.ifremer.fr/doc/00737/84949/>

### 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).

In the last 12 months, 58 535 profiles from 828 active floats were collected, controlled and distributed. Compared to 2020, the number of profiles has increased (+12%), the number of floats increased by 5%. These figures show a fair stability in Coriolis DAC activity. The 828 floats managed during that period had 52 versions of data formats.



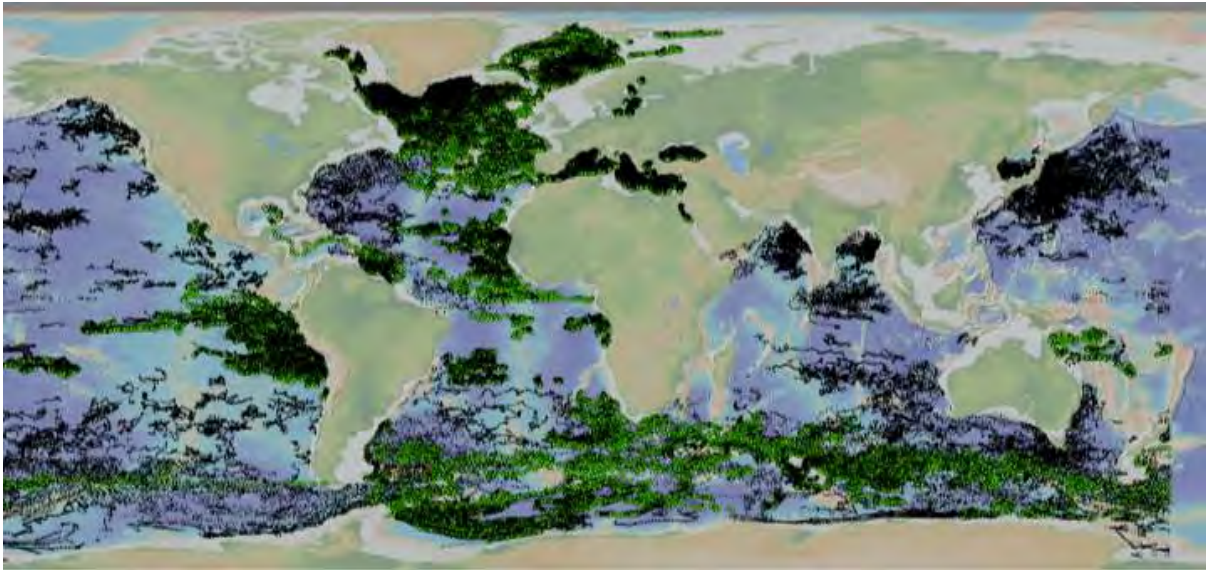
Map showing the 58 535 profiles from 828 active float decoded by Coriolis DAC in 2021

Apex Nova Provor Nemo

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 622 BGC-Argo floats from 5 families and 57 instrument versions. They performed 79 192 cycles. The data processing chain is freely available:

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



Map of 622 flotteurs BGC-Argo managed by Coriolis DAC (gray: BGC floats from other DACs). Measurements are dissolved oxygen, chlorophyll, turbidity, CDOM, backscattering, UV, nitrates, le bisulfite, pH, 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 633 unique visitors, performing 5218 sessions and downloading 4.53 terabytes of data files.

Within the EMODnet and CMEMS-INSTAC projects, in continuity of the prototype developed in the [EU AtlantOS project](#), Ifremer is setting up a dashboard (Semaphore) to monitor data distribution and give credit to data providers such as Argo floats partner institutes. FTP downloads log files are ingested in an Elasticsearch index. A link between downloaded files, download originators, floats included in the downloaded files and institution owners of the floats is performed. These links are displayed in a Kibana dashboard. This dashboard will offer the possibility to give credit to Floats owner institutions such as how many data from one particular institution was downloaded, by whose data users

