National Report - Europe – AST22

The Euro-Argo Research Infrastructure organizes and federates European contribution 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. Since then membership has grown, and in 2020 the Euro-Argo ERIC involves 13 countries, 11 members, 1 Observer, and 1 Candidate. 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 2020

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 2020, 7 EU-funded floats were deployed: 1 float (T/S/O2) funded under the Euro-Argo ERIC budget, deployed in the South Atlantic, and 6 T/S floats in the framework of the EU H2020 Euro-Argo RISE project in European marginal Seas (2 in the Mediterranean Sea, 2 in the Black Sea and 2 in the Baltic Sea), aiming at evaluating Argo possibilities in shallow water coastal areas. These floats come in addition to the 156 floats deployed by the 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 2020, per parameter measured (blue, 7 first columns) and per type of float (green, 5 last columns).

	T&S	O2	Chla	BBP	NO3	Irradiance	pH	Deep	Bio	BGC	core	**Total (floats)**
EU funded	*7*	*1*	*0*	*0*	*0*	*0*	*0*	*0*	***1***	***0***	***6***	***7***
Member states	156	52	10	9	2	10	4	29	**25**	**5**	**93**	**156**
total	**163**	**53**	**10**	**9**	**2**	**10**	**4**	**29**	**26**	**5**	**93**	**163**

A total of 163 floats have been deployed in 2020, with 70% of them being NKE floats, and 8% with Argos communication (92% Iridium). 7 out of the 163 floats have been recovered, most of them in the marginal seas.

