ACTIVITY REPORT 2020

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EUROARGO

EUROPEAN RESEARCH INFRASTRUCTURE CONSORTIUM FOR OBSERVING THE OCEAN

Foreword

Year 2020 will go down in history as a year in which our daily lives were deeply, if not dramatically, affected by the Covid-19 pandemic, which has reminded us all of the value of social contact, care and communication. But we were also able to see science play a central and widely accepted role in the way we humans can deal with a situation like this. So there is hope that evidence and knowledge based action is possible on a global scale.

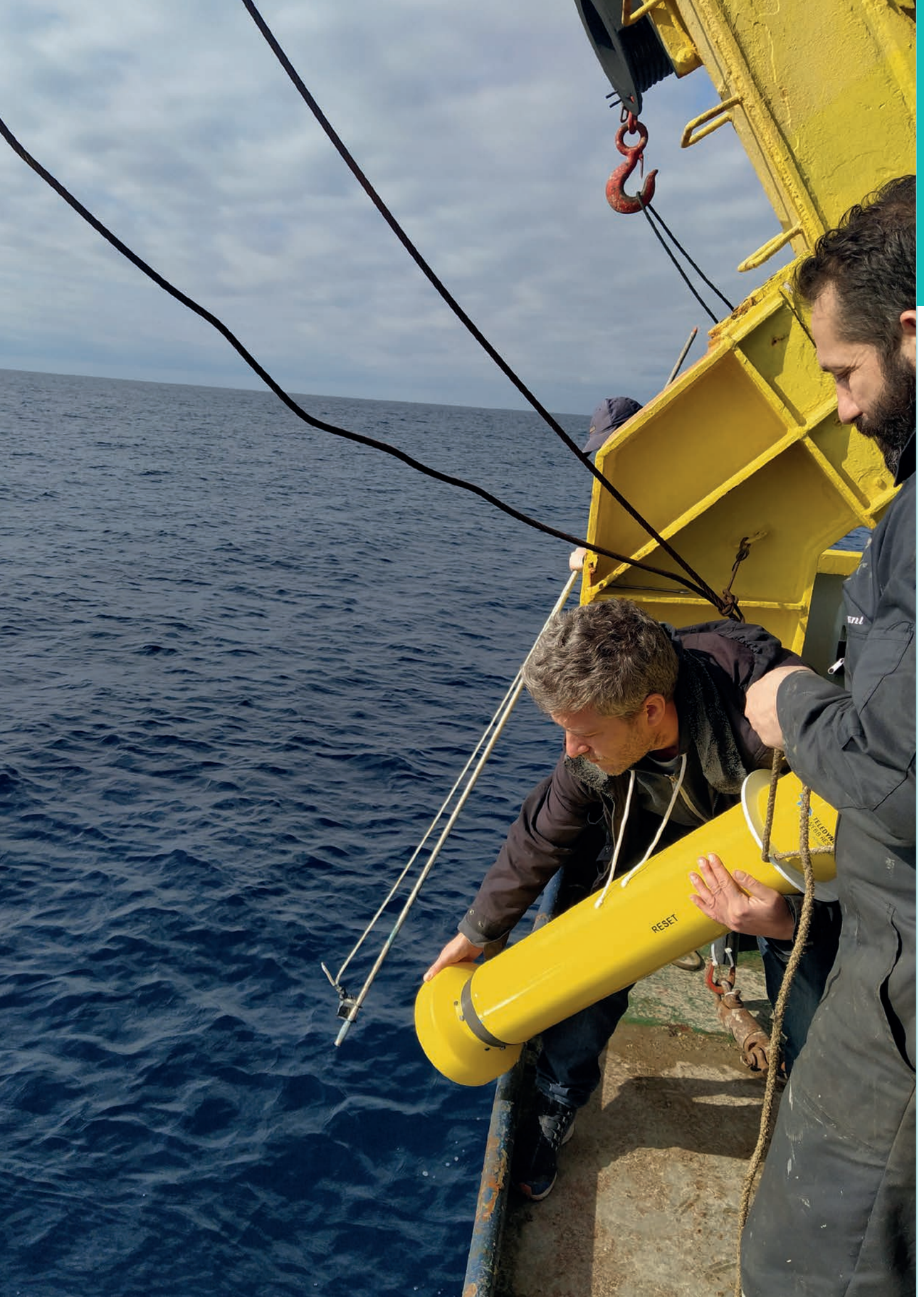
For Euro-Argo this had two consequences. From a strategic point of view, it increases the value of Euro-Argo as a key player in an important component of Earth system observation, that contributes to the evidence needed for a more sustainable use of our planet. From a practical point of view however, it confronted the Euro-Argo ERIC with considerable hardship in executing its planned activities. I invite you to read this 2020 Activity Report to witness the amazing success the Euro-Argo Team has been able to accomplish on all its five main objectives even under the constraints of lockdowns, home office and a temporary reduction of the Office's workforce.

Not surprisingly and similar to elsewhere in the world, the number of float deployments fell short of the plans as a large number of research cruises were cancelled. The deployment rate was further affected by the end of MOCCA and NAOS, two major and very successful EU projects through which part of the array was supported. While in 2020 Euro-Argo still was able to maintain 22.3% of the active global float array, this points at the considerable efforts needed to raise national and European funding to sustain and enhance Europe's contribution to this important global ocean observing system.

Euro-Argo, however, is much more than a float deployment organization. Through its manifold activities, its involvement in a suite of EU-funded projects, its interaction with the national Argo networks, the European DACs, float and sensor manufacturers, stakeholders and the general public, Euro-Argo advances the float observatory in multiple ways. This among other activities has contributed to facilitate float procurement, to diversify the landscape of sensor manufacturers, to improve float performance in ice-covered and coastal regions, to enhance data management and quality control routines particularly for biogeochemical sensors, to ease Argo data access, to integrate and collaborate with other European research infrastructures, and – last but not least – to inform public audiences in many ways about the value and excitement of ocean research with profiling floats.

I would like to take this opportunity to applaud the Euro-Argo ERIC office for its dedicated performance and wish the team continued success and good spirit in this troubled time.

Arne Körtzinger, Chair of Euro-Argo Scientific and Technical Advisory Group



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Executive summary

2020 was an unusual year marked by the COVID-19 global pandemic. Despite this tricky situation, everybody did their best to progress towards the objectives of the five-year plan (2019-2023), elaborated jointly by the ERIC Office and Euro-Argo Members and Observers, and published in December 2019. Although there were delays in deployments due to research vessels being locked down at port for nearly six months, the Euro-Argo ERIC managed to progress on the target fixed for 2020, through a collective European effort.

Euro-Argo's five objectives are:
1. Sustain the existing Core Argo mission;
2. Develop the extension of Euro-Argo as a contribution to the "Global, full-depth and multidisciplinary Argo" design;
3. Develop scientific and technological coordination and contribute to a Global Ocean Observing System (GOOS) design and its European contribution through European Ocean Observing System (EOOS) initiative;
4. Develop the engagement with European Argo user communities and stakeholders and reinforce Euro-Argo visibility;
5. Operate the Euro-Argo ERIC Office under good governance.

The European contribution to the active float network remained at about 22% (similar to 2019).

Implementation of the five-year plan continued through European and national projects. In particular, the Euro-Argo ERIC was involved in key European projects (ENVRI-FAIR, EuroSea and ERIC-Forum) and the Euro-Argo Office coordinated the MOCCA and Euro-Argo RISE projects.
This year the ERIC Office team welcomed the arrival of Luca Arduini Plaisant, involved in float technical activities and Euro-Argo RISE and EuroSea projects. The ERIC Office also experienced a reduction of the Office staff (due to the absence of three people at various times of the year) that generated overload on the rest of the team and the necessity to delay some activities. The Euro-Argo ERIC Office wished all the best to Grigor Obolensky who moved on to new horizons after six years of work at the Office.
As a contribution to the Argo network, the total number of 163 floats deployed by the Members and the ERIC in 2020, was below the target because of Research Vessels were locked down in port for nearly six months. Because the pandemic impacted vessel operations throughout the world, the European contribution to the active float network remained at about 22% (similar to 2019). The delays should be recovered in 2021 unless the pandemic situation deteriorates again. Enhancement of the BGC and Deep floats extensions also continued in 2020. 57 BGC floats with at least an oxygen sensor were deployed in 2020 by European partners. In 2020, there were 158 active EU BGC floats, representing 42% of the international effort.
In 2020, despite the fact that both BODC and Coriolis/Ifremer DAC and GDAC were operated remotely, most of the data was processed in less that 12 hours from acquisition and the GDAC presented a high level of reliability, close to 99,99%. 62,326 Argo data profiles were processed by the two European DACs. Nearly 75% of the European floats were scientifically assessed to reach the accuracy needed for climate applications.

In addition to the data processing itself, both Coriolis/Ifremer and BODC were able to make progress in different aspects of Argo data management, in the framework of the Euro-Argo RISE and ENVRI-FAIR EU projects:
– Enhancement of the FAIRness of Argo data system with the establishment of an Argo Vocabulary using BODC Vocab server and development of Argo FAIR services on Coriolis GDAC;
– Development of quality control (Real-Time (RT) and Delayed-Mode (DM)) for BGC Argo with first proposal shared with Argo international, and submission of DM data for some European BGC floats;
– Reinforcement of collaborative Euro-Argo framework with new tools and "Best Practices" shared among the community and with Argo International.
The MOCCA and Euro-Argo RISE projects, coordinated by the ERIC Office, were important projects as they supported and fostered the infrastructure development. In 2020, the MOCCA project ended and a video and a brochure were issued for the final meeting with DG-MARE which was organised as a video conference involving the Council members. The main achievements were highlighted and the need for further support from European Commision for the development of the extension of Argo to the abyss, high-latitudes and Marginal Seas as well as to ecosystem monitoring.
Euro-Argo RISE project reached its mid-point end in 2020 with all work on schedule. It's a multi-dimensional project for the development of the Euro-Argo ERIC five-year plan work, as it contributes to all the objectives. In 2020, 11 deliverables and five milestones due by the end of 2020 were released (out of 63 deliverables in total). The OceanObservers workshop was postponed until 2021 due to COVID-19, as more time was needed to organise community building workshops remotely. The first 18-month report was accepted and significant developments were achieved regarding: technology, data management, networking, outreach, training and engagement with stakeholders.

Euro-Argo RISE reached its mid-point in 2020 and is progressing as planned. It's a multi-dimensional project for the development of the Euro-Argo ERIC five-year plan work.

Activities aimed at increasing Euro-Argo visibility were pursued in 2020, through 38 news items published throughout the year on the Euro-Argo website and four videos on the new Euro-Argo YouTube channel. The Twitter account continued to gain new followers, exceeding the 1000 follower mark (reaching 1182 followers at the end of the year, i.e. an increase of 609). A new corporate identity was introduced on social media, newsbriefs and website to reinforce Euro-Argo ERIC brand image.

In relation to the projects MOCCA, AtlantOS, and ENVRIplus the expenditure was in line with budget projections and the justified financial claims were received in the second half of 2020. The payment for the first reporting period for Euro-Argo-RISE, ENVRI-FAIR and ERIC-Forum were also received as planned. In 2020, Euro-Argo continued seeking additional funds, submitting several proposals in response to H2020 calls issued by the European Commission. The DOORs proposal involving Bulgarian partners was successful. This year's report highlights three scientific papers published in 2020 in which Argo data play a critical role: the study of Adrian Martin et al. (2020) on the oceans' twilight zone and two publications about the NAOS project scientific and technological achievements by Pierre-Yves Le Traon et al. and Xavier André et al.

1 FIVE-YEAR PLAN OBJECTIVES

Over the past six years, the Euro-Argo ERIC has demonstrated its ability to develop and manage the European contribution to the international Argo programme. Many activities and services have been implemented and need to be continued through the next phase of Argo. Committing to the Euro-Argo ERIC five-year plan (2019-2023) will ensure programme sustainability.

▸ *See the full five-year plan on https://doi.org/10.13155/71936*

The five-year plan articulated five objectives against which its achievements will be measured in the coming years. The challenges of this next phase are multiple:

- Core Argo activities need to be maintained.
- Extensions towards the "Global, full-depth and multidisciplinary Argo missions" need to be further developed in a sustainable way.
- Engagement with existing and new end-users is necessary to meet societal needs. Euro-Argo is not alone and must evolve within a landscape of complementary Research Infrastructures (RIs). The development of an integrated ocean observing system is being pursued by various observation coordination bodies (Goos at global level, AtlantOS and SOOS at basin levels, EOOS at European scale) in their respective strategies as a contribution to the UN Decade of Ocean Science for Sustainable Development. Euro-Argo must contribute to this landscape to complement the other observation networks as efficiently as possible.

To face these challenges, the five Euro-Argo objectives are interconnected and many partners are involved → **Figure 1**.

This report describes the activities carried out by the Euro-Argo ERIC with respect to the five objectives.

THE FIVE OBJECTIVES OF THE 2019-2023 FIVE-YEAR PLAN

Objective 1	Objective 2	Objective 3	Objective 4	Objective 5
Sustain the existing Core Argo mission.	**Develop the extension of Euro-Argo contribution to Argo according to the Euro-Argo** strategy as a contribution to the "Global, full-depth and multidisciplinary Argo" design.	**Develop scientific and technological coordination** with other ocean observing networks and contribute to a Global Ocean Observing System (GOOS) design and its European contribution through European Ocean Observing System (EOOS) initiative.	**Develop the engagement with European Argo user communities and stakeholders and reinforce Euro-Argo visibility.**	**Operate the Euro-Argo ERIC Office** under good governance.