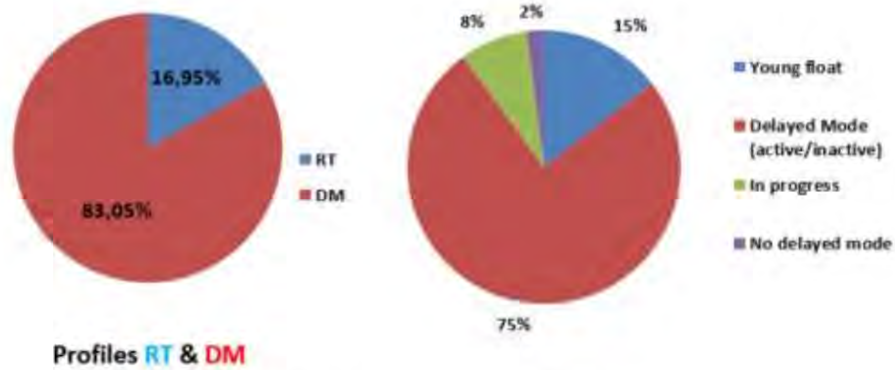
### North Atlantic Argo Regional Centre

See section 5.4

## Status of delayed mode quality control process

Last year (November 2020-November 2021), 49 671 new delayed mode profiles were produced, validated by PIs and sent to GDACs. A total of 323 450 delayed mode profiles have been produced and validated since 2005. In November 2021, 83.05% (75%) of the profiles (floats) processed by the Coriolis DAC were in delayed mode (see Figure below).



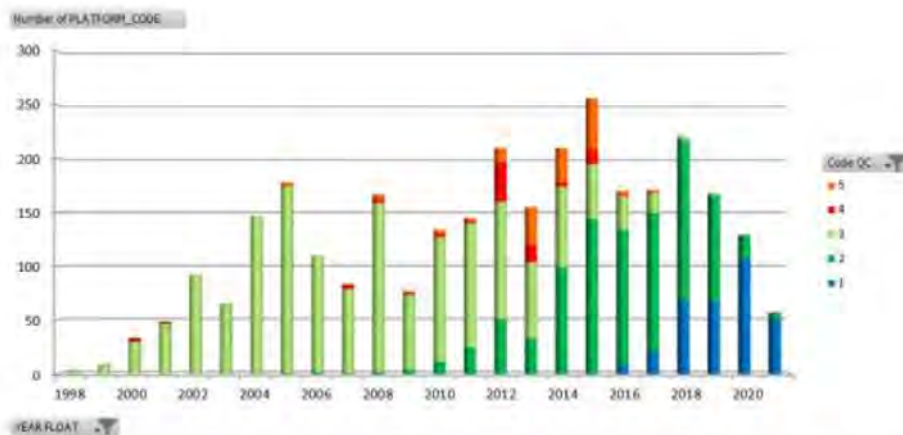


Profiles RT & DM

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 (2020- 2021), most of the floats are still too young (code 1) to be performed in delayed mode. For the period 2012-2015, 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.



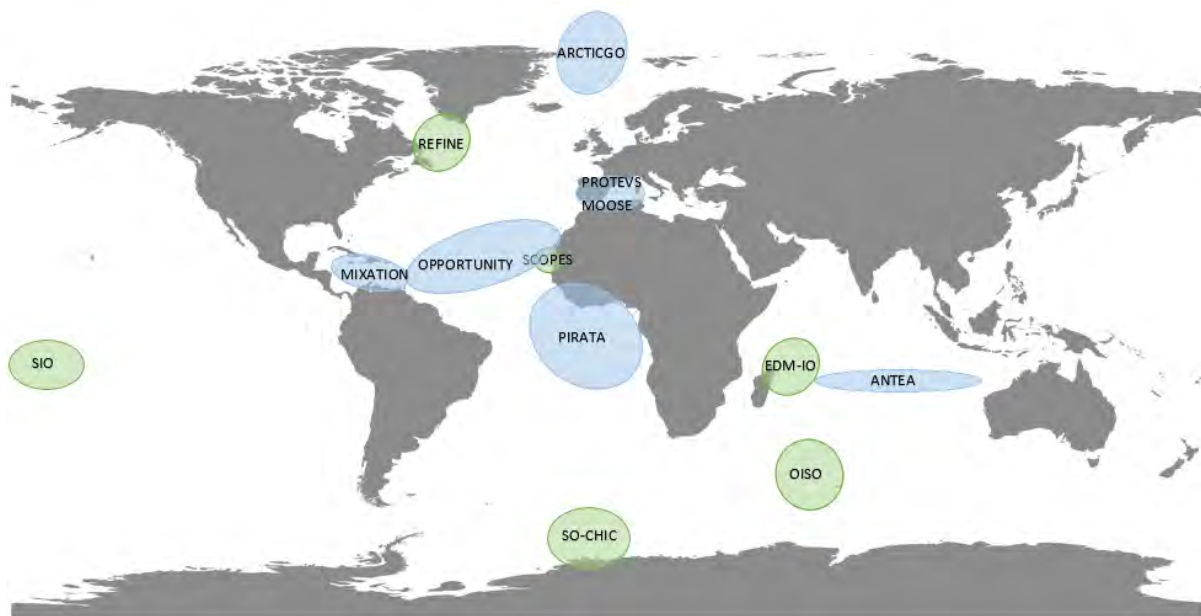
Status of the quality control done on profiles sorted by launch's year, code 1: young float, code 2: active float, DM done, code 3 : dead float, DM done; code 4 : DM in progress, code 5 : waiting for DM, code 6 : problems with float.

