



Euro-Argo Report – AST23

The Euro-Argo Research Infrastructure organises and federates European contributions to Argo (www.euro-argo.eu). The Euro-Argo ERIC (European Research Infrastructure Consortium) and its governance structure (Council, Management Board and Science and Technological Advisory Group) was set up by the European Commission in May 2014, with 9 funding members. The Euro-Argo ERIC is made up of a central office based in France (Ifremer, Brest) and distributed national facilities (Figure 1). The distributed national facilities operate with direct national resources. As part of the Euro-Argo Research Infrastructure, they agree to a multi-annual commitment of resources (in particular in terms of floats to be deployed and for the data system), and to coordinate their activities through the Euro-Argo ERIC. The Euro-Argo ERIC delegates some of its activities to the national facilities who have the relevant expertise (e.g. data management and quality control, float deployment), and according to their areas of responsibility.

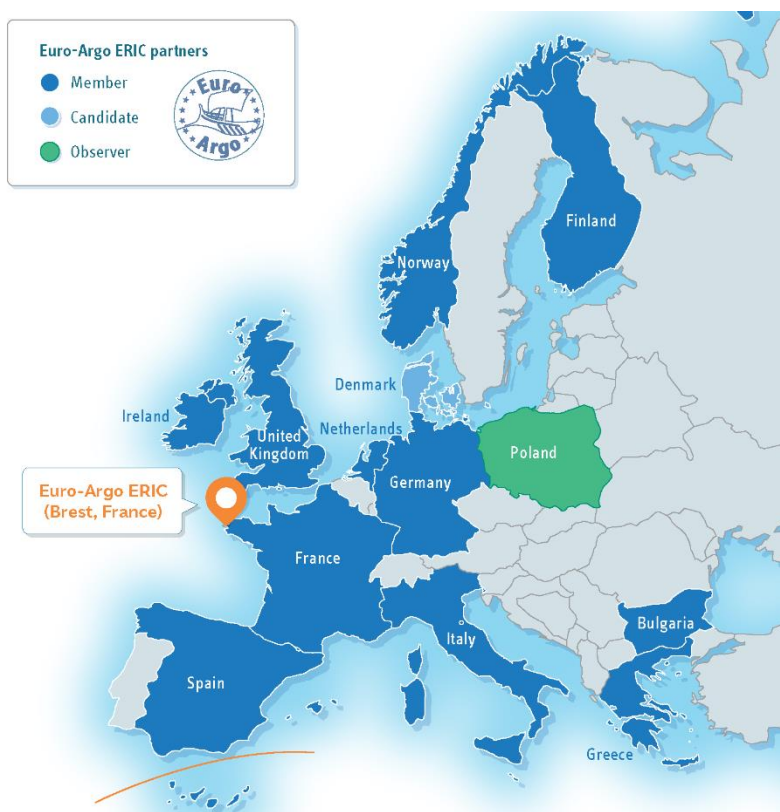


Figure 1. Euro-Argo ERIC membership in 2021

In December 2021, the Euro-Argo ERIC involved 13 countries: **11 Members, 1 Observer** and 1 Candidate (Denmark, newly involved).

This report presents the contribution of EU funded Argo activities as well as the integrated view of EU plus national European contributions.

1. The status of implementation of the new global, full-depth, multidisciplinary Argo array (major achievements and problems in 2020)

a. floats deployed and their performance

In 2021, 17 EU-funded floats were deployed. Among these 17 floats, 10 were funded under the EU H2020 EuroSea project: 5 BGC with 5 variables (no Nitrate) deployed in the tropical Atlantic and 5 DEEP floats with optodes deployed in the North Atlantic. The 7 other floats were bought under Euro-Argo ERIC budget (2 core floats and 5 floats with oxygen sensors). These 17 floats come in addition to the 240 floats deployed by the National members. The table below shows the floats deployed, both as number of measurements per variable and per type of float.

Table 1. European floats deployed in 2021, per parameter measured (blue, 7 first columns) and per type of float (green, 5 last columns). "BGC" stands for floats measuring the 6 BGC variables and "Bio" stands for other floats equipped with 1 to 5 BGC sensors, except the Deep-O2 floats only counted in the "DEEP" column.