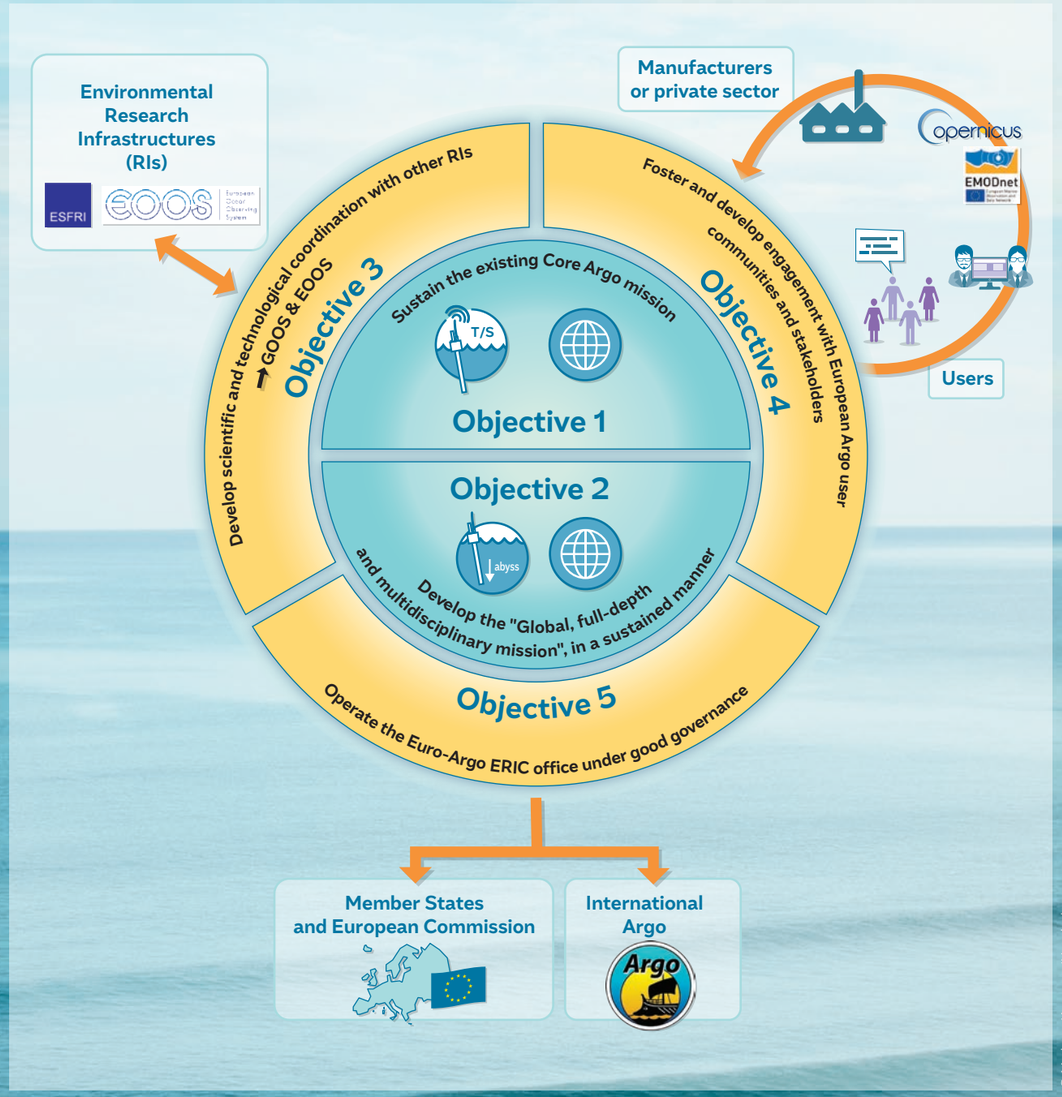

Figure 1: The five objectives of the five-year plan and the involved partners.

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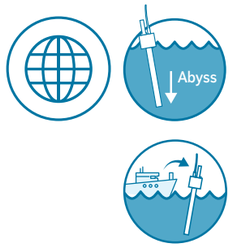
2 REVIEW OF 2020 ACTIVITIES

2020 was marked by the COVID 19 pandemic: the number of deployments was lower than in previous years, notably because many campaigns were postponed to 2021. Nevertheless, the Euro-Argo Office and the 12 national Members continued their efforts to continue their activities, in line with the five objectives of the five-year plan.

Objective 1

Objective 2



SUSTAIN THE EXISTING CORE ARGO MISSION AND EXTEND THE EURO-ARGO CONTRIBUTION TO THE "GLOBAL, FULL-DEPTH AND MULTIDISCIPLINARY ARGO" DESIGN

Network implementation

→ 2020 float deployments

In 2020 Euro-Argo deployed 163 floats. → Table 1 shows the distribution of 2020 floats deployments by basins, by parameters measured (in orange) and types of floats (in blue). Numbers are compared to the targets in the two lasts rows. Where the target was reached, the number of floats above this target is indicated in a green cell. The geographical distribution of deployments is also shown, → see Figure 3 p. 11. The objective is to annually deploy 350 floats within 10 years, gradually increasing from 250 to 350 and integrating the new design (50 BGC and 50 Deep floats per year).

Number of floats	Variables							Float types				
	T/S	O_2	Chla	suspended particles	Nitrate	downwelling irradiance	pH	Core	BGC	BIO	Deep	Total
Nordic Seas	17	6	6	6	1	6	1	6	1	6	4	17
Mediterranean Sea	26	4	1	1	0	1	0	22	1	3	0	26
Black Sea	4	1	0	0	0	0	0	3	0	1	0	4
Baltic Sea	5	2	0	0	0	0	0	2	0	2	na	5
Southern Ocean	14	1	0	0	0	0	0	14	0	1	0	14
Arctic Ocean	3	1	1	1	1	1	0	2	0	1	na	3
Global Ocean without the specific regions above	94	39	3	2	1	3	3	43	3	13	25	94
Total	**163**	**53**	**10**	**9**	**2**	**10**	**4**	**93**	**5**	**26**	**29**	**163**
Target	350	175	50	50	50	50	50	250	50		50	350
GAP	- 187	- 122	- 40	- 41	- 48	- 40	- 46	- 157	19		- 21	- 187

Table 1: Euro-Argo float deployments in 2020, by variables measured (orange) and float types (blue). BGC stands for Biogeochemical floats (6 variables) & BIO stands for all Biogeochemical floats with only 1 to 5 variables. Cells in green show where the target is reached.

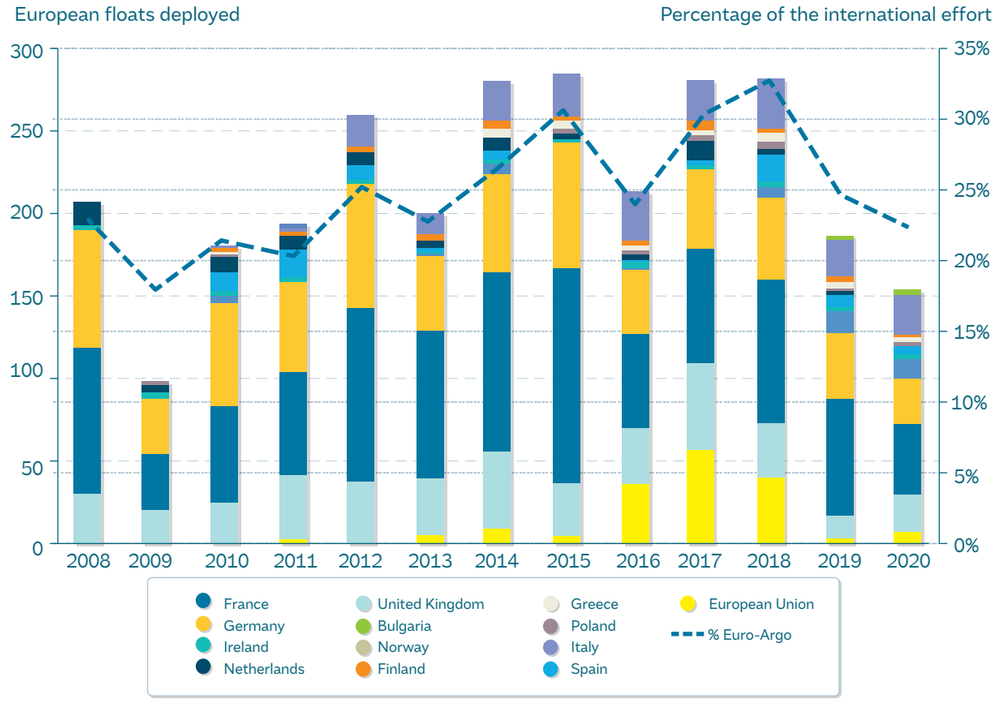


Figure 2: Timeline of European Argo float deployments showing the evolution of European float deployments in float number (colors, left axis) and as a percentage of the international effort (blue dashed line, right axis). © OceanOPS/AIC

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The number of floats deployed in 2020 was lower than the number of floats deployed in any of the previous 10 years → **Figure 2** – still representing 23% of the global effort – mainly due to the pandemic and due to the fact that two significant European projects, MOCCA, → **see p. 34** and NAOS, ended in mid 2020. This highlights the need to obtain new funding, through both national partners' contribution and direct European Union funding, to implement the new Argo mission. This new phase of Argo relies on BGC and Deep floats, which are more expensive than the Core mission and is forecast to double the total cost for the same number of floats.

The → **Figure 3** shows the locations of 2020 deployments.

Float deployments in 2020.

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Float deployments in 2020

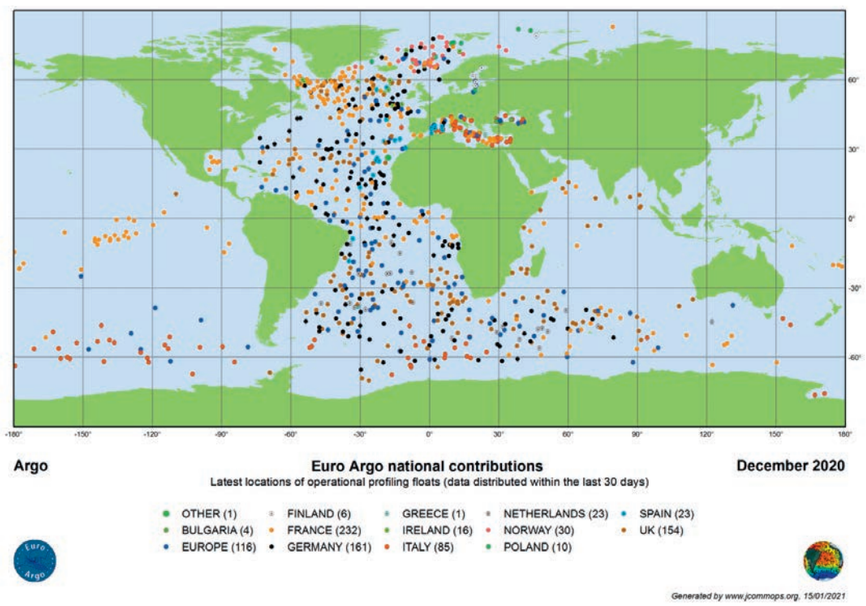

Figure 3: Argo 2020 deployments: 163 Euro-Argo floats among the 692 deployed in 2020, representing 23% of the deployments. © OceanOPS/AIC

© Massimo Pacciaroni/OGS

→ 2020 float procurements

Since 2017 a service for float procurement was available for Euro-Argo partners. This concerns standard Temperature and Salinity (T/S) Core Argo floats, as well as Deep and BGC floats. Options for Dissolved Oxygen (DO) measurements and Ice Sensing Algorithm (ISA) for deployments in high-latitude regions are also available. Arising from calls for tenders in 2016 and 2017, nke Instrumentation were awarded multi-annual float procurement contracts.

In 2020 a multi-annual contract was awarded to SeaBird Scientific Inc., for the supply of BGC sensors. This made possible the purchase of sensors to measure nitrate, chlorophyll-a concentration, backscattering coefficient, radiometry and colored dissolved organic matter (CDOM) concentration. Sensors have been purchased for the BGC floats of the H2020 EuroSea project, as well as for Norway.

For floats purchased through this service, Euro-Argo Office technical team offered to handle for Members to deal with the inbound logistics (follow-up of the manufacturing process, delivery dates, coordination of the telecommunication, contracts opening etc.), to handle the acceptance tests in the Ifremer testing facilities (seawater basin for real profiling down to 20 meters, hyperbaric chamber for the Deep floats) and finally to ship the equipment either to the purchasing institutes, or directly to the deployment vessels. Assistance with the handling of float metadata for the data centres, as well as "at-sea monitoring" is also offered.

The details of the 22 floats purchased in 2020, for four countries and a total of about €600,000 are provided below in → **Table 2**.

COUNTRY	Number of floats					
	Total	Core	Core + DO	DEEP + DO	BGC 6 variables	BGC 4 variables
NORWAY	11	2	2	2	2	3
NETHERLANDS	5	5				
SPAIN	3	3				
BULGARIA	3		3			
Total	22 floats (~625 k€)	10	5	2	2	3

Table 2: ERIC float procurement in 2020 (by country and float types), on behalf of Euro-Argo Members.

Technical developments

→ Diversifying providers to secure sensor provision in order to sustain and expand the network

2020 was a fruitful year in terms of technical developments: within Euro-Argo RISE project, several tasks aimed at testing alternative sensors for the Core, the Deep and the BGC Argo missions were completed.

For the Core, after the 2019 preparatory work, Ifremer and nke Instrumentation jointly developed the Arvor-I profiling float equipped with an RBRargo3 CTD. A series of tests for float qualification in lab, hyperbaric chamber and test pool were successfully made by Ifremer in mid-June, allowing the floats to be prepared for at-sea deployments. Two Arvor-I fitted with RBR CTDs were deployed by Ifremer in the Canary Basin during the RAPROCAN2012 campaign, in December 2020, in collaboration with IEO. The data from the two deployed floats will be processed for analysis and will be compared to an Arvor-I fitted with SBE41 CTD, deployed at the same location by Argo-France.

For the Deep mission, work also progressed within Euro-Argo RISE to compare the different sensors accuracy/stability to monitor the abyssal ocean. To that end, Ifremer developed two 3-headed Deep-Arvor profiling floats fitted with the RBR Concerto, SBE41 and SBE61 sensors, to allow an *in situ* intercomparison between them. After a software integration step, the qualification process of the 3-head floats was successfully completed in the seawater test pool at Ifremer facilities, in November 2020. Thanks to a fruitful collaboration with IEO, these floats were deployed in December 2020 during the RAPROCAN2012 cruise in the Canary Basin. Parallel work also started on the 2-headed floats, fitted with the final design of the RBR sensor and the SBE61 sensor on the flank and will continue in 2021.

Testing low-cost sensors for BGC also progressed in the frame of Euro-Argo RISE. The data of the first dual sensor prototype for nitrate (Opus from TriOS GmbH and Suna from SeaBird), developed and tested in 2019 by LOV, were processed. At this stage, results in terms of accuracy and precision of the nitrate retrieval for Opus sensor, as defined by the BGC Argo planning group, do not have the required maturity yet for being implemented for an

Euro-Argo RISE scientific and technical teams from Ifremer for the 3-headed Deep-Arvor profiling float.

© Xavier André/Ifremer

© Xavier André/Ifremer

Romain Cancouët from the Euro-Argo ERIC Office testing a profiling float at Ifremer facility.