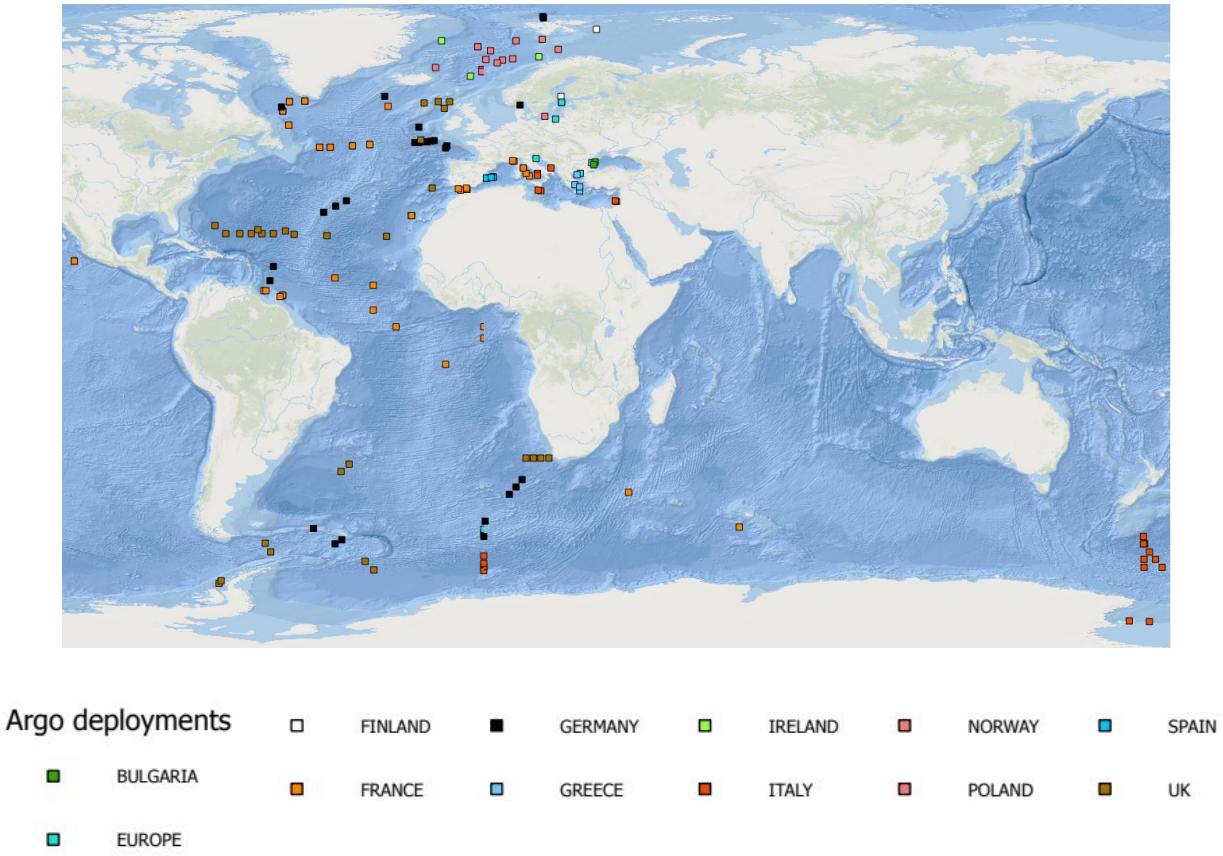

Figure 2. Deployment positions of the European floats deployed in 2020 (Credit OceanOPS)

Figure 3 represents the evolution of Euro-Argo deployments since 2008. The number of floats deployed in 2020 is still low compared to the period 2014-2015. The low values both in 2019 and 2020 are mainly due to delays in deployments by several European partners. Floats not deployed in 2019 were supposed to be deployed in 2020 but this did not happen due to the pandemic situation, when most of the European research vessels were stuck at harbor for nearly 6 months. However, the drop should be compensated by a much higher number of floats to be deployed in 2021 (see section 3).

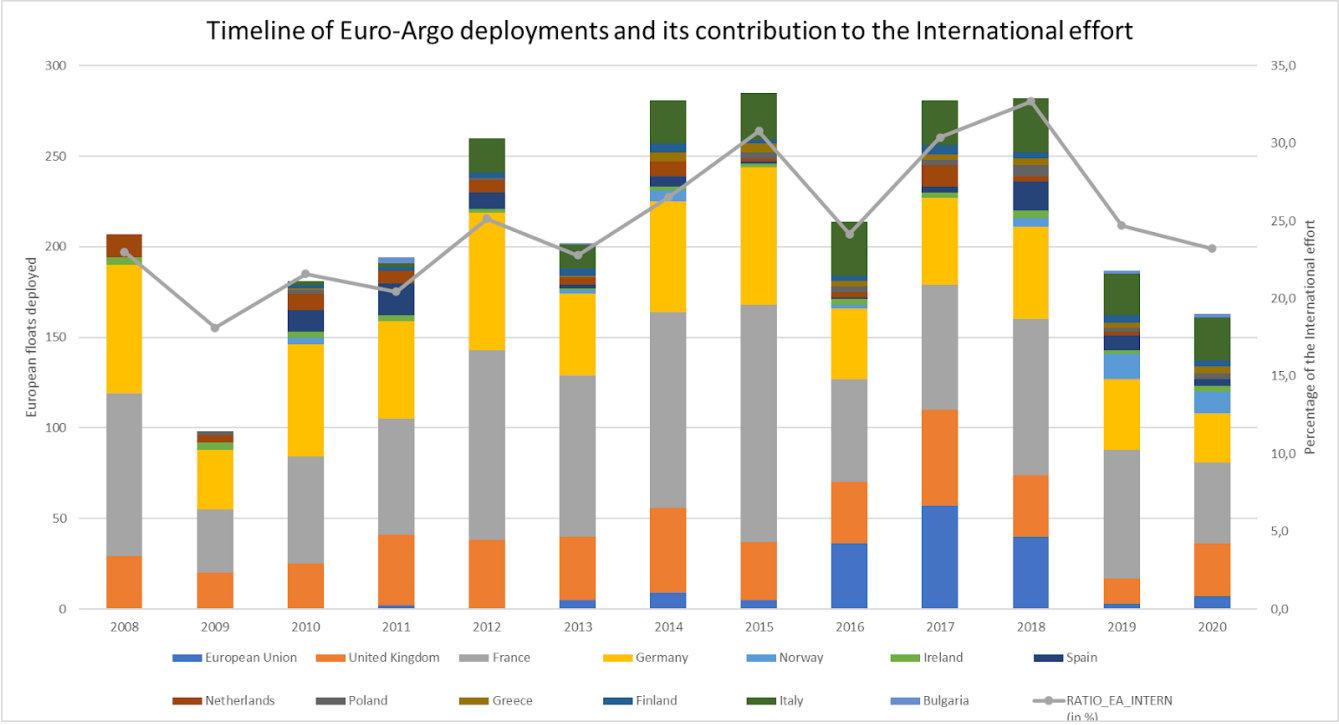

Figure 3. Timeline of Euro-Argo deployments (in number of floats, colored bars, left axis) and its contribution to the international effort (in %, grey line, right axis).