	T&S	O2	Chla	BBP	NO3	Irradiance	pH	core	BGC	Bio	Deep	Total (floats)
EU funded	17	14	5	5	0	5	5	3	0	9	5	17
Member states	240	83	33	33	8	22	12	153	2	57	28	240
total	257	97	38	38	8	27	17	156	2	66	33	257

A total of 257 floats have been deployed in 2021, with 86% of them being NKE floats. 6 out of the 257 floats have been recovered, most of them in the marginal seas.

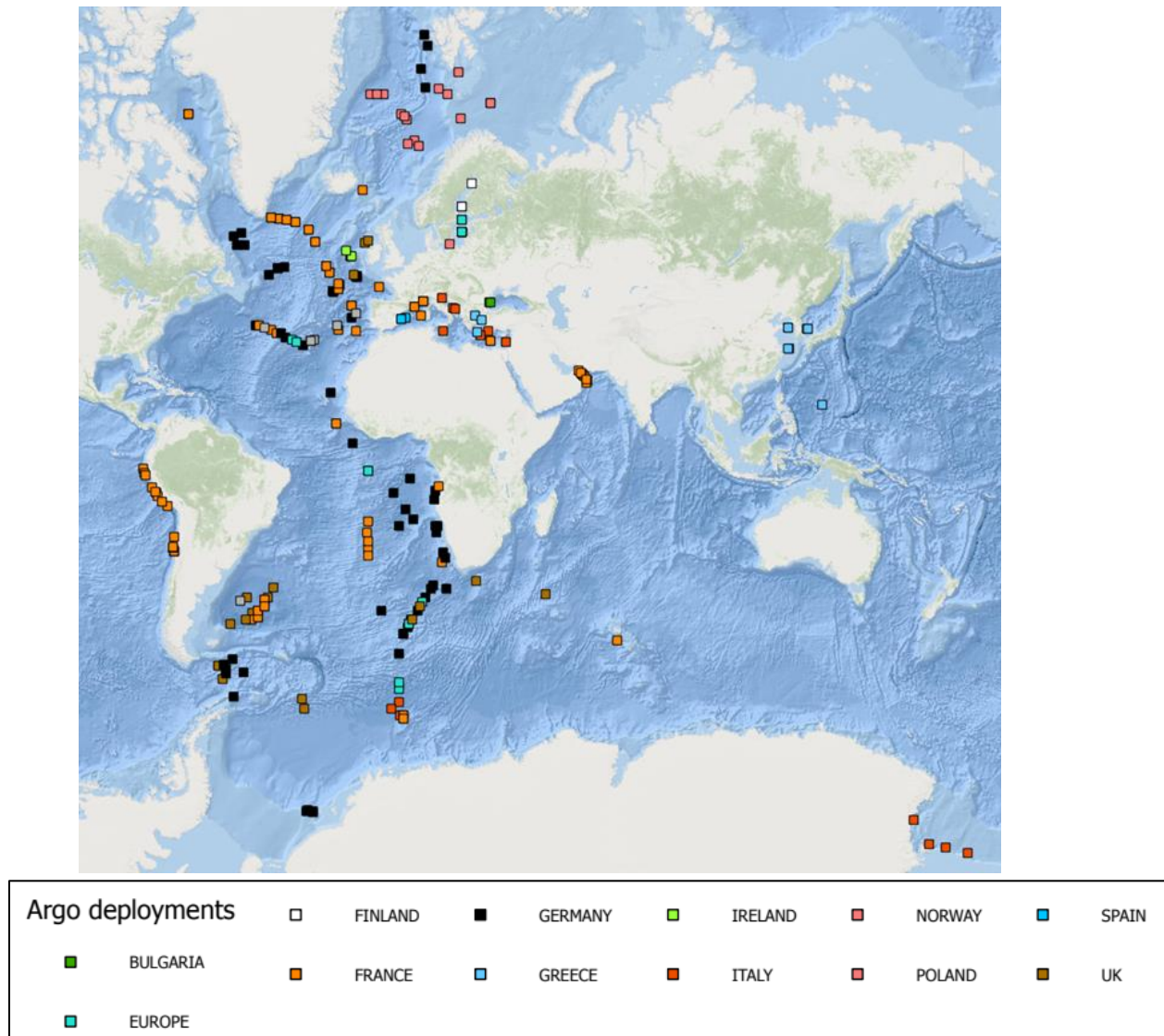


Figure 2. Deployment positions of the European floats deployed in 2021 (Credit OceanOPS)

The launch location of all Argo floats deployed in 2021 are shown in Figure 2.