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

According to the current deployment plan, 80 floats are scheduled to be deployed in 2022 (57 confirmed : 16 T/S, 29 BGC, 12 DEEP), see map below.

Coriolis will continue to run the Coriolis DAC and the European GDAC as well as coordinating the Atlantic ARC (A-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 A-ARC.

France also will continue to contribute to the funding of the AIC.



Deployment locations of Argo-France floats planned in 2022 by ship cruises : blue are core Argo deployments and greens will include BGC floats.

**COVID19:** In 2021, Argo-France has managed all deployment postponed from 2020. The COVID19 impact has been reported at the OceanOPS and Euro-Argo level for possible coordinations to sustain the array

(<https://docs.google.com/spreadsheets/d/1of05jipeBLFRpNVKpcbTZuiKjpCmWwVU2TPI3-bBO0BM/edit#gid=0>).

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

### Operational ocean forecasting

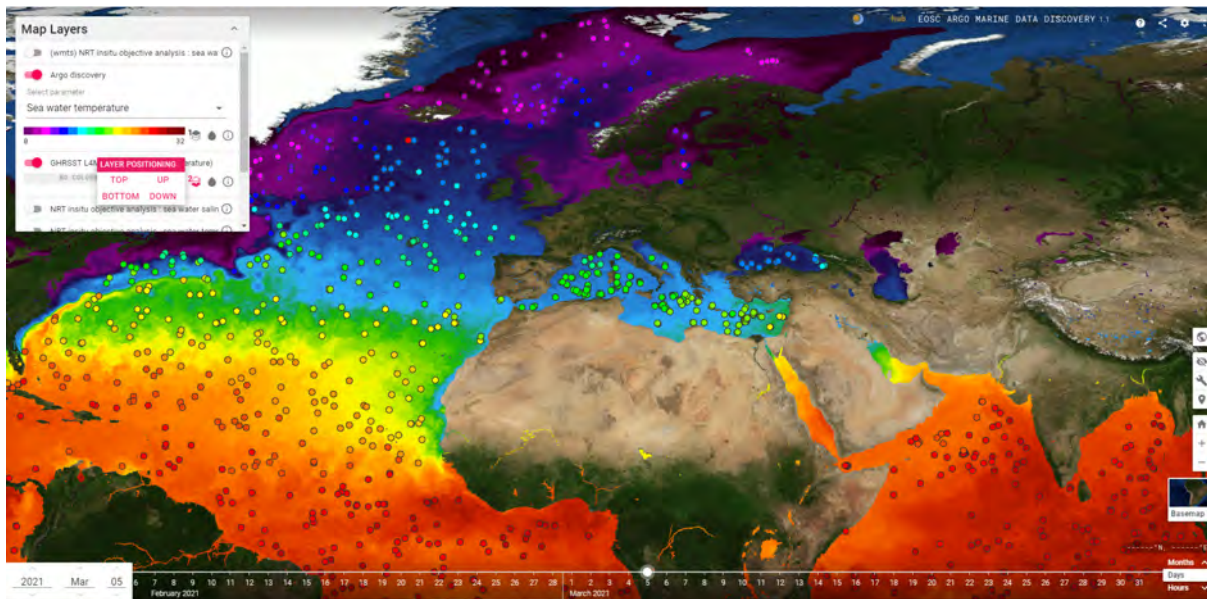
All Argo data (alongside with other in-situ and remotely sensed ocean data) are routinely assimilated into the MERCATOR operational ocean forecasting system run by the MERCATOR-Ocean structure. MERCATOR also operates the Global component of the European Copernicus Marine Environment Monitoring Service ([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 a call for scientific proposals. 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 the link between the French scientific community and Coriolis with regard to the development of qualification procedures for "Argo extensions" floats.