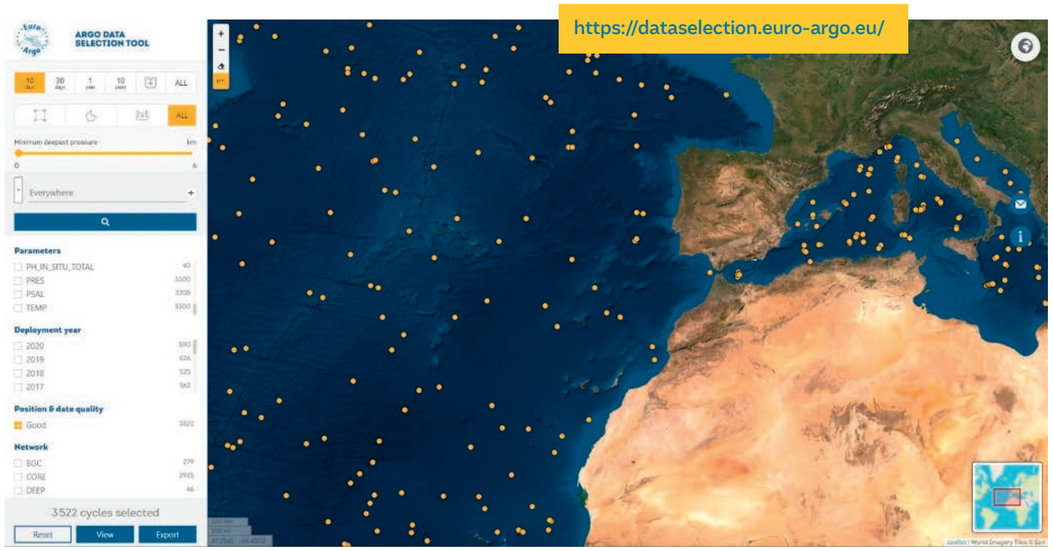

Figure 4: Landing page of the new Argo data selection tool, allowing a search of Argo float profiles on different fields (left panel) such as temporal, geographic selection or with predefined indexes (measured parameters, deployment year etc.). **https://dataselection.euro-argo.eu/**

operational deployment. Further technical work with the manufacturer will continue outside the project.

The second prototype tested by LOV, a dual sensor float for irradiance, consisted in an OCR sensor from SeaBird and a Ramses sensor from TriOS GmbH, specially modified for float applications. After successful software integration on the new profiler Provor CTS5 by LOV, technological tests carried out on a bench and with the final profiler at the end of 2020, demonstrated the good performance of the prototype. The irradiance dual sensor prototype is now ready for a scientific experiment in the Baltic Sea in 2021.

→ Data selection tool

The new Argo data selection tool developed by Ifremer → **Figure 4** in Euro-Argo RISE and ENVRI-FAIR projects will ease access to Argo data. This update of the previous tool available at the Argo Data Management website will allow users to select, visualise and download Argo scientific data. The beta-version was presented during the 21st Argo Data Management Team meeting (ADMT, online event) by Euro-Argo ERIC and the official release is planned in 2021.

→ Ice Sensing Algorithms

To better define the Ice Avoidance Algorithms thresholds to be implemented in floats software, the reference dataset in the Arctic built by BSH was complemented with new data from ICES and IOPAN (AREX cruises). This dataset will also benefit from the experience gained from deployments of floats by BSH, IMR and FMI in these areas. Parallel work on a reference dataset is ongoing for the Antarctic and should help to assess the quality of the regional data in the Southern Ocean, a dedicated task within Euro-Argo RISE project WP5.

→ Test Argo into shallow coastal waters

As part of the Euro-Argo RISE project, six floats were deployed in the European Marginal Seas in 2020, in addition to the two 2019 floats. This led to a total of four floats in the Mediterranean Sea, two in the Baltic Sea and two in the Black Sea. By testing different float configurations on targeted shallow areas, HCMR, SOCIB, SU, OGS, FMI, IOPAN and IOBAS aim to highlight the importance of Argo expansion in the shallow coastal areas and develop a common European strategy.

→ Rescue device for float recovery in shallow waters

Increasingly, Argo floats operate in shallow and enclosed seas. The experience from the Baltic Sea showed that the recovery of floats, maintenance and re-launching can be cost effective. Floats in shallow waters are more likely to be trapped in the bottom or in fishing nets. That is why IOPAN, in cooperation with the Polish Naval Academy, worked on a device to throw off the ballast when the float sticks to the bottom. This provides additional buoyancy that allows the float to reach the surface. The prototype tests were successful and further work is planned. The device can be useful especially for expensive BGC floats.

© Stéphane Lesbats/Ifremer

→ Improving fleet monitoring

Luca Arduini Plaisant joined the Euro-Argo Office team in August 2020 to contribute to the Euro-Argo RISE and EuroSea projects activities, and work on the continuous monitoring of the European fleet, the logistics of floats' deployments and tests.

Gathering the inputs from DMQC operators, Luca made an audit to flag all the floats affected by a fast salinity drift problem. These floats were registered on a specific list to inform users of their sensor failures.

Luca also developed methods to monitor life expectancy of floats. This work took place in the frame of the Euro-Argo RISE project, task 2.1, led by the ERIC Office and was carried on from the materials and scripts elaborated by Andrea García Juan in 2019-2020.

The aim of this study was to provide new tools to describe the fleet configuration status and estimate life expectancy. To this end, several key points were investigated, such as the impacts of:

– float's configurations on its lifetime: testing if specific configurations had a lower long term battery consumption that others;

– key indicators on European fleet survival rates (according to float models, deployment years or sea basin);

– grounded cycles on a float energy budget → **Figure 5**.

Audits on float's recoveries and causes of death are underway to provide better estimations of the survival rate of the European network. All the materials and scripts used to provide these results are now available for the Argo community on the Euro-Argo collaborative framework on Github.

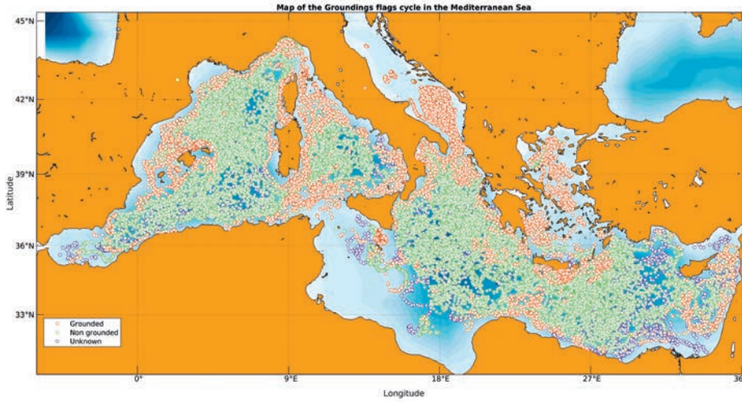

Figure 5: Grounding flags geographic repartition in the Mediterranean Sea.

Members specific contributions through projects

→ Argo France

As part of the ERC project REFINE (Robots Explore the plankton-driven Fluxes in the marine twilight zoNE), the development of an upgraded version of BGC Argo floats was undertaken with two main objectives:
– this float should have a life-time of at least five years, while being compliant with Core Argo standard cycling.
– the float should be able to accommodate additional sensors or application to progressively evolve towards a platform dedicated to the monitoring of phyto and zooplankton communities and their impact on the biological carbon pump.
In partnership with nke Instrumentation a float called JUMBO CTS5-Usea was developed. This float carries an Underwater Vision profiler (UVP, imager for particles and zooplankton), a two-wavelength fluorometer (phytoplankton communities) and a transmissiometer (phytoplankton communities and biological carbon pump).

In 2020, Argo-France submitted the Argo-2030 proposal to a French call for supporting structuring equipment for research. This project called PIA3 was successfully evaluated and will be funded over the period 2021-2028. Argo-2030 proposes to acquire 15 BGC-Argo floats to consolidate France's contribution to BGC-Argo and enable the country to fulfil its international commitment. Argo-2030 also proposes to prepare Argo's next phase by testing and validating a second generation of BGC and Deep-Argo floats that will dramatically increase the network's scientific potential. For the latter objective, Argo-2030 aims to acquire 14 BGC-ECO-Argo floats and 22 Deep-6000 floats. The BGC-ECO-Argo floats will be BGC Argo floats equipped with ecological sensors to observe marine ecosystems. The Deep-6000 floats will reinforce the Argo array by sampling abyssal layers, and by providing deep biogeochemistry observations thanks to oxygen sensors. These innovative Argo-2030 floats will revolutionize ocean sciences by improving the current chronic undersampling of marine ecosystems and abyssal layers.
The BGC-ECO and Deep-6000 will be developed as part of an Ifremer PIANO project (PI G. Maze, 2021-2025). In particular, PIANO will develop a low-power active high-frequency micro-echo sounder (μ-ES) to detect plankton and micronekton (2–20 cm) as well as marine snow (1 mm–30 cm). The BGC-ECO floats will be equipped with such sensors.
PIANO will also develop new sensors to substitute standard BGC-Argo sensors (fluorometer, backscatterometer, and irradiance sensors, SeaBird-WET Labs) with more competitive improved sensors developed by French companies.

→ Argo Germany

DArgo2025 is a joint project of BSH, GEOMAR, ICBM and IOW and was funded by the Federal Ministry of Science (BMBF) for the period 8/2020-12/2021. It is providing support for the implementation of the new multisdisciplinary Argo strategy. The 20 floats funded in the project will be used to address technological questions and aim at testing new sensors on floats. The tests comprise RBR CTDs, nitrate sensors from TRIOS and hyperspectral radiometers from TRIOS. First deployments have already been performed for five floats with RBR CTDs in the Northeast Atlantic and a float with dual nitrate sensors in the Baltic.

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Data management

Europe hosts one of the two Argo Global Data Assembly Centres (GDAC): Coriolis/Ifremer in France; and two of the eleven Argo Data Assembly Centres (DAC): Coriolis/Ifremer, and BODC in the UK. In 2020, 62 326 Argo data profiles have been processed by these two centres → **Figure 6**. Delayed Mode Quality Control (DMQC) of the European floats are performed by European institutes and nearly 75% of the European floats have been scientifically assessed to reach the accuracy needed for climate applications.
In addition to the data processing itself, European partners made progress in different aspects of Argo data management in the framework of the MOCCA, Euro-Argo RISE and ENVRI-FAIR EU projects. These efforts were presented to the international community at last Argo Data Management Team meeting (AMDT) in November 2020:
– Python conversion of the OWC toolbox used for temperature and salinity DMQC, started with MOCCA project and continued within Euro-Argo RISE project (BODC);
– release of a new version (v3) of the Matlab OWC software for salinity DMQC (Ifremer);
– continuation of the work started in 2019 within ENVRI-FAIR project at BODC to use the NERC Vocabulary Server (NVS) to provide Machine readable access to all the Argo reference tables described in the Argo User's Manual;
– French GDAC web services and new viewing service: Euro-Argo data selection tool developed within Euro-Argo RISE and ENVRI-FAIR projects (Ifremer & Euro-Argo ERIC);
– further development of the Euro-Argo-dev collaborative framework (on GitHub) set up in Euro-Argo RISE project in 2019 (Ifremer and all European partners involved in Euro-Argo RISE WP2) and opening to the international community. The framework includes sections dedicated to help DMQC operators (DMQC report template, software, DMQC cookbook);
– development of monitoring tools and DMQC procedures for BGC variables as part of Euro-Argo RISE project, in particular for radiometry, nitrate and backscattering (SU-LOV, PML);
– development of a unified reference database for the DMQC of BGC parameters.
In 2020, European partners were also strongly involved in international working groups around several issues related to Argo data management and quality control:
– high salty drifts (how to monitor the issue and correct the data – BSH/Ifremer/OGS/BODC),
– Deep Argo data flags and correction of the pressure effect on salinity computation, in real time and delayed mode (Ifremer/BODC);
– how to better collaborate between the 11 DACs, and within Argo Regional Centres (ARCs, BODC).

KPIs regarding floats and data processing

→ Number of Argo profiles

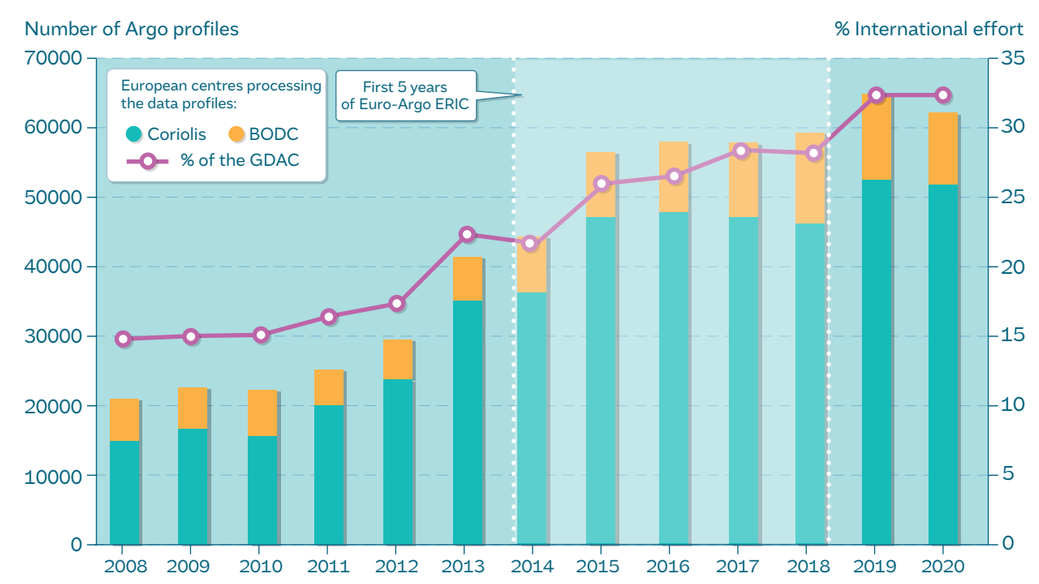


Figure 6: Argo data profiles available on Coriolis and BODC DACs: in number of profiles (left axis, blue: Coriolis and orange: BODC) and in percentage of the total number of profiles available on the GDAC (right axis).