Figure 3 presents the evolution of Euro-Argo deployments since 2008. In 2021 Euro-Argo deployed 257 floats, representing 32% of the global effort, one of the highest percentages since 2008. The year 2021 remained influenced by the COVID pandemic, but Euro-Argo ERIC members managed to catch up with most of the deployment backlog due to Research Vessels cruises postponed or cancelled in 2020. Those efforts resulted in the deployment of ~100 more floats than in 2020.

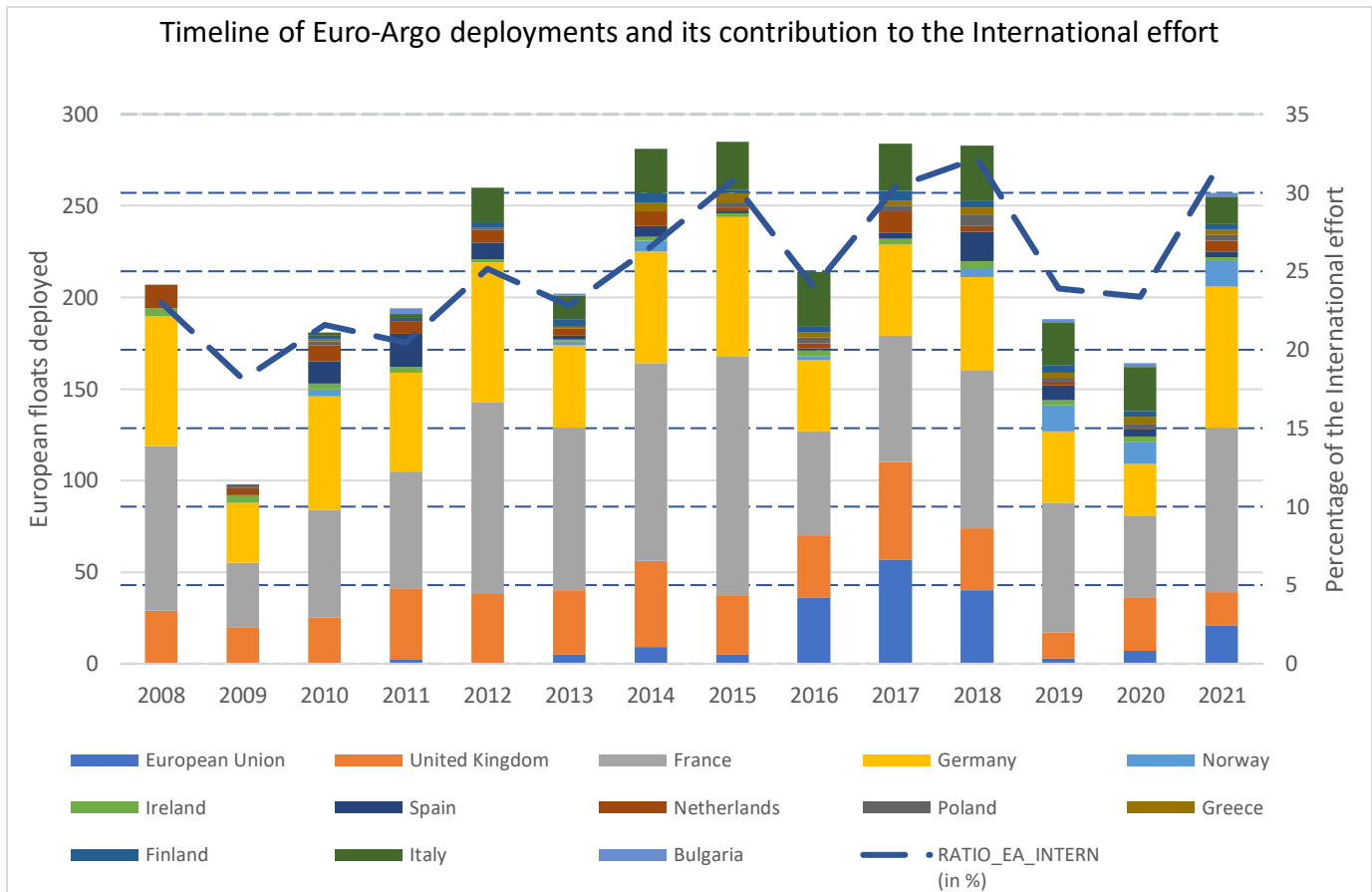


Figure 3. Timeline of Euro-Argo deployments (in number of floats, colored bars, left axis) and its contribution to the international effort (in %, blue dashed line, right axis).