b. technical problems encountered and solved

Out of the 163 floats deployed in 2020, 19 are now inactive. Some of these inactive floats have been recovered, some are currently located under-ice but are expected to surface again in ice-free waters; these are actually not considered to have failed. 3 NOVA floats from Greece have failed right after or a few cycles after deployment. A few floats seem to have failed prematurely, possibly because of grounding. There have been some early losses with the Deep floats (2 ARVOR_D, 2 APEX_D) as well. The other floats have failed without clear explanations.

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 78% and 22% of the global European fleet), and DMQC is currently shared between four institutes (BSH, OGS, Ifremer, BODC).

The European fleet is impacted by the high 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). In the Google spreadsheet maintained by the international WG on this subject, the tab on statistics of the issue for European floats shows that (as

of 12/03/2021) for the 4435 cycles processed for European floats deployed in 2020, 34 had to be corrected and 16 were lost (Figure 4). See German report for more details.

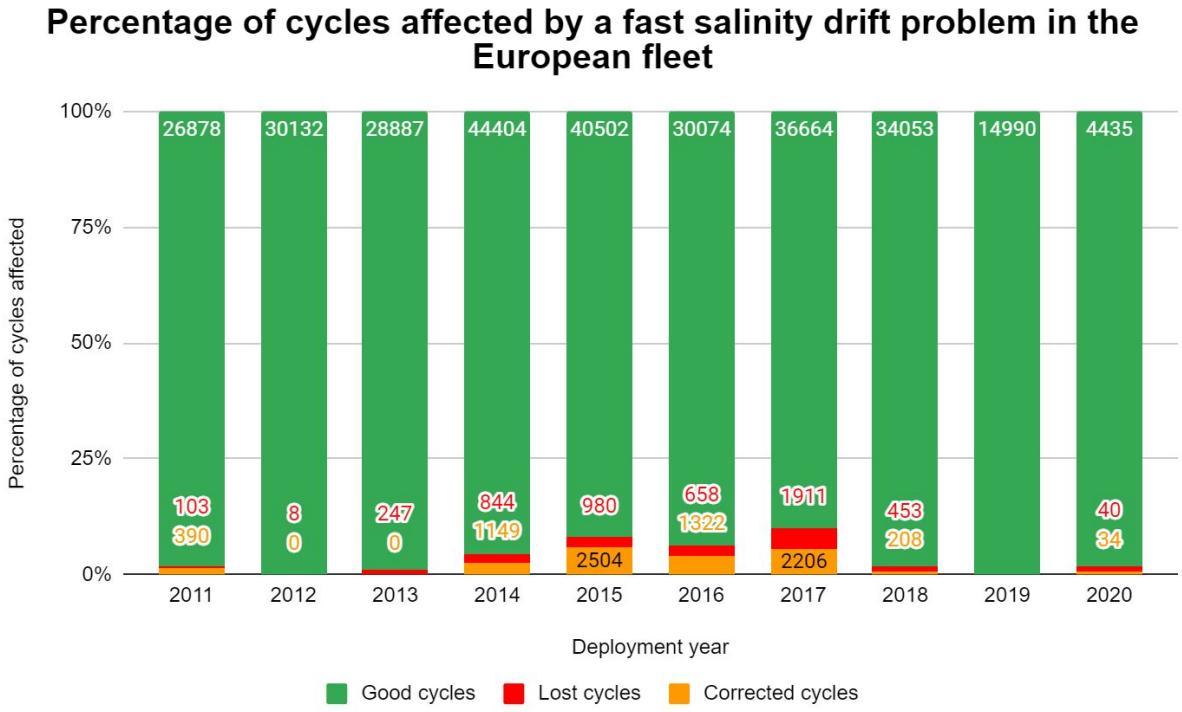

Figure 4. Percentage of cycles affected by fast salinity drift problem in the European fleet

d. status of delayed mode quality control process

The percentage of EU-funded floats processed in Delayed Mode (for floats deployed up to the end of 2020) amongst eligible floats is 80%, and 80% if we consider the whole European fleet (EU-funded + National). On the GDAC, 75% of European profiles are available in Delayed Mode.