→ Number of operational floats

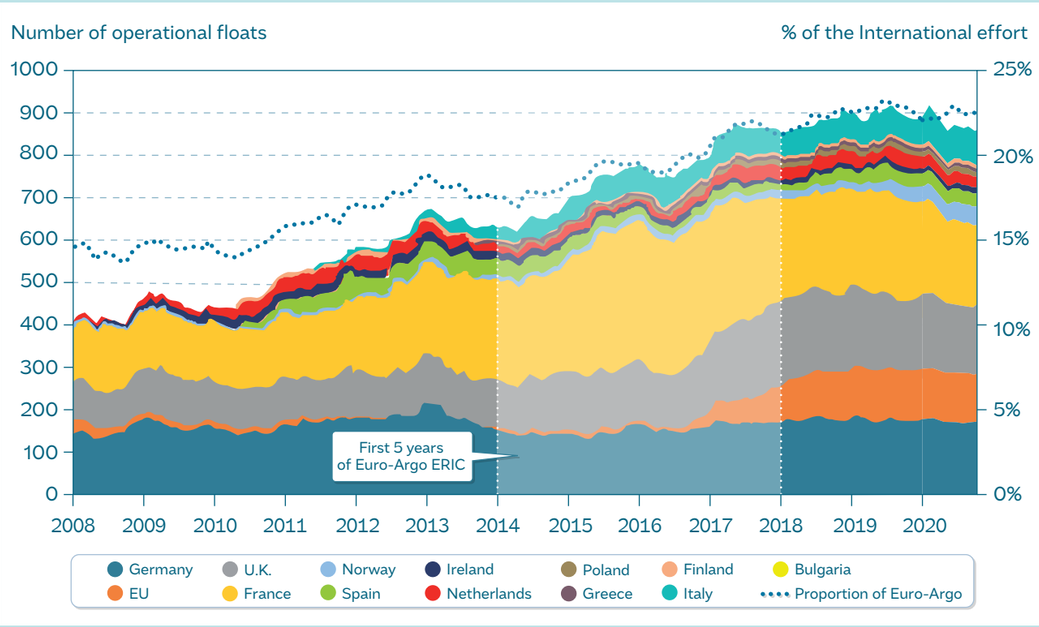


Figure 7: Evolution of the European contribution to the Argo network in number of operational floats (colour, left axis) and in percentage of the international effort (blue dashed line, right axis). © OceanOPS/AIC

→ Euro-Argo implementation of Argo Core, BGC and Deep extensions

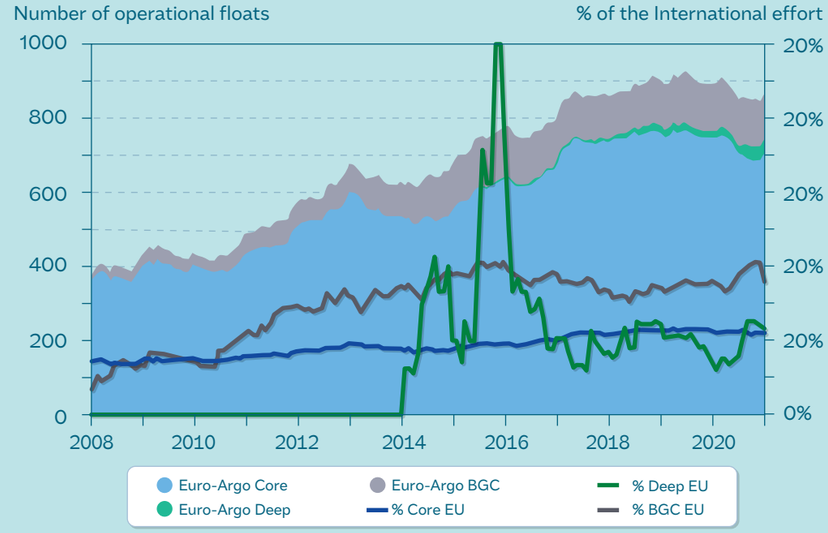


Figure 8: Evolution of the Core (T&S), BGC and Deep floats, in number of operational floats (colour, left axis) and in percentage of the international effort (blue, grey and green lines, right axis). © OceanOPS/AIC

→ Number of floats reaching the 50 or 100 cycles target

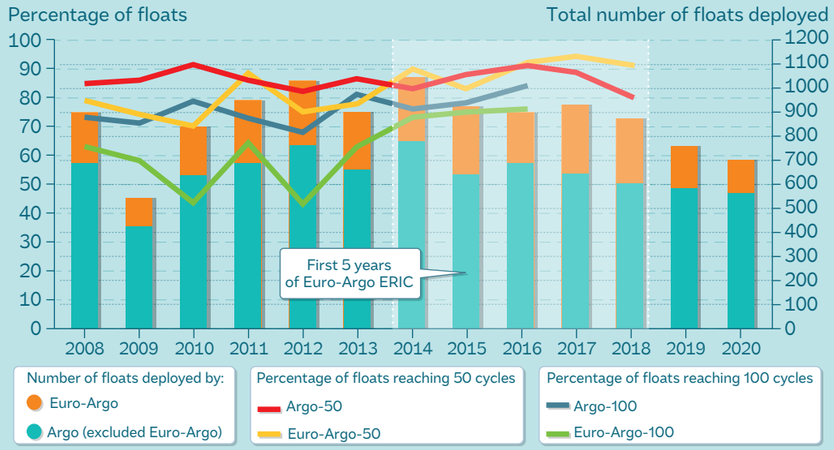


Figure 9: Percentage of floats reaching the 50 or 100 cycles target compared to the Argo fleet (coloured lines, left axis) and total number of floats deployed (right axis). After the MOCCA project, the deployment rate of Euro-Argo floats decreased to around 25% (compared to 30% in 2017 and 2018), close to that of operational floats. © OceanOPS/AIC

→ Number of floats per manufacturer

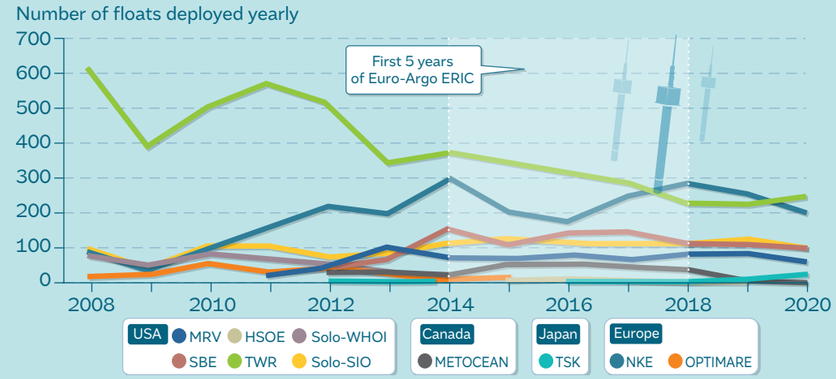


Figure 10: Evolution of number of floats deployed per year, grouped by float manufacturer. © OceanOPS/AIC

© Nattanan Kanchanaprat/Pixabay.jpg

ECONOMIC IMPACTS OF THE NEW ARGO MISSION

The Argo programme plays a key role in climate change and environmental research. The long-term socio-economic impacts of this international effort to better observe the ocean are therefore expected to be large. Now that the programme is moving into its new mission, it seems important to consider its impacts and some concrete socio-economic indicators, to better convince stakeholders of its crucial interest.

Ocean monitoring: a critical value-added chain for decision making

The new "global, full-depth and multi-disciplinary Argo" design (Roemmich et al. 2019) consists of significantly increasing the number of ocean measurements, as well as their coverage and diversity. Increased measurements, and with more accuracy, will reduce uncertainties in scientific models predicting future ocean behaviour, both at global and regional scale. Argo's socio-economic impacts therefore extend to the wide range of ocean services. Ocean and marine ecosystems provide a range of valuable services to humans, including benefits such as carbon sequestration – better assessed thanks to Biogeochemical (BGC) Argo floats data – or mitigation of sea level rise – better assessed thanks to Deep Argo floats data. All these scientific topics can also be associated with risks and related costs → see the Table "Risks and economic impacts of science assessed by BGC and Deep Argo" in Annex 1 p. 44. These negative or positive economic impacts are still poorly understood and need to be further investigated in the future.

Improvements in marine data quality and marine data coverage enabled by the new Argo mission will help establish advanced science-based evidence and address knowledge gaps. They will therefore efficiently guide policy formulation and implementation for the future, reducing costs for private and public actors.

Nevertheless, publications dealing with economic impacts of a reduction in ocean observations' uncertainty are still scarce today, so the → Table in Annex 1 p. 44 also shows what kind of information is required in the future and how Deep and BGC floats will help answer the remaining questions.

Sustainable investment in such global-ocean observations will therefore be translated into a high benefits/costs ratio and improve mitigation strategies. The proposed extension of the Argo mission is a relatively cost-effective way (5 M€) to reduce the uncertainties related to the ocean.

How to measure Euro-Argo economic impacts?

This paragraph is based on the publication: *"Assessing economic impacts of environmental research infrastructures: overview of methodological tools, R. Kalaydjian et al., 2020"*. The economic impacts of Euro-Argo ERIC as an environmental Research Infrastructure (RI) can be classified into three categories: upstream, downstream and feedback impacts, and are identified in → Figure 11.

→ Assessment of upstreams impacts

Upstream impacts are generated by the development and running of Environmental RIs and their requirements for equipment supply and related services. The economic impacts on suppliers are commonly assessed in terms of turnover, employment, workforce earnings, innovation and exports.

→ Assessment of downstream impacts

Downstream impacts represent the business opportunities. Performance assessment is based on comparison with the "do nothing scenario" and/or on non-market indicators:

– the performance of observational data is assessed thanks to KPIs (delay, accuracy of measurements, number of downloads and number of users);

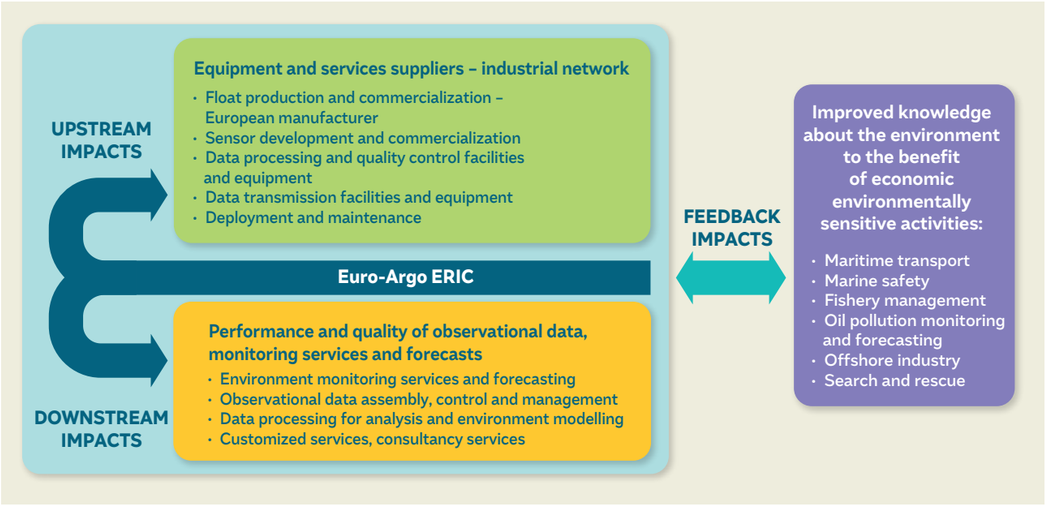
– the performance of analysis and forecasts are assessed thanks to "Observing System Experiments" (OSEs), based on the observing system impacts on ocean models and forecasts. "Observing System Simulation Experiments" (OSSEs) are also used to quantify the potential impacts of new assimilation techniques and new generations of observation instruments.

Relevant impact assessment methods must then include market-related indicators, e.g. the number of value-added businesses, or the amount of demand for data and services. Inquiries can be used to classify the different types of data users and evaluation of the size of the ocean-related value-added service market, based on the income generated to service providers.

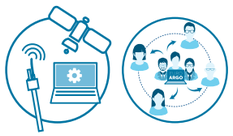
→ Assessment of feedbacks impacts

Environmentally sensitive activities require environmental information that are supplied with data, monitoring services and forecasts by global and regional operational oceanography systems (e.g. Copernicus and other value-added services). Cost–benefit analysis is a classic tool to test whether an environmental Research Infrastructure project serves public interest. It consists of calculating the benefits to environmental data users in terms of increased welfare, efficiency and avoided costs, minus the costs of the project.

Figure 11: The three categories of economic impacts associated to Euro-Argo ERIC.



Objective 3

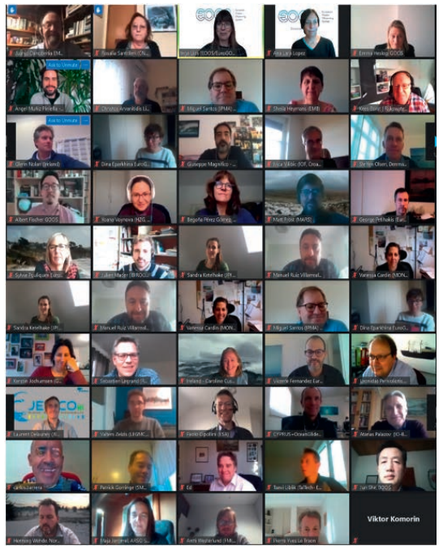


CONTRIBUTE TO A GLOBAL OCEAN OBSERVING SYSTEM

Integration with other Research Infrastructures

In 2020, links with some other European RIs (EMSO-ERIC, ICOS, JERICO-S3) and EuroFleet were further developed for better cooperation at the European level. Contacts were made at a regional level, to highlight the complementarity of the different RIs. The ERICS have started to identify areas of collaboration and also started to contribute jointly to various proposals to European H2020 calls with a multiplatform approach: such as MOISSES (on how to consolidate the sensors), DOORS in the Black Sea or INTAROS-2 (see p. 39). They also contributed jointly to the Digital Twin of the Ocean proposal led by Mercator Ocean International (MOi). Despite some unsuccessful proposals, this collaborative work was a first step in efficient networking between the European RIs.

In February, a joint statement between the six European Marine RIs → **Figure 12** to prepare the UN Decade of the Ocean



EOOS online meeting, in November 2020.

© EOOS

was released. In March, a review regarding a comprehensive and integrated strategy of the European Marine RIs for Ocean Observations was published.