b. technical problems encountered and solved

No specific technical problem has been encountered last year.

c. status of contributions to Argo data management (including status of high salinity drift floats, decoding difficulties, ramping up to include BGC or Deep floats, etc)

All European floats are processed by Coriolis and BODC DACs (respectively 87% and 13% of European profiles in 2021), and DMQC of T and S parameters is currently shared between several institutes (4 leading: BSH, OGS, Ifremer & BODC, and several new partners entering the game). European partners have proposed several new procedures for the QC of BGC parameters that were endorsed at the last ADMT meeting. The organisation of BGC DMQC is also presently being discussed at European level, with various scenarios investigated, and a consolidated proposition of organisation between various institutes involved should be ready at the end of 2022.

The European fleet is impacted by the abrupt salinity drift on SBE sensors and Euro-Argo had started to investigate this issue from a DMQC point of view in 2019 (see Euro-Argo github public Forum: <https://github.com/euroargodev/publicQCforum/issues/11>). Euro-Argo maintains an international [Google spreadsheet](#) on the subject, and is actively participating in the international WG on the subject. The spreadsheet records have been extended to gather all observed drifts, including early “moderate” drifts.

The tab on statistics of the issue for European floats in the spreadsheet (Figure 4) shows that (as of mid-March 2022) the issue was most significantly present in profiles made by floats deployed in 2015-2016-2017, but is still affecting data made by floats deployed in the more recent years: 4.3% of data made by floats deployed in 2019 are impacted by a drift, with 1.4% of the data being lost (uncorrectable drift).

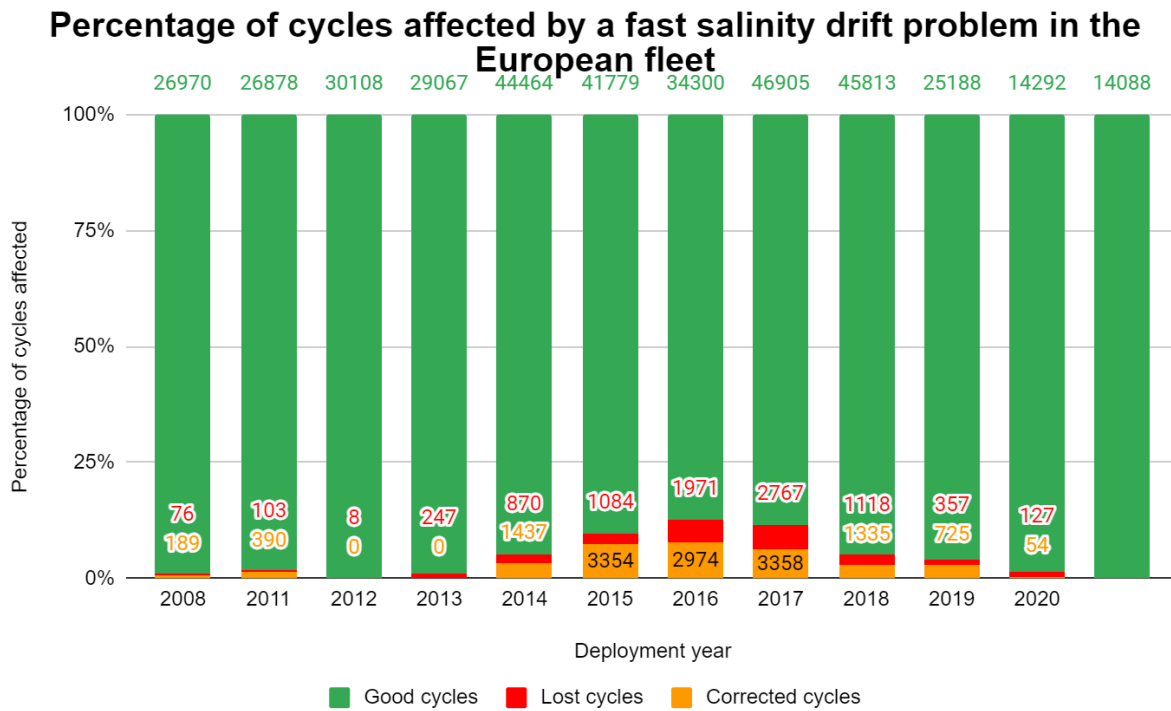


Figure 4. Percentage of cycles affected by fast salinity drift problem in the European fleet – as of mid-March 2022.

d. status of delayed mode quality control process

At the end of 2021, the percentage of the whole European fleet (EU-funded + National) processed in Delayed Mode amongst eligible floats was almost 80%.