## European Argo-data project involving French Argo community

- Euro-Argo RISE (2019-2022):  
<https://www.euro-argo.eu/EU-Projects/Euro-Argo-RISE-2019-2022/News/Euro-Argo-RISE-progress-already-halfway-there>
  - Development & Implementation of DMQC machine learning methods
  - Improvement of data access
  - Sensors: addressing SBE61 accuracy and stability & testing RBR on core and deep floats
  - DMQC method for Argo extended missions (Deep, BGC)
  - Viewing service : <https://dataselection.euro-argo.eu/>
  - Outreach
- ENVRI-FAIR: connecting ERICs (Euro-Argo) to EOSC Blue Cloud:
  - Improving data access to European data base including Argo dataset through new API on Coriolis GDAC
- EOSC-Blue cloud
  - Improving visualization tools for Argo data combined with satellite information (<http://bluecloud.odatis-ocean.fr/>)



Map of Argo-Float surface temperature overloaded with satellite SST

## 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.

## Key project activities

### ISAS T/S gridded fields

Argo France provide updated T/S gridded monthly fields from Argo profiles and some other CTDs (CCHDO, ICES, PIRATA-TAO-RAMA, MEOP, ITP, ...), all the ISAS releases have been now accessible from an unique DOI:

Kolodziejczyk Nicolas, Prigent-Mazella Annaig, Gaillard Fabienne (2021). ISAS temperature and salinity gridded fields. SEANOE. <https://doi.org/10.17882/52367>

### ANDRO Trajectory dataset

Argo-France contributes to the DMQC on Argo float trajectories and provides updates to the ANDRO product (Atlas of Argo trajectories). An update for the period 2010-2021 including the floats of the AOML and Coriolis DACs was published in 2021. The delayed-time QCs of the Argo float trajectory data have been updated, as well as the Andro Atlas of float travel velocities at DOI:

Ollitrault Michel, Rannou Philippe, Brion Emilie, Cabanes Cecile, Reverdin Gilles, Kolodziejczyk Nicolas (2021). ANDRO: An Argo-based deep displacement dataset. SEANOE. doi:<https://doi.org/10.17882/47077>

### ICES North Atlantic Ocean State Report (IROC)

As every year, in 2021, Argo-France contributed and assembled the French contribution to the ICES report on the state of the North Atlantic Ocean in 2020. The ISAS temperature and salinity fields are

used in its "Ocean State Report" ([www.ices.dk](http://www.ices.dk)): Kolodziejczyk Nicolas, Desbruyeres Damien (2021). Contribution to the ICES Report on Ocean Climate : North Atlantic Ocean in 2021. National report: France, May 2021. LOPS-WGOH-2021-05:

[https://www.umr-lops.fr/content/download/157761/file/LOPS\\_21\\_05\\_IROC\\_WGOH\\_France\\_v2.pdf](https://www.umr-lops.fr/content/download/157761/file/LOPS_21_05_IROC_WGOH_France_v2.pdf)

H2020 EARISE (Euro-Argo Research Infrastructure Sustainability and Enhancement, 2019-2022)

The H2020 EARISE project has seen its third year of activities (see above):

- design of the integration of the new RBR probes on the Arvor and Arvor-Deep
- start of the implementation of a DAC for the BGC extension (Coriolis)
- integration design of new bio-optical sensors on PROVOR
- Implementation of a collaborative framework for the Argo community. Collaborative tools are available on [github.com/euroargodev](https://github.com/euroargodev). All these tools are free and available for the global Argo community, among others:
  - A public forum on Argo QC to be used by the Argo-France community: [github.com/euroargodev/publicQCforum](https://github.com/euroargodev/publicQCforum)
  - Hosting of digital codes for distribution and development (repositories),
  - Tools for team organization and discussion
  - Project management tools.

ERC REFINE (Robots Explore plankton-driven Fluxes in the marine twilight zoNE, 2019-2022)

After obtaining a first ERC in 2011 ( remOcean ), Hervé Claustre obtained in 2019 a second ERC (Advanced Grant) for the REFINE project . The scientific objective of REFINE is to understand and quantify the physical, biological and biogeochemical processes that control the biological carbon pump, a key element in CO<sub>2</sub> sequestration. It is in the mesopelagic zone (or twilight zone), between 200 m and 1000 m, that most of the key processes occur. Yet this zone represents one of the least well known ecosystems on our planet. The REFINE project will therefore focus on exploring the meso-pelagic zone and will be implemented through four major coordinated actions:

1. Development of a new generation of multidisciplinary profiling floats, focusing in particular on the composition of phyto- and zooplankton communities.
2. Realization of ~4 years of robotic studies in five ocean areas, representative of the diversity of biogeochemical conditions and responses to climate change in the world ocean, on a continuum of time scales from diurnal to interannual.
3. In-depth analysis of the REFINE dataset, enabling carbon flux budgets to be established for each of the five areas, and understanding the physical and biogeochemical mechanisms involved in the transfer of organic carbon to the deep ocean.
4. "Upscaling" regional processes to the global ocean, notably through the use of artificial intelligence that takes advantage of multi-source observations from REFINE robots and Earth observation satellites.