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 2020, the Euro-Argo ERIC coordination office was a team of 5 Full Time Equivalent (3.5 permanent and 1.5 project-funded). This team supports European countries to sustain and optimize 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** to be deployed in 2021 as well as the organisation of workshops on Deep and BGC, 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), starting 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 2 BGC floats.

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.

Table 2. European deployment plans for 2021: total [national + EU-funded] & (EU-funded in brackets). "BGC" stands for floats equipped with the sensors able to measure the 6 BGC variables, "T/S/O2" for core floats equipped with an additional oxygen sensor (DEEP floats equipped with an oxygen sensors are counted in the DEEP column) "Bio" stands for other floats equipped with only some of the BGC sensors.

	Core	T/S/O2	Bio	BGC	DEEP	**Total**
Nordic	9	3	3	4	2	**21**
Med Sea	14	6	3	1	2	**26**
Black Sea	1	3	1			**5**
Baltic	1	3	2			**6**
Southern	19					**19**
Arctic		2				**2**
Global	142	15 (10)	11	12 (5)	33 (5)	**213 (20)**
Total	**186**	**32 (10)**	**20**	**17 (5)**	**37 (5)**	**292 (20)**

Float deployments planned for 2021 are presented in Table 2 per region and type of float. In total, Europe plans to deploy 292 floats, including a lot of floats that could not be deployed in 2020 due to the pandemic situation.

In addition to the 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 the coming years.

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. Euro-Argo is for instance developing a Leaflet based on the work of Riser et al. to show the environmental impact of Argo floats (cost/benefits) to be able to communicate on this subject to a wide audience. We have also started to work on a way to promote the new Argo design to policy makers, through an analysis of the impact of the new Argo design on society.

4. **Here is a link to the commitments table at OceanOPS. If you cannot edit the online table, please send a list of deployment plans for each of the columns in the table as needed.**

The commitments table is up-to-date for all the European partners, including the EU-funded floats ("Europe").

5. **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 for operational oceanography within the Copernicus Marine Environment Monitoring Service (http://marine.copernicus.eu/), for satellite calibration and validation and for research carried on by the Euro-Argo ERIC partners (see national reports for details).

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).

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.**

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

- Increase coordination at basin scale level to take into account the development of deep and BGC pilot array and adjust CORE+DEEP+BGC deployment to fill gaps.
- Continue to evaluate the impact of SBE high salty drift failure (data lost, impact on Argo data products).
- Reinforce the links with operational community (ocean and weather forecasting centers) to better assess their needs and difficulties in particular with the development of the One Argo mission

7. **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.

8. **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)). 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. A new subsection "Read of the Month" has been created in 2020 that includes plain language summaries of scientific publications, one each month. Work is foreseen to enhance this section of the website: it is planned to present the bibliography in a "sortable" table (similar to BGC-Argo bibliography) and to advertise European scientific publications related to Argo on a regular basis through Twitter.

9. **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.**

Many cruises have been cancelled or postponed in 2020, which lead to fewer floats deployed (163 in total). However, the floats that could not be deployed will be deployed in 2021 (total 292) and Euro-Argo is also contributing with USA and Canada to an Atlantic charter that aims at filling gaps in the Atlantic Ocean in complement to member states plans.

10. 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 2021 and 2022 (if known) and where they might be deployed.

Europe is 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. The data are being analysed. 2 more floats equipped with RBR CTDs will be deployed in 2021, and Europe will continue to investigate the potential of these new CTD in the coming years. In particular, Germany is conducting a pilot study with 5 floats deployed in early 2021, UK has 3 floats equipped with RBR sensors ready to be deployed, Poland plans to buy one float with an RBR CTD, and France 10% of its core-Argo fleet.