2. Present level of and future prospects for national funding for Argo including a summary of the level of human resources devoted to Argo, and funding for sustaining the core mission and the enhancements: BGC, Deep, Spatial (Polar, equator, WBCs)

In 2021, the Euro-Argo ERIC coordination office was a team of 5,3 FTE (3.3 permanent and 2 project-funded). This team supports European countries to sustain and optimise the European contribution to the Argo International programme, and comes in addition to the national members' personnel.

The European contribution to Argo is still benefiting from the Euro-Argo RISE EU project (Euro-Argo Research Infrastructure Sustainability and Enhancement), that involves all the Euro-Argo ERIC members except Netherlands for a 4 years duration (until December 2022). The project has been granted 4M€, including funds for float purchase (**12 floats in total including Deep and BGC floats**) and a total of more than **100 men months per year** dedicated to Argo activities in all aspects (technological development, science, data management, outreach, legislation, etc.). Euro-Argo RISE is coordinated by the Euro-Argo ERIC.

Euro-Argo is also involved in the **EuroSea EU project** that funded **5 Deep floats and 5 BGC floats** deployed in 2021 as well as the organisation of workshops on Deep and BGC Argo in Autumn 2021, and in the **ENVRI-FAIR EU project** in which Euro-Argo is funded to work on improving **FAIRness** (FAIR: Findable, Accessible, Interoperable, Reusable) of **Argo data**, through the involvement of the two European Argo DACs (BODC & Ifremer).

The new EU project DOORS (Developing Optimal and Open Research Support for the Black Sea), started in 2021, will also allow Europe to further develop Argo in the Black Sea and demonstrate the importance of BGC-Argo for Blue Growth development in the Black Sea as part of a multiplatform integrated observing system. The project includes the funding of sensors for 2 BGC floats to be deployed in 2022 if the political situation improves in the countries surrounding the Black Sea.

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

Float deployments planned for 2022 are presented in Table 2 per region and type of float. In total, Europe plans to deploy 235 floats, significantly more than the number of floats effectively deployed in 2021, but these numbers are to be taken with care because of uncertainties in fundings availability for several partners. Only one of these floats will be funded by the Euro-Argo ERIC.

Table 2. European deployment plans for 2022: total [national + EU-funded] & (EU-funded in brackets). “T/S/O2” stands for core floats equipped with an additional oxygen sensor (DEEP floats equipped with an oxygen sensors are counted in the DEEP column), and “Bio/BGC” stands for all other floats able to measure other BGC variables.

	Core	T/S/O2	Bio/BGC	DEEP	Total
Nordic	5	2	13	4	24
Med Sea	12	4	3	1	20
Black Sea	1	3	2 (1)	0	6 (1)
Baltic	4	0	2	0	6
Southern	36	0	6	8	50
Arctic	7	0	0	0	7
Global	175	3	34	10	222
Total	183	12	60	23	335 (1)

In addition to data processing, European institutes are continuing **their R&D work for improving data quality**, through the development of new DMQC methods, both for T/S and for BGC parameters. Collaboration at European level is being enhanced and this will continue in the coming years, thanks to work carried out in **Euro-Argo RISE & ENVRI-FAIR projects**. BGC data management is also being organised at European level and this work will continue in 2022. A new EU project will start in 2022 (**FAIR-EASE**) in which Euro-Argo will be funded (150 K€) to develop a BGC data QC workbench that should ease the use of QC tools and methods, in particular for Oxygen, by a wide community.

European Research teams are also involved in **technological activities**, in particular regarding ice avoidance systems and tests of alternative sensors (RBR, TRIOS, etc.), and work carried out in current EU projects also includes **outreach and training activities**, as well as **community strengthening**. In particular, the 7th Argo Science Workshop will be hosted by Euro-Argo in Brussels on 11-13 October 2022.

4. Summary of national research and operational uses of Argo data as well as contributions to Argo Regional Centers. Please also include any links to national program Argo web pages to update links on the AST and AIC websites.