PIE Ifremer PIANO (Argo Novel Observations Investment Plan ; 2021-2025)

The objective of the PIE PIANO project (Argo New Observations Investment Plan) is to carry out innovative technological developments on Argo floats, on sensors (for T/S and BGC-Argo) and to implement the French contribution to the new Argo phase over 2021-2027. This will involve:

- procurement of BGC-Argo floats (12 floats over 5 years)

- to develop a French offer of BGC sensors (active optics, passive optics, micro sonar and pH chemini)
- to develop a Deep-Argo 6000 m float
- to improve float technology (electronics, communication)
- finally to ensure the processing of project data including the development of innovative methods

### Equipex+ Argo-2030 (3<sup>rd</sup> Investment Plan of French Research Ministry; 2021-2028)

The objective of the Equipex PIA3 Argo-2030 project is to acquire BGC floats to consolidate the French contribution to the BGC component of the Argo network (15 floats, i.e. 2-3 floats/year over 8 years). Argo-2030 also plans scientific experiments to test and validate the new generations of BGC and Deep floats developed in complementary projects (ERC Refine for the platform, PIE Ifremer PIANO for "Made in France" sensors) :

- The new generation of French BGC-Argo floats (referred to as "BGC-ECO" Argo) will add unique imagery and active acoustics capabilities. These floats will allow the exploration of the mesopelagic zone (100-1000 m) including its biological/fishing dimension (it is believed that the protein resources of this zone are underestimated by at least an order of magnitude) assuming that it is the main site of the remineralization of CO<sub>2</sub>, and therefore it is decisive for CO<sub>2</sub> sequestration.
- The new generation of French Deep-Argo floats (the Deep-Arvor "6000") will target 6000 m depth (the floats developed and successfully tested in the NAOS Equipex are designed to target 4000 m depth). It will offer a high capacity for carrying additional sensors (oxygen in particular), allowing the Deep-Arvor "6000" to be positioned as the first Deep + BGC mixed float. These floats will help estimate the role of the deep ocean on the planet's energy balance, sea level rise, deoxygenation, and acidification in key regions (Atlantic, Southern Ocean). Their deployment will be combined with Deep-Argo 4000 floats to best resolve geographic structures and seasonal to interannual variations in heat and freshwater content, steric height and circulation at the basin scale within deep (> 2000 dbar) and abyssal (> 4000 dbar) oceanic layers.

## Argo-Regional Center: Atlantic

France leads the A-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 Atlantic ARC activities and in particular the float deployment in Atlantic.

1903 floats that have been processed in delayed time in the Atlantic ARC, north of 35°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.umar-ops.fr/en/SNO-Argo/Activities/NAARC/Consistency-checks-of-DM-salinity-correction>

[S](#)

**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*

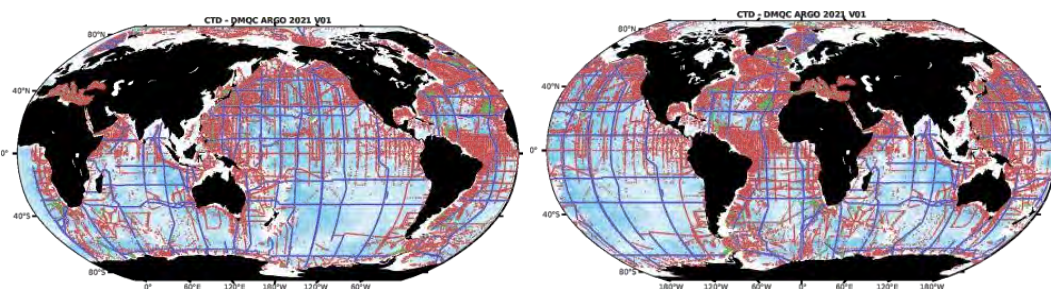
performance of the Argo data system. If you have specific comments, please include them in your national report.