In May, Euro-Argo ERIC attended the high level "European Research Infrastructures for a smarter future", ESFRI digital conference. In November, the ERIC also joined the 1st EOOS Operations Committee, co-organised by EuroGOOS and the European Marine Board. EOOS aims at coordinating ocean observing in Europe as part of GOOS and the activities are fostered within the scope of the EuroSea

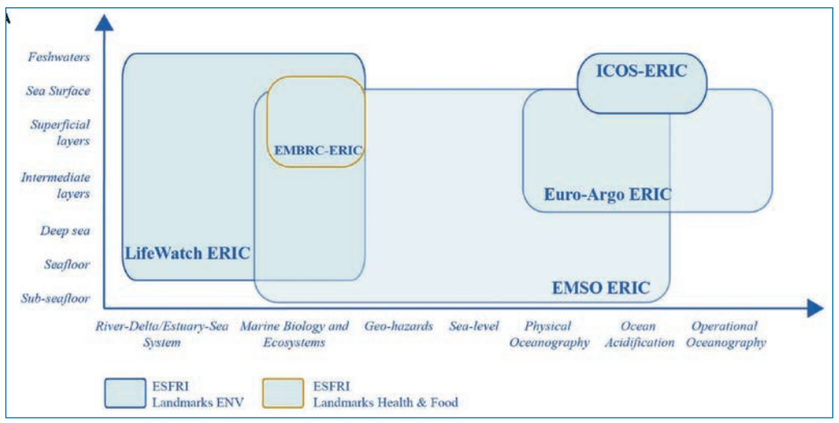


Figure 12: The observation capabilities of five pan-European RIs with respect to their hydrosphere components (Y axis) and environmental processes (X axis) © ESFRI 2018

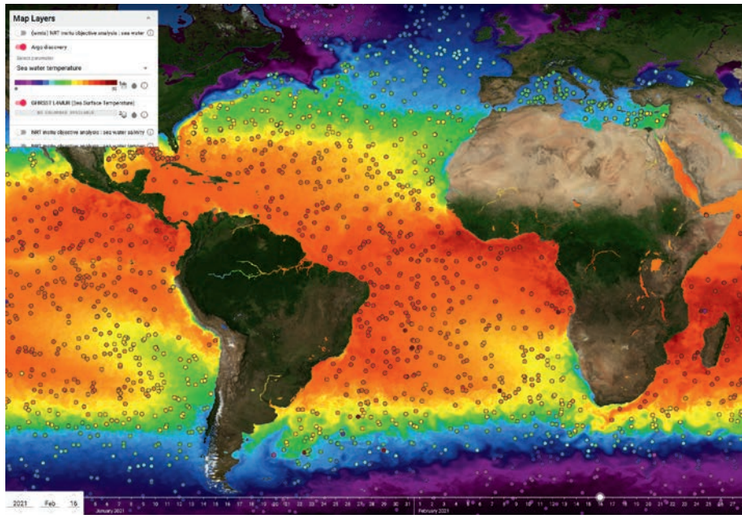


Figure 13: Screen shot of the EOSC Argo marine data discovery, showing the sea water temperature from Argo on top of sea surface temperature measured by satellite.

project (see p. 37). The goal is to support the integration and long-term sustainability of the ocean observing efforts in Europe.

Integration within GOOS and EuroGOOS

In 2020, Euro-Argo remained involved in the EuroSea project (see p. 37), in the continuity of AtlantOS, to reinforce Argo as an observing network as part of the EOOS, including Deep and BGC extensions and as a task team of EuroGOOS. One of the purposes of this engagement is to better integrate Argo with other observing platforms and networks and highlight the importance of sustained ocean observation to answer the challenges of the UN Decade of Ocean Science for Sustainable Development initiated by the IOC.

In September, the Euro-Argo ERIC Office attended the 2020 “European Research and Innovation Days” that provided important information on the Green Deal call as well as on the main missions of Horizon Europe. It clearly highlighted the importance of a coordinated approach with the other European RIs. In October 2020, Euro-Argo ERIC joined the 2nd workshop on the connection of ESFRI Research Infrastructures (RIs) to the European Open Science Cloud (EOSC), "Research Infrastructures shaping EOSC" that is an important step to influence EOSC development so that it can be useful for European RIs.

In the last quarter of 2020, Euro-Argo ERIC, with the other marine ERICs, was consulted to contribute to the Digital Twin of the Ocean proposal, that aimed at creating a digital image of the oceans combining *in situ*, satellite and model products into a digital consistent high-resolution, multi-dimensional and (nearly) real-time description of the ocean. This proposal, led by Mercator Ocean International, contributes to the Commission’s Green Deal as part of Destination Earth initiative.

In November, Euro-Argo ERIC answered on behalf of its Members to the DG-MARE Maritime Affairs and Fisheries consultation on how to achieve a common EU approach for ocean observations.

Improved services

In 2020, many services have been improved to allow development of integrated services for end-users, such as the enhanced interoperability of the metadata (Argo vocabulary set up, see p. 17) or the design of new back-end and front-end (the “data selection tool”) services for GDAC. This last service was a result of synergies between ENVRI-FAIR (see p. 36) and Euro-Argo RISE (see p. 32) to develop/enhance FAIR services (API) and improve data access and visualization. Ifremer, France also demonstrated how EOSC could support the development of new Argo marine data discovery service in support of BlueCloud users → **Figure 13**. Such service may be enhanced within the framework of the Digital Twin of the Oceans if successful.

Objective 4

DEVELOP ENGAGEMENT WITH THE EUROPEAN ARGO USER COMMUNITIES & STAKEHOLDERS AND REINFORCE EURO-ARGO VISIBILITY

Major events

Co-organised by Argo France and Argo Canada for Arvor/Provor Argo float users, the Arvor/Provor technical workshop was held on 28-30th January 2020 at Ifremer, in Brest, France. Gathering 58 attendees, the objective was to improve the level of technical expertise and to share best practices. In addition to scientists and technicians that deploy floats, the workshop also included representatives of the Argo data management community, the Arvor/Provor float manufacturer (nke Instrumentation) and sensor providers (Sea-Bird, RBR, JFE). The format of the workshop combined classroom presentations and discussions with hands-on training at the Ifremer test tank. The workshop concluded with a discussion about key issues and potential recommendations generated over the preceding three days.

The Arvor/Provor technical workshop.

© Euro-Argo ERIC

On 2-5th March, a whole week of meetings for two important projects coordinated by the Euro-Argo ERIC was held in Paris:
– the first part was dedicated to MOCCA project. This final meeting gathered all the partners to discuss the results achieved during these five years as well as the future challenges for Euro-Argo;
– the second part of the week in Paris was dedicated to Euro-Argo RISE project. The General Assembly (Deliverable 1.3: 1st General Assembly Report) was held and gathered more than 30 people (including people in videoconference), representing 17 partners and 12 countries. Among the topics addressed, a breakout session was dedicated to definition of the Argo users. It allowed brainstorming on potential actions to be carried out (within and beyond the project) to reach new users.

At the regional level, the Euro-Argo ERIC was also represented at the BOOS annual meeting and MonGOOS General Assembly, to continue fostering engagement with new communities.
This year, at-sea activities such as deployments and float recovery provided other opportunities to collaborate and reach new partners. In October, the first floats under Portuguese scientific responsibility were deployed in the Gulf of Cádiz. These deployments were the results of a collaboration between IPMA and Argo-France and represented a step forward in the entry of Portugal as a Member of the Euro-Argo ERIC and as a contributor to the global Argo network.

© Franck Dumas/SHOM

The two Provor floats equipped with oxygen sensors deployed as a collaboration between France and Portugal during the French SHOM PROTEV Gibraltar's campaign.

© Euro-Argo ERIC

The MOCCA project final meeting.

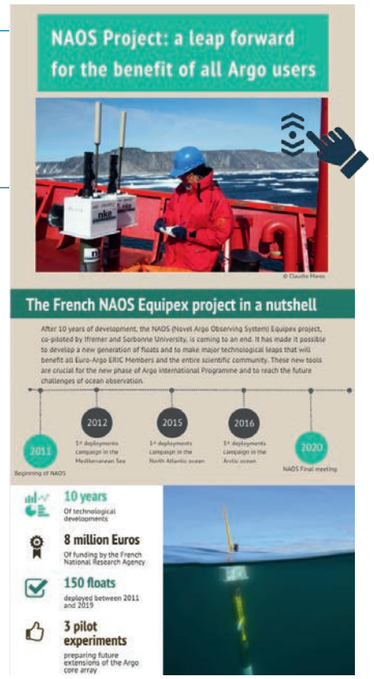
As an important stage of cooperation in the Baltic Sea, a float from Argo Poland, deployed in 2018, was recovered by the Estonian vessel R/V Salme, north of the island of Hiiuma.
The European Research Infrastructures for a Smarter Future conference, organised by ESFRI in May 2020, was an occasion to reinforce Euro-Argo visibility at a high-level. This event, held online due to Covid-19, was hosted by the Croatian Presidency of the Council of the EU, as part of the Future of Research Infrastructures in European Research Area event. Over 600 participants followed the conference throughout the day, while in the policy panel over 800 participants followed the discussion. Euro-Argo was present amongst the landscape of Research Infrastructures and represented its members and the European contribution to the new Argo design, at the virtual poster session.

EVENTS WHERE EURO-ARGO WAS PRESENT IN 2020	DATES
ADMT-21	30 Nov.-04 Dec.
DAC workshop	29 November
MOONGOOS General Assembly	26 November
EOOS Operational Committee Meeting	24-25 November
BOOS Annual Meeting	04-06 November
SeaTech Week	12-16 October
2nd ESFRI RIs-EOSC Workshop	06-07 October
NAOS Final Meeting	17 September
EuroGOOS General Assembly	07-08 September
European Research Infrastructures for a smarter future Conference- ESFRI	15 May
EGU	04-08 May
AST-21	14-17 April
Euro-Argo RISE General Assembly	03-05 March
MOCCA Final meeting	02-03 March
Marine Institute Transition Year	26 February
Ocean Science Meeting	16-21 February
ENVRI-FAIR week	06-07 February
Arvor-Provor technical workshop	28-30 January
INTAROS General Assembly	08-10 January

Table 3: Events where Euro-Argo was present in 2020.

Figure 14: The new corporate identity (introduced in the Newsbriefs and for Euro-Argo website and Twitter profile) and an interview on Euro-Argo YouTube channel.

The news about NAOS project published with an infographics format you can scroll.



Communication activities and tools

Activities aiming at increasing Euro-Argo visibility were pursued in 2020, through 38 news items published throughout the year on the Euro-Argo website, and sent to a large audience in two News Briefs campaigns (in May and December). Euro-Argo's brand image was enhanced with a new corporate identity → **Figure 14**.

→ New online content

Four videos were added to the new Euro-Argo Youtube channel to present the Euro-Argo ERIC, the MOCCA project main achievements **(see p. 34)**, the Arvor/Provor technical workshop, and the 7th Euro-Argo Science meeting. A new format for specific News items was defined including infographics and scrolling possibilities and the 1st News using this format has been published about NAOS Equipex French project. A press release highlighting scientific results was published online and broadcast.

→ Two printed documents published

The 2019 Euro-Argo Activity Report was released with a new design and organization with respect to the five objectives of the Five-year Plan 2019-2023. For the end of the MOCCA project, a leaflet describing the main achievements was also published.

→ Social media in constant progress

The Twitter account continued to gain new followers → **Figure 16**. Since 2020, Twitter has been used to highlight a scientific publication every month, called "Read of the Month", also recorded on the website.

→ Ocean Observers community reinforced

Euro-Argo continued its activities with the Ocean Observers educational community initiated in collaboration with OceanOPS (previously JCOMMOPS) in 2017. Three teleconference meetings of the Ocean Observers international Working Group were held to prepare the 2nd Ocean Observers Workshop. Due to the pandemic, it was decided that it will be a fully online event in 2021 and if budget allows, that another one could be organised in person in 2022. The virtual event should be short and mainly focus on teachers' hands-on experiments. An Ocean Observers website was also drafted and an abstract was submitted to EuroGOOS.

KPIs regarding users, data access and publications

→ Data access in average

848 VISITORS PER MONTH (AVERAGE)

5322 SESSIONS

3.9 TERABYTES OF DATA FILES DOWNLOADED

→ Number of publications

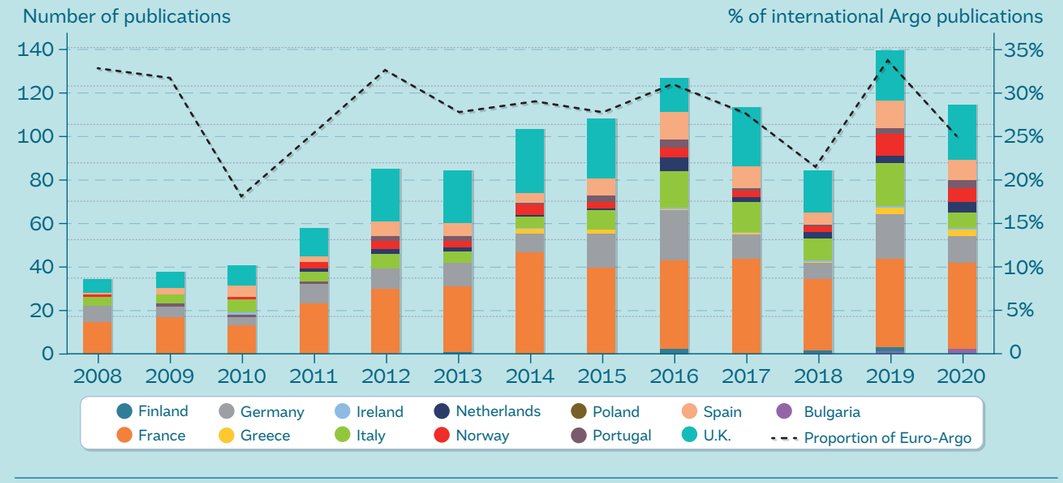


Figure 15: Euro-Argo publications per year (defined as publications mentioning Argo with first author's affiliation in a European country) in number of publications (left axis) and in percentage of the international Argo publications (right axis).

→ Number of Twitter followers

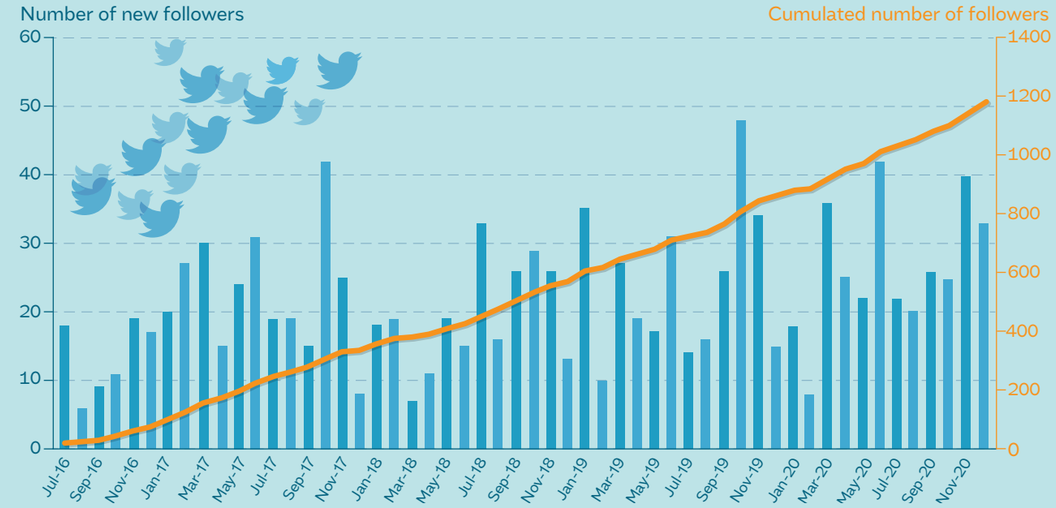


Figure 16: Evolution of the number of new (left axis, in blue) and cumulated (right axis, in orange) followers of the Euro-Argo Twitter account.