Argo data and/or products derived from Argo data are used by European operational services such as Copernicus Services and ECMWF, for satellite calibration and validation and for research carried on by the Euro-Argo ERIC partners (see national reports for details). Regarding operational services, a **MoU** was signed in 2021 between **Euro-Argo ERIC and Mercator Ocean** in charge of the implementation of

the Copernicus Marine Service to better define areas of collaboration between the two entities, and discussions have started **to better define future collaborations with the Copernicus Climate Change Service and ECMWF** as well.

Within the Euro-Argo RISE EU project, European contribution to Argo ARCs is being reinforced, in particular in the Southern Ocean ARC (see UK national report).

5. 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. Also, during the AST-23 plenary, each national program will be asked to mention a single highlight or issue via a very brief oral report.

Here is a list of several items that Euro-Argo would like to be addressed at AST level:

- Large costs increase on sensors and other float components (expected 5-10%) may have a strong impact on the network implementation, for 2022 and the years to come.
- Increased coordination is needed at basin scale level to take into account the development of all missions and the contribution of DEEP and BGC to the CORE mission. In the context of price increase, this coordination is even more important for an efficient implementation of OneArgo.
- Around 5% of recent European floats are impacted by salty drifts. It is essential to continue to evaluate and monitor the impact in terms of data loss and to extend the monitoring to other sensors.
- The current political situation is impacting the development of Argo in several regions of European interest: Arctic Ocean, Black Sea and Baltic Sea, including delays or cancellation of cruises for deployments.

6. To continue improving the quality and quantity of CTD cruise data being added to the reference database by Argo PIs, it is requested that you include any CTD station data that was taken at the time of float deployments this year. Additionally, please list CTD data (calibrated with bottle data) taken by your country in the past year that may be added to the reference database. These cruises could be ones designated for Argo calibration purposes only or could be cruises that are open to the public. To help CCHDO track down this data, please list the dates of the cruise and the PI to contact about the data.

See national reports.

7. Keeping the Argo bibliography ([Bibliography | Argo \(ucsd.edu\)](#)) up to date and accurate is an important part of the Argo website. This document helps demonstrate the value of Argo and can possibly help countries when applying for continued Argo funding. To help me with this effort,

please include a list of all papers published by scientists within your country in the past year using Argo data, including non-English publications.

There is also the thesis citation list ([Thesis Citations | Argo \(ucsd.edu\)](https://thesis.citations.ucsd.edu/)). If you know of any doctorate theses published in your country that are missing from the list, please let me know. Finally, if you haven't already sent me a list of Argo PIs in your country, please do so to help improve the statistics on how many papers are published including an Argo PI vs no Argo PIs.

The Euro-Argo ERIC maintains a summary of the European bibliography at <https://www.euro-argo.eu/Outreach/Bibliography>. It includes a subsection “Read of the Month” that proposes plain language summaries of scientific publications, one each month, advertised through Twitter. In 2021, the Bibliography section of the website was enhanced with a new presentation of the full Euro-Argo bibliography in a “sortable” table (similar to BGC-Argo bibliography).

8. How has COVID-19 impacted your National Program’s ability to implement Argo in the past year? This can include impacts on deployments, procurements, data processing, budgets, etc.

The COVID-19 impacted Euro-Argo in terms of float and sensor procurement, with delays on manufacturers’ side. In terms of deployments, Euro-Argo caught-up its back logs with about 100 more floats deployed in 2021 compared to 2020. Euro-Argo also contributed with USA and Canada to an Atlantic charter that aimed at filling gaps in the Atlantic Ocean, with a total of 17 European floats deployed this way in 2021.

9. Argo is still interested in piloting the RBR CTD. Does your National Program have any deployment plans for RBR floats in the next couple years? If so, please indicate how many floats will you be buying in 2022 and 2023 (if known) and where they might be deployed.

Europe has been involved in RBR CTD pilot studies, with 3 head-float prototypes (for intercomparison with SBE CTDs) and Arvor-I RBR developed within the Euro-Argo RISE project and successfully deployed in 2020, and 2 more floats equipped with RBR CTDs deployed in 2021. Two ‘2-Headed’ and one ‘3-Headed’ Deep Argo floats (range 4000 m depth) have also been deployed in March 2022 in the Canary basin under the framework of the EA-RISE project, through collaborative work between Ifremer & IEO. Two of the 3 floats are equipped with an RBR argo3 sensor.

Europe will continue to investigate the potential of these new CTD in the coming years, with most of the European partners planning to have part of their fleet equipped with RBR sensors (e.g. UK, Germany, France).