- Large cost increases in 2022 on Seabird Sensor and other float components (expected increase of float cost by 5-10%) with no additional budget at national level to cover the cost increase. We thus expect to buy 5-10% less float than originally planned in the coming years. We expect the same issue in other countries and that cost will continue to increase regarding the current international situation. This will certainly impact the Argo program.
- In this context and to be as efficient as possible, Argo France stresses the need for international coordination among the One Argo network for the implementation of the BGC and Deep components as a contribution to the Core component.
- 6% of our fleet was impacted by salinity sensor drift. Such monitoring needs to be done on the long-term and extended to other sensors.

## 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 March 2021, an updated version 2021V01 was provided including the GO-SHIP EASY ocean data product (16231 stations) for the DEEP baseline. Where the GO-SHIP profile from the CCHDO existed in the previous version, it has been replaced by the easy product version (higher QC version). In the reference database, this data can be identified with the GSD QCLevel (for GO-SHIP Deep Argo).



Version 2021V01: **GSD Easy-Ocean**, **GSH GO-SHIP** and **Others**

In mid-December 2021, a new version 2021V02 has been provided with minor corrections, following the feedback received by the users. Some CTDs have also been added: CTDs provided by scientists, CTDs made during float deployments and some GO-SHIP CTDs retrieved from the CCHDO website.

Coriolis manages the Argo reference databases for the DMQC (CTD boat casts and Argo floats). In order to facilitate access by QC software, Ifremer undertakes to serve these databases via the ERDDAP API: <https://www.ifremer.fr/erddap/info/ArgoFloats-ref/index.html>. For the moment, only Argo reference data is available (because it is freely accessible). Ship data will also be provided via a simple authentication system. The new Argo simplified data access library (such as Argopy library) also provides access to reference data.

## Bibliography

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

In 2021, at least 65 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 web page. To date, more than 400 articles have been listed:

<https://www.argo-france.fr/en/Bibliography/Publications>

## How has COVID-19 impacted your National Program's ability to implement Argo in the past year?

### Argo France program

The Argo France program has not been impacted by the Covid-19 pandemic. The steering meetings were carried out remotely.

### Purchases and tests

The activity was nominal, with no postponed deliveries, the usual tests (pressure tests, basin tests) were not impacted. The teams remained mobilized and Ifremer's test resources adapted with great responsiveness. The slots were shared with the Euro-Argo ERIC team, with an optimization of the weeks in terms of the quantity of instruments tested.

### Deployments at sea

Due to COVID19 pandemic ship opportunities from the French Scientific fleet previously scheduled in 2020 have been deployed in 2021.



## DAC/GDAC and data management

Data management activities ( DAC, GDAC, DMQC, A-ARC)) have been carried on as planned despite the fact that most people were working from home thanks to the services set up by the IT departments of Ifremer and CNRS. ).

## Meeting/outreach

AST 22 in visio conference March 2021

Deep and BGC workshop in visio conference in September/October 2021

ADMT 22 in visio conference December 2021

Most of meeting and outreach events have taken place in mixed presental/remote in 2021

## Does your National Program have any deployment plans for RBR floats in the next couple years?

In the framework of the H2020 Euro-Argo-RISE project, Ifremer has developed the Arvor-I/RBR, which is a standard Arvor-I float equipped with the RBR CTD. 2 floats of this type were deployed during the Spanish RAPROCAN2020 campaign off the Canary Islands in December 2020. 2 other Arvor RBRs purchased by Argo-France (Ifremer budget) were also deployed in the North Atlantic in 2021. The data will be analyzed by LOPS in the framework of Euro-Argo RISE. 6 Arvor RBRs were purchased by Argo-France in 2021 for deployment in 2022. Argo-France also provided 4 Arvor with SBE41CP to be deployed by Argo Netherlands in the Caribbean in April 2022 with simultaneous deployments of 4 Arvor RBR owned by KNMI.



New RBR CTD mounted on the head of the Arvor float (left) and deep-Arvor prototype equipped with 3 CTDS: RBR, SBE41 and SBE61 (right).

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Argo-France: <https://www.argo-france.fr/>  
French bibliography: <https://www.argo-france.fr/en/Bibliography/Publications>  
Argo PhD list: <https://www.argo-france.fr/en/Bibliography/Theses>  
NA-ARC data mining website: <https://www.umr-lops.fr/SNO-Argo/Activities/A-ARC>  
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>  
Argo2030 project : <https://www.argo-france.fr/en/Projects/Argo-2030>  
PIANO project : <https://www.argo-france.fr/en/Projects/PIE-PIANO>  
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>