Objective 5

OPERATE THE EURO-ARGO ERIC OFFICE UNDER GOOD GOVERNANCE

Main operational outcomes in 2020

This year has been marked by the COVID-19 pandemic. A lockdown in most European countries sometimes hindered the smooth running of certain activities. Many events were held online or postponed but the Euro-Argo ERIC managed to fulfil all its engagements both for Members and in projects. 2020 saw the end of the MOCCA project, presented at the occasion of a meeting with DG-MARE (see p. 34). The Euro-Argo ERIC also maintained its involvement in the four H2020 projects launched in 2019: ENVRI-FAIR, EuroSea, ERIC-Forum and Euro-Argo RISE (see p. 32). The Euro-Argo ERIC also contributed to a few H2020 proposals: one of them, DOORS led by GeoEcoMar for the Black Sea, was successful (see p. 39) and another one, Ocean2, led by MOi on the Digital Twin of the Oceans, will be submitted in early 2021.

Table 4: Euro-Argo Management Board and Council meetings in 2020.

Event	Date
17th Management Board meeting	March, Paris - France
13th Council meeting	April, online
18th Management Board meeting	June, online
19th Management Board meeting	October, online
14th Council meeting	December, online

Management of the Euro-Argo ERIC

Three Management Board and two Council meetings were mainly held remotely → Table 4 allowing good management of the ERIC despite the pandemic situation. A meeting with the Scientific and Technical Advisory Group (STAG) was also organised to assess progress made in 2020 and review the 2021 work plan prior to presentation in Council a month later. Euro-Argo progress and status were presented online at the 21st Argo Steering Team (AST) and BGC-Argo Science Team international meetings, co-organised in April 2020, and at the 21st Argo Data Management Team (ADMT) international meeting, organised late November – early December 2020.

© Euro-Argo ERIC

The 12th Council, held online.

Euro-Argo ERIC Office team

2020 was marked by the departure of Grigor Obolensky, who had been the Programme Engineer of Euro-Argo for six years, and the arrival of Luca Arduini Plaisant, the new Research Engineer.

→ Grigor Obolensky

Grigor joined the Euro-Argo Office team in September 2015 and was the first full time employee of the Euro-Argo ERIC. He supported the Program Manager in the setup of the ERIC in link with the Euro-Argo Management Board. He contributed on clarifying some aspects of the ERIC implementation in France, such as VAT exemption with French ministries.
He organised the first tender for the procurement of Argo float by the ERIC within the DG-MARE MOCCA project, as well as the ones needed afterwards for the AtlantOS and EuroSea EU H2020 projects. He was involved in the whole process of EU project, both as a contributor to proposals (EuroSea, DOORS) as well as assuming the Euro-Argo Office task in projects, such as MOCCA, AtlantOS, ENVRI, ERIC-Forum.
Based on the expertise he had acquired previously in CNRS/France on BGC-Argo technology and in partnership with the French Coriolis team, he organised the acceptance tests at the Euro-Argo ERIC for the Core and then the Deep and BGC floats and trained the new ERIC personnel that joined the ERIC one year later. His expertise on technology and sensors was very valuable to the Euro-Argo Office team and all the Members. He ensured a technological watch on progress on Argo and other related technology, as well as on sensors.
He organised the procurements of floats for Euro-Argo Members, through the ERIC, a service that is now managed by Romain and includes not only procurement but also acceptance tests and support to at-sea activities.
Grigor is a person who enjoys sharing his expertise and know-how with others and therefore he has always volunteered to contribute to the outreach booth, user workshops organisation, general public events (such as "fêtes maritimes" in Brest) or training workshop and cooperation with manufacturers.
Grigor had developed expertise in most of the Euro-Argo Office activities and we will miss him. We wish him all the best in his future endeavours.

© Euro-Argo ERIC

→ Luca Arduini Plaisant

Luca Arduini Plaisant joined the Euro-Argo ERIC Office team to assist the at-sea monitoring activities and some of the objectives of the Euro-Argo RISE project. In this frame, Luca is specially focused on the description of floats configuration habits and their impacts on the life expectancy of the fleet. Beside these aspects, Luca will also be involved in all the work packages which involve the ERIC Office (see p. 15).
Luca graduated from INTECHMER, a hydrographic and oceanographic technician Institute, before pursuing his studies as a hydrographic and marine geophysics engineer, at ENSTA Bretagne and UBO. Through his academic career he gained a strong background in the practical field of marine sciences during the mobilization of oceanographic instruments onboard, or embarking for several campaigns offshore (Belgian, French coast, 2018 Amundsen science campaign in the Arctic, etc.).
He is passionate about the ocean and more specifically the polar regions. He fell in love with these environments during a two month period onboard of the icebreaker NGCC Amundsen, in the Arctic and he is glad to play a role in the development of ocean's monitoring systems in these key regions.

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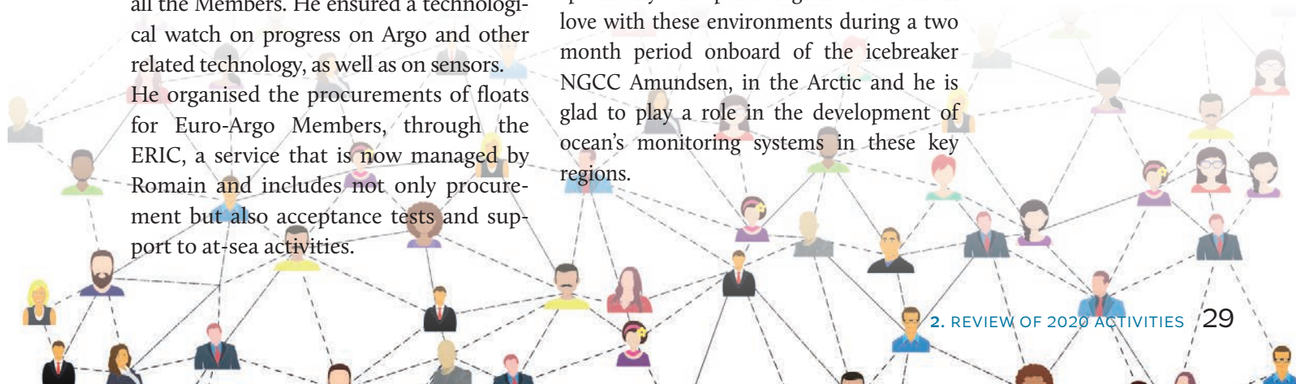


3 PROJECTS INVOLVING EURO-ARGO IN 2020

In 2020, Euro-Argo Office was involved in 4 projects. It coordinated one of them (Euro-Argo RISE) and contributed to the other three (ENVRI-FAIR, EuroSea and ERIC-Forum), through dedicated work packages. This year was also marked by the end of MOCCA project.


© Jaromir Jakacki/IOPAN

A float recovery by IOPAN in the Baltic Sea.

EURO-ARGO RISE

EURO-ARGO RESEARCH INFRASTRUCTURE SUSTAINABILITY AND ENHANCEMENT

The Euro-Argo RISE project will enhance and extend the European capacity of the Argo network to provide essential ocean observations to better answer societal and scientific challenges. To reach this goal, it enhances and organises the new EU Argo observations towards biogeochemistry, greater depth, ice-covered and shallower water regions. In addition, Euro-Argo RISE allows Europe to develop its contribution to Argo in the long-term, engaging with new teams and developing a sustainability plan with the Member States and the funding agencies.

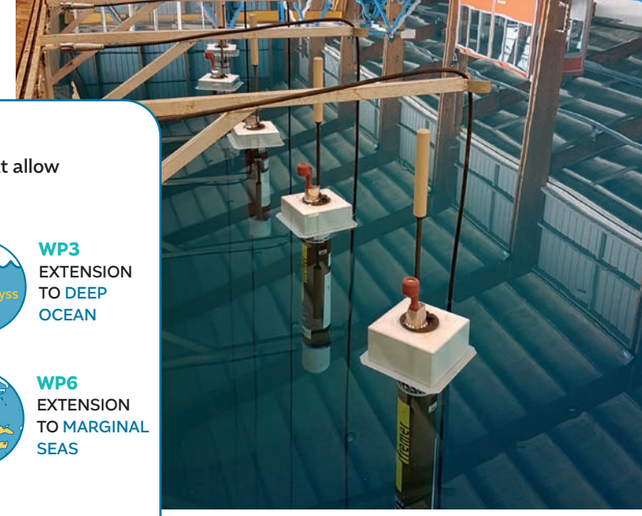
2019-2022
Coordination by Euro-Argo ERIC

- **Funding:** 3.95M€, 536K€ for Euro-Argo European Union's Horizon 2020 research and innovation programme
- **Grant agreement ID:** 824131
- **Call for proposal:** H2020-INFRADEV-2018-1

WORK PACKAGES

The Euro-Argo RISE project is organised in eight work packages that allow the project to progress along Euro-Argo five-year plan objectives.

- **WP1** PROJECT MANAGEMENT
- **WP2** IMPROVEMENT OF THE CORE ARGO MISSION
- **WP3** EXTENSION TO DEEP OCEAN
- **WP4** EXTENSION TO BIOGEOCHEMICAL PARAMETERS
- **WP5** EXTENSION TO HIGH LATITUDES REGIONS
- **WP6** EXTENSION TO MARGINAL SEAS
- **WP7** EURO-ARGO RISE VISIBILITY: COMMUNICATION AND DISSEMINATION TOWARDS USER'S COMMUNITY
- **WP8** INTEGRATION OF EURO-ARGO ACTIVITIES IN THE GENERAL CONTEXT OF GLOBAL OCEAN OBSERVATIONS



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https://www.euro-argo.eu/EU-Projects/Euro-Argo-RISE-2019-2022 read the two news about the progress of the project

MAIN ACHIEVEMENTS IN 2020

Since last year, the work has been progressing on the four main pillars: 11 deliverables have been released and five more milestones achieved. Here is a summary of the main results in 2020.

TECHNOLOGICAL PROGRESS

About deployments

In 2020 the Euro-Argo RISE partners continued to test different float configurations closer to the shallow coastal waters to evaluate Argo's potential use in Marginal Seas (see the map on the right). IOPAN, BSH, FMI and IMR also enhanced Argo coverage in the high latitude areas, deploying floats with Ice Sensing Algorithm.

Location of floats deployed in 2020.

About prototypes

To diversify providers and to secure sensor provision at a competitive cost in order to sustain and expand the network various sensors have been tested in 2020:

→ RBR sensors for Core floats

Since June, thanks to Ifremer's testing work, nke instrumentation manufacturer offers a new version of the Arvor float fitted with an RBR CTD. Ifremer successfully deployed two Arvor-I floats with RBR CTDs in the Canary Basin, in collaboration with IEO in mid-December.

→ Sensors accuracy for Deep floats

Two 3-headed Deep-Arvor floats were successfully tested by Ifremer in mid-November and then deployed in the Canary Basin in collaboration with IEO in mid-December.

→ New sensors for BGC floats.

LOV tested the irradiance dual-sensor prototype which is now ready to be deployed for scientific experiments in the Baltic Sea by FMI. Processed data of the nitrate dual sensor prototype by SU indicated that accuracy and precision of the NO_3 retrieval for Opus sensor do not have the required maturity yet for being implemented for an operational deployment. Technical work with the manufacturer will continue outside the project.

COMMUNITY ENHANCEMENT

In December, IOPAN collaborated with Estonia to recover a Polish float in the Baltic Sea. Argo float operations for the Baltic and the Mediterranean Seas were presented respectively at the BOOS annual meeting, by IOPAN/FMI, and at the MONGOOS General Assembly, by OGS. In October, Argo France and IPMA (Portugal) collaborated for the 1st floats deployment in the Gulf of Cádiz. In November, a new Argo app for Android smartphone was released by Ifremer. IEO is preparing specific interactive classes of the Argo online school to explain the access to the Argo data.

SERVICES TO USERS

In November, a beta-version of the new Argo data selection tool, developed by Ifremer, was presented by Euro-Argo ERIC at the ADMT-21 meeting. This tool is the result of a synergy with the ENVRI-FAIR project (see p. 36). 57 users replied to the online survey designed by the Marine Institute mid-2020 to better understand their requirements and help Euro-Argo to propose fit-for-purpose services.

DATA MANAGEMENT

In December, Euroargodev collaborative framework was officially introduced by Ifremer to Argo international during the ADMT-21 meeting. The Euro-Argo community quickly took ownership of this tool to develop and share new softwares (Argopy, Virtual fleet, OWC in Python etc.) along new data management cookbooks, tutorials and reference datasets for Core Argo. Development of the delayed mode procedure for BGC Argo were enhanced and then also presented to Argo international at the BGC-ADMT meeting by SU, Ifremer, GEOMAR/IOW and PML.

Euro-Argo RISE partners gathered at the project General Assembly, in Paris, in March 2020.

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PARTNERS

MOCCA

MONITORING THE OCEANS AND CLIMATE CHANGE WITH ARGO

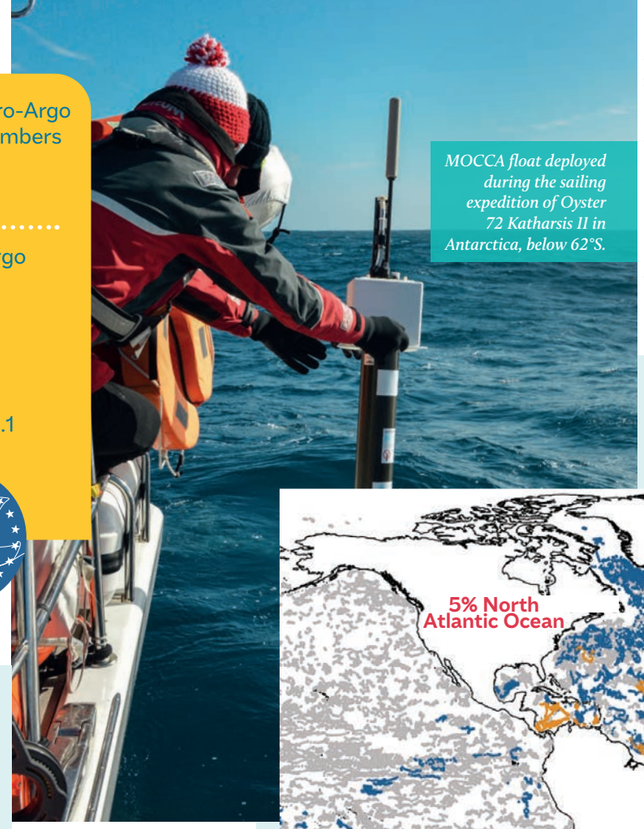
In 2015, the Executive Agency for Small and Medium-sized Enterprises (EASME) co-funded the Monitoring the Oceans and Climate Change with Argo (MOCCA) project for five years. With 5 M€, this project allowed Euro-Argo to procure and deploy 150 new floats measuring temperature and salinity. MOCCA made available more than 20,000 quality-controlled data to the oceanographic and scientific communities.

▸ *https://www.euro-argo.eu/EU-Projects/MOCCA-2015-2020*

2015-2020
Coordination by Euro-Argo ERIC

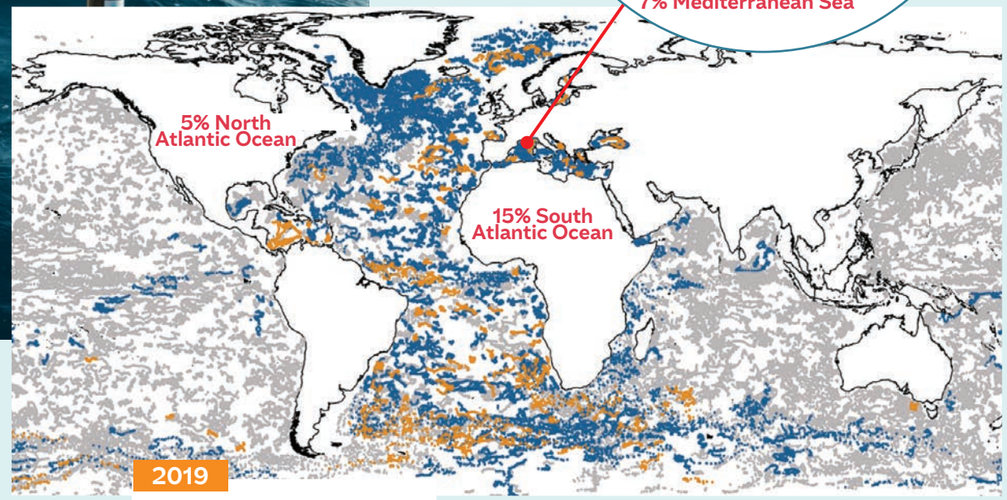
Euro-Argo Members

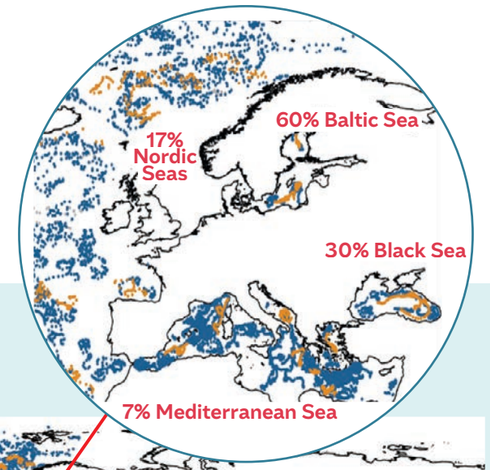
- **Funding:** 5M€, 3.14M€ for Euro-Argo
  Co-funded by
  The EMFF programme of the European Union
- **Grant agreement** ID: SI2.709624
- **Call for proposal:** EASME/EMFF/2015/1.2.1.1



MOCCA float deployed during the sailing expedition of Oyster 72 Katharsis II in Antarctica, below 62°S.

© Hanna Leniec-Koper & Piotr Kuklinski





Source: Coriolis GDAC & AIC

MAIN ACHIEVEMENTS BETWEEN 2015 AND 2020

2020 saw the end of the MOCCA project. The synthesis and outcomes of the project were presented during a meeting with DG-MARE, on September 25th.
Following this meeting, the Euro-Argo Office and the project's partners released a final D1.6 deliverable, in addition to the 44 previous deliverables (available here: https://www.euro-argo.eu/EU-Projects/MOCCA-2015-2020/Deliverables). This deliverable gave a global overview of the project and some recommendations for the future. It highlighted the necessity to develop jointly between the Euro-Argo Member countries and the European Commission additional sustained fund to maintain 1/4 of the new Argo mission.
To describe and summarize the main achievements and results of this five year project a leaflet (available at https://doi.org/10.13155/74328) and a video (available at https://www.youtube.com/watch?v=nqii6xMS-YM) were also published.

Romain Cancouët's interview in the video presenting MOCCA project main achievements.

FIVE YEARS OF MOCCA PROJECT ACHIEVEMENTS

- Demonstration that Europe can significantly **contribute in a coordinated way to the international Argo programme.**
- Implementation of the **Euro-Argo strategy with complementary EU funded float deployments.**
- **Better monitoring activities** and maximization of Argo float life expectancy.
- **Strengthening European Argo data efforts.**

GENERAL MOCCA STATISTICS IN JANUARY 2021:

Regarding MOCCA Floats

126 operational floats
160 cycles per float (average number)
1700 days lifetime ~4.7 years Oldest days lifetime
95% of the fleet achieved 50 cycles
1300 Median age ~3.5 years
90% of the fleet achieved 100 cycles

Regarding MOCCA Data

24500 temperature and salinity profiles (+450 each month)
70% of observation have been quality controlled
86% of the data is science ready (good data)

Susan WIJFFELS
Senior Scientist, Physical Oceanography Department Woods Hole Oceanographic Institution

"MOCCA has greatly strengthened Europe's contribution to global Argo – by helping improve and sustain coverage in the Atlantic Ocean, through vital enhancements in Argo data management and quality control and through improving float reliability. Many of these developments have had very positive flow-on effects to the global array."

Pierre-Yves LE TRAON
Special Advisor to the Euro-Argo Council
French representative

"The project has been highly successful and demonstrated that the procurement, deployment and processing of Argo floats can be very efficiently organised at European level. All MOCCA floats have been used and assimilated in real time in the Copernicus Marine Service (CMEMS) monitoring and forecasting centers. Data have also been integrated in the European Marine Observation and Data Network (EMODNET). Euro-Argo ERIC teams and Euro-Argo partners must be proud and congratulated for all these achievements. The challenge for the coming years will be to build on MOCCA to develop a sustained direct EU contribution to Argo and its deep ocean and biogeochemistry extensions."

PARTNERS

ENVRI-FAIR

FINDABLE, ACCESSIBLE, INTEROPERABLE AND REUSABLE SERVICES

ENVRI-FAIR aims at enhancing the connection of the Cluster of ENVRI to the European Open Science Cloud (EOSC). It supports all participating Research Infrastructures to build a set of FAIR data services to increase efficiency and productivity of researchers and enable data and knowledge-based decisions.

2019-2022

Coordination by FZJ

- **Funding:** 18.99M€, 105,5K€ for Euro-Argo

European Union's Horizon 2020 research and innovation programme

- **Grant agreement ID:** 824068
- **Call for proposal:** H2020-INFRAEOSC-2018-2

EURO-ARGO CONTRIBUTION

Built on ENVRIplus achievements, ENVRI-FAIR enhances access to environmental research infrastructure data and products. It is first driven by individual RI user needs, then by Marine domain user needs for integrated services, services that will be in the future available through the European Open Science Cloud (EOSC). These two themes allow the project to progress along the Euro-Argo Five-Year plan objective n°3 (see p. 18). Euro-Argo and EMSO Research Infrastructures coordinate the WP9 about the improvement of the FAIRness of the Marine Research Infrastructures.

EURO-ARGO MAIN ACHIEVEMENTS IN 2020

In 2020, a FAIRness gap analysis of marine subdomain RIs was performed and an implementation plan was defined to fill the identified weaknesses and improve machine-to-machine service to RI users but also to integrate service at Marine and ENVRI level.

At the Marine subdomain level, a series of inter-RI "mandatory" elements were identified to allow the development of crosscutting FAIR services.

In February 2020, the WP9 Euro-Argo partners (Ifremer/ France and BODC/ UK) met in Dresden during the ENVRI week. They collaborated on the technical specification of Euro-Argo services and on the interfaces for the other Marine RIs. Main priorities for the Euro-Argo ERIC were defined to move to a data system FAIR for people to a data system FAIR for machines.

On top of the FAIR services developed by the five RIs of the marine domain, a machine interface was specified to ensure the translation and conversion (mapping) from the language used by the users for their queries into RIs language, through a standardized vocabulary managed by BODC/ UK. This broker will be used to collect the data from the different RIs, according to some user criteria, such as Essential Ocean Variable (EOV), time period, geographical area etc. The broker will then send to each RIs a specific order thanks to the FAIR application programming interface (API) developped by the RIs → Figure 17.

In that framework, the partners of task T9.3 (Euro-ARGO FAIR data implementation) developed a set of new services that will be soon connected to the Euro-Argo website and the Argo Data Management website. Ifremer and BODC also collaborated with Euro-Argo and Argo international partners to create an Argo vocabulary, with 50% of Argo metadata reference tables uploaded and publicly available on NERC Vocabulary Server (NVS) by June 2020. These vocabularies will be finalized in 2021.

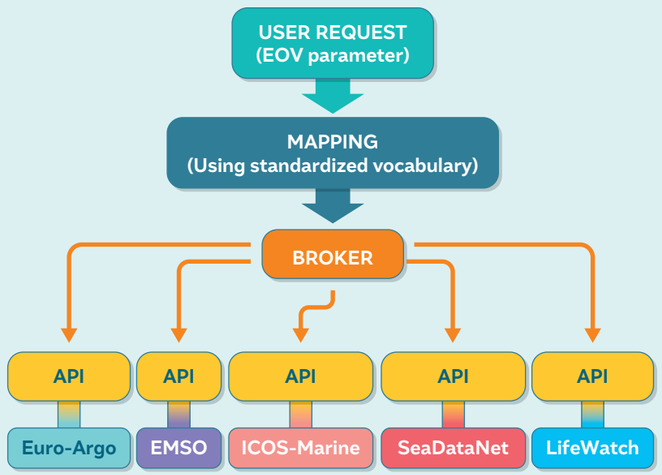


Figure 17: Euro-Argo RI Implementation plan for a FAIR data management system.

PARTNERS

EUROSEA

EUROPEAN OCEAN OBSERVING AND FORECASTING SYSTEMS

In the continuation of the AtlantOS project achievements, the EuroSea international consortium aims at advancing research and innovation towards a user-focused, truly interdisciplinary, and responsive European ocean observing and forecasting system for a sustainable use of the ocean.

2019-2023

Coordination by GEOMAR

- **Funding:** 12.642M€, 796K€ for Euro-Argo
- **Grant agreement ID:** 862626
- **Call for proposal:** H2020-BG-2019-1

EURO-ARGO CONTRIBUTION

The Euro-Argo ERIC is involved in two work packages: WP3 "Network Integration and Improvements" and WP7 "Ocean Climate Indicators Demonstrator", with the following objectives:
– WP3 will improve and strengthen ocean observing networks, foster networks innovations and oversee key aspects of technological integration;
– WP7 to assess the ocean role in climate through new ocean climate indicators with decreased uncertainty and to evaluate the economic value of the ocean carbon sink.

EURO-ARGO MAIN ACHIEVEMENTS IN 2020

For Euro-Argo the priority was placed on the BGC and Deep missions and their connection with other observing networks. The funding for the OceanOPS BGC Argo project office position was secured for an initial two-year term and the BGC Argo website was improved with respect to statistical tools for publications. In addition, discussions with Argo international also started to organise a Deep and a BGC workshop in 2021. In the WP3 framework, the EuroSea partners also contributed to the global ocean oxygen atlas international initiative. Moreover, some actions were carried out in concert with the H2020 Euro-Argo RISE project (see p.32):
– improvements of the real-time and delayed-mode processing procedures of the BGC Argo and the Deep Argo data were discussed and presented at the ADMT meeting early December;
– development of Argo Best practices using the Euro-Argo ERIC github is underway.

In the frame of the EuroSea WP7 activities and the North Atlantic demonstrator, five Deep floats were successfully tested in autumn 2020. They are ready to be deployed in 2021.

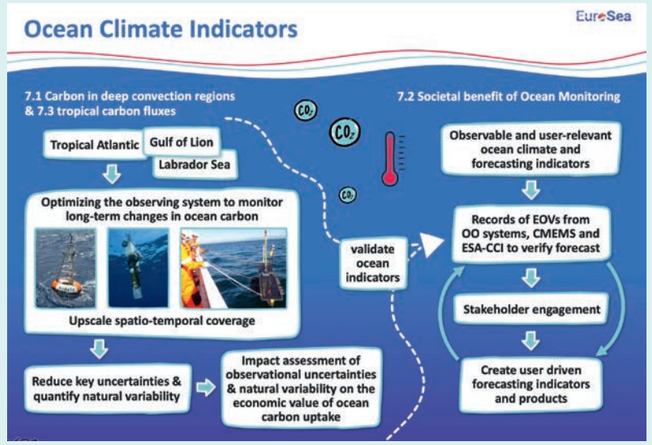


Figure 18: Connections between tasks 7.1 and 7.3 in WP7.

The two tasks related to WP7 were presented during the EuroSea General Assembly, early 2021 → Figure 18:
– Task 7.1: to evaluate the economic value of the ocean carbon sink in deep convection regions;
– Task 7.3: to develop indicators for air-sea carbon flux and ocean acidification based on an improved Atlantic observing system.

Moreover, stakeholder engagement activities were enhanced through a series of workshops organised within WP8 that aimed at better understanding stakeholder interests. Main stakeholders were identified, relations with them were assessed and weaknesses identified. The process is still going on to define priorities in term of action to be taken throughout the project lifetime. The final aim is to develop a joint Euro-Sea stakeholder strategy an implement it during the project.

PARTNERS

ERIC-FORUM

EUROPEAN RESEARCH
INFRASTRUCTURES CONSORTIUM

The European Commission had initiated a networking event, twice a year, where Managers of existing ERICs and scientists of future RIs who wanted to use the ERIC instrument could discuss shared experiences, highlight challenges and meet national policy makers establishing a platform for exchange of best practices.

2019-2022

Coordination by BBMRI ERIC

- **Funding:** 1.5M€
  44K€ for Euro-Argo
- **Grant agreement ID:** 823798
- **Call for proposal:**
  H2020-INFRASUPP-2018-1

ERIC FORUM

PROJECTS OBJECTIVES AND EURO-ARGO CONTRIBUTION

The project supports the organization of specific meetings, targeted thematic workshops focusing on shared challenges such as harmonized reporting and development of KPIs, ERIC evaluation process, VAT exemption practice, development of internal procurement rules, insurances and pensions policies, training of governance bodies representatives, etc. It also aims at supporting ERICs in preparation through the production of best practices documentation, as well as common communication and outreach activities in order to strengthen external representation of ERICs.
Within the project, Euro-Argo has been involded in a task on VAT exemption, enabling progress on Euro-Argo Five-Year plan objective n°5 **(see p. 6)**.

EURO-ARGO MAIN ACHIEVEMENTS IN 2020

At the beginning of the year 2020, a new governance model of the ERIC Forum was defined and set up. Dr Womersley and Dr Ussi were elected as Chair and Vice-Chair during the ERIC Forum Annual Meeting. This new governance has helped improving the interactions between the ERICs involved in the ERIC-FORUM and the European commission in a coordinated manner.

In 2020, the ERIC-Forum was instrumental in increasing visibility for the services that each ERIC can provide to researchers involved in the fight against COVID-19 or how they were impacted by COVID-19 though their link with the ENVRI cluster.
In parallel, the ERIC Forum remained the main contact point for several European stakeholders during the negotiation of the EU multiannual financial framework (MFF) and its impact on the development and maturity of research infrastructures, in particular concerning the final outlook of Horizon Europe. 2020 was also marked by contributions to the new ERIC guidelines through best practices and targeted analysis. The deliverables put in place will help the ERIC Euro-Argo to better integrate Euro-Argo in the European context.

In December 2020, the Euro-Argo ERIC joined the workshop on "Impact Assessment, Evaluation and Monitoring of Research Infrastructures". This workshop aimed at highlighting the recent developments in the field of impact assessment, scientific evaluation and monitoring of research infrastructures and is co-organised by three European Commission cofunded projects, ERIC Forum but also ACCELERATE and RI-PATHS.

In January 2021, Dr Womersley and Dr Ussi were reelected as Chair and Vice-Chair during the ERIC Forum Annual Meeting.

Euro-Argo ERIC participated to the ERIC-FORUM joint contribution to some consultation's issues by the European Commission:
– in August 2020, to the online public consultation on the roadmap towards "the communication on the future of Research & Innovation and the European Research Area (ERA)";
– in June 2020, "The ERIC community and Horizon Europe Mission Areas" was published, with a table showing which ERIC/prep-ERIC contributes to which "Horizon Europe Mission Area";
– a policy brief overview "Funding models for access to ERIC multinational / transnational services: Key recommendations" was also released.

ERIC-Forum community representatives.

© ERIC-Forum

PARTNERS

PROPOSALS

In 2020, the Euro-Argo ERIC Office collaborated with national members to develop three proposals: DOORS which has been accepted, MOISSES and INTAROS-2 which have been rejected. Two of them are detailed below.

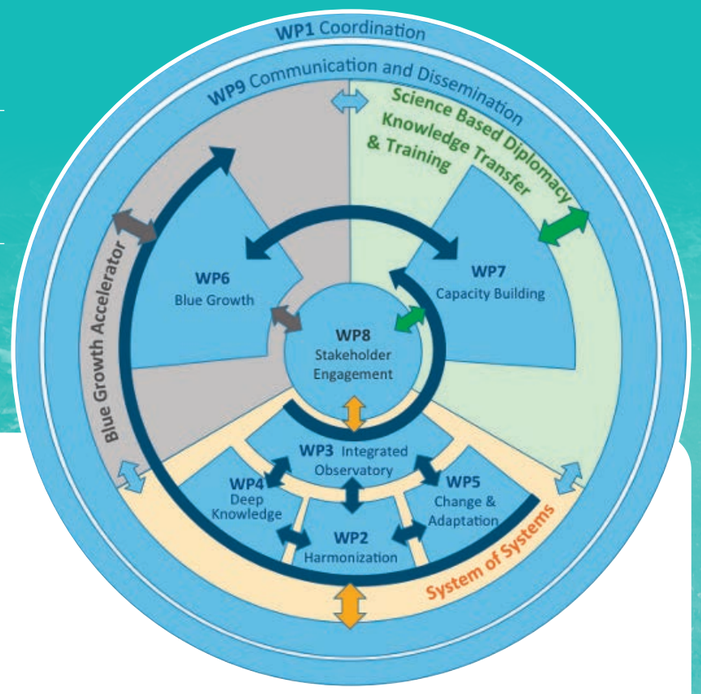


Figure 19: The DOORS objectives will be achieved through nine WPs. Euro-Argo ERIC Office and IO-BAS will be involved in the WP3.

DOORS

As part of the H2020 call BG-11,2020 "Towards a productive, healthy, resilient, sustainable and highly-valued Black Sea" Euro-Argo was involved in the DOORS proposal coordinated by GeoEcoMar (Romania). The overall objective of DOORS is to work with stakeholders to implement the Strategic Research Innovation Agenda (SRIA) for the Black Sea, to support the successful implementation of Blue Growth and to contribute to a healthy, productive and resilient Black Sea. It is organised into nine workpackages → Figure 19. After a successful step 1 proposal in January 2020, Euro-Argo ERIC jointly with IO-BAS, proposed an Argo contribution to this proposal. Euro-Argo goal is to demonstrate the potential of BGC-Argo, as part of the integrated multiplatform observing system for the Black Sea. The step 2 proposal was submitted in September and accepted. If the project is successful it should facilitate the development of BGC-Argo in the Black Sea and help engaging with new countries.

INTAROS-2

As part of the H2020 EU Call LC-CLA-20-2020 "Supporting the implementation of GEOSS in the Arctic in collaboration with Copernicus", Euro-Argo was involved in the INTAROS-2 proposal coordinated by NERSC (Norway). After two writing meetings in November 2019 and January 2020, the first stage proposal was submitted in February 2020 and successfully passed the evaluation in May. A detailed work plan was then elaborated in which Euro-Argo activities were planned around ice avoidance strategies for Argo floats and the deployment of five Core Argo in the Arctic (Laptev Sea or Kara Sea). The second step proposal was submitted in September 2020 but unfortunately the grant was allocated to another consortium, despite a score of 13 out of 15 (in December 2020).
Despite the rejection of the INTAROS-2 proposal, this experience allowed Euro-Argo partners interested in Arctic region (BSH, IOPAN, IMR, LOV) – as well as Euro-Argo ERIC as a whole – to identify key activities in order to better implement and further develop Euro-Argo strategy in the Arctic. The discussions that happened in the framework of INTAROS-2 preparation also strengthened links with key partners strongly involved in ocean observations in the Arctic for possible future collaborations.

4 SCIENTIFIC HIGHLIGHTS

"The oceans' twilight zone must be studied now, before it is too late"

Authors: Adrian Martin et al.
First published: 31 March 2020
https://doi.org/10.1038/d41586-020-00915-7

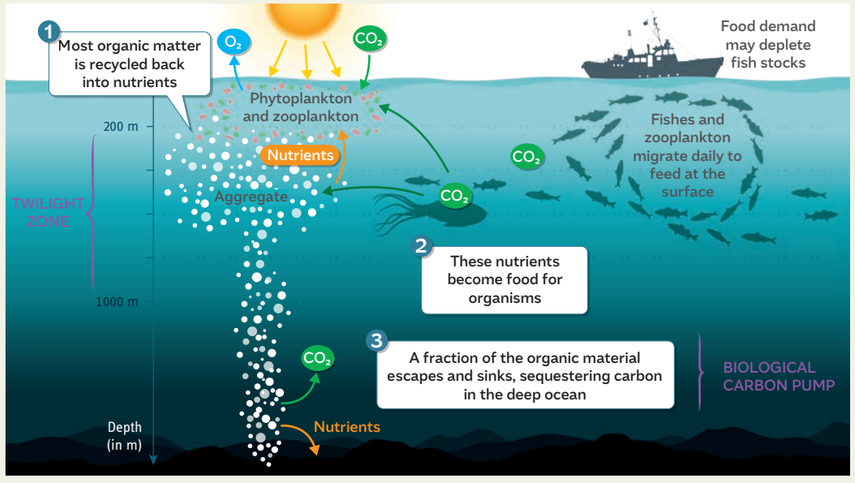
Abstract

The twilight zone has a major role in removing carbon dioxide from the atmosphere and storing it and represents the largest fish stocks of the world's ocean. Yet this mysterious layer between the sunlit ocean and the abyss is poorly understood, physically and biogeochemically. Nevertheless, there is an urgent need to plug these knowledge gaps because this fragile layer is triple threatened: the sea-floor mining could release waste into the region, climate change – altering temperature, acidification and oxygen concentrations – and the growing pressure on fish stocks might affect the food chain there. Recently, imaging systems capable of measuring the size and abundance of organic particles have been added to the Argo BGC floats. They allow to track organic material and might be very useful to better assess complex global ecosystem to inform decisions about the impacts of climate change and potential future exploitation of this twilight zone.

As a matter of fact, the "Phytoplankton growing in the sunlit layer fuel multiple food-supply routes into the zone that sustain organisms from bacteria to giant squid. In the process of consuming this food, and each other, the twilight-zone animals produce CO_2, consume oxygen and release nutrients back into the water. In the winter, cold, windy weather mixes water containing the recycled nutrients with water from the surface layer. In this way, the twilight zone has an important role in supporting phytoplankton growth the next spring. Although winter mixing can release carbon back into the atmosphere, a fraction of it ends up in deeper waters, where it can be locked away, typically for centuries. This downward transport of organic matter, mediated by life in the twilight zone, is called the biological carbon pump, and the twilight zone is central to its strength. This deeper flux of material becomes food for the animals there. The small amount that eventually reaches the sea floor sustains everything from bacteria to sea cucumbers."

This publication eventually highlighted three questions about the elusive and fragile ocean twilight zone that should be prioritized: How many organisms live there, and how diverse are they? Which ecological processes transform and consume organic material? How is organic material transported into and out of the twilight zone?

To obtain the most complete picture possible of the global twilight zone, researchers and institutions should better work in a coordinated way. To this end, Joint Exploration of the Twilight Zone Ocean Network (JETZON) initiative has been launched in 2020 to improve communication and coordination.



The animals influence on recycling of nutrients and long-term storage of carbon in the twilight zone. Climate change and human exploitation are likely to change these functions.

"Preparing the New Phase of Argo: Scientific Achievements of the NAOS Project"

Authors: Pierre-Yves Le Traon et al.
First published: 14 October 2020
https://doi.org/10.3389/fmars.2020.577408

"Preparing the New Phase of Argo: Technological Achievements of the NAOS Project"

Authors: Xavier André et al.
First published: 5 November 2020
https://doi.org/10.3389/fmars.2020.577446

Abstract

The Novel Argo Observing System (NAOS) Equipex project, co-piloted by Ifremer and Sorbonne University, has been a dimensioning project over the last 10 years to consolidate the French contribution to Argo's Core mission and to develop the future generation of French Argo profiling floats. It was devoted to the preparation of the next phase of the Argo program and of its extension to the deep ocean (Deep Argo), the biogeochemistry (BGC Argo) and the polar seas.

It allowed the development of a new generation of floats and the achievement of major technological leaps and scientific breakthroughs that will benefit the Euro-Argo ERIC Members and the entire scientific community. The NAOS realizations are undoubtedly a milestone for the new phase of the Argo international Program and definitively a strong improvement to reach the future challenges of ocean observation.

A stronger French/European contribution to Argo

Thanks to NAOS, the French contribution to Argo international (Argo France) has been unprecedentedly strengthened, with an increase of 5% of observations between 2011 and 2020. The success is still more evident for the extensions, for which NAOS improved dramatically the networks. The NAOS contribution represents also a major support for Europe and its 12 Members, strengthening the EU impact to the global array.

Crucial technological and scientific advances

At global scale, the Argo network fixed a new objective of a "Global, full-depth and multidisciplinary Argo" mission. The NAOS project relevantly contributed by increasing the technical performance of the Core floats, as well as those of the new generation of floats and sensors, which was demonstrated thanks to three pilot experiments in Mediterranean, Arctic and North Atlantic Seas. The technology of NAOS will be further implemented, particularly in the framework of the Euro-Argo RISE project.

More specifically, NAOS developed the Deep Arvor, a deep profiling float that samples the ocean down to 4,000 m depth. A new BGC float, the Provor CTS5-Payload, was designed to facilitate the integration and evaluation of new sensors, and its interest was demonstrated for under ice applications. The project also invested in the direct measurement of Absolute Salinity: the NOSS sensor has been improved and implemented on Provor floats for at-sea demonstration. Finally, an unprecedented work has been done to improve the performance at sea of the French Arvor floats, used for the Core Argo application.

The Mediterranean pilot test for a BGC network demonstrated the feasibility of an operational network of BGC floats has been achieved and dramatically improved our understanding of the physical-biological functioning of the basin. In the Arctic, several complete annual cycles of physical and biogeochemical parameters have been collected for the first time, thanks to the new profiling float named "ProIce", which embeds the ISA algorithm and allows to postpone data transmission in case of ice detection.

The NAOS Deep Argo pilot array demonstrated the feasibility of sampling the ocean beyond 2,000 m depth, thanks to the deployment of many Deep Arvor profiling floats in the subpolar gyre (North Atlantic Ocean). It has been a successful step toward a sustained Deep Argo array, and allowed discovering a new route for North-Atlantic deep-water masses. The dissolved oxygen sensor embedded on the Deep Arvor revealed that oxygen is a key parameter for investigating deep mixing and deep circulation.

150 floats
deployed between 2011 and 2019

3 pilot experiments
preparing future extensions of the Argo core array

10 years
Of technological developments

8 million Euros
Of funding by the French National Research Agency

5 FINANCIAL STATUS

There is a positive balance of about 98K€ in Euro-Argo ERIC 2020 budget execution. This is due, in part, to the contribution of about 218K€ that the ERIC received in 2020 for staff funding from the EU projects. The central ERIC income in 2020 stayed at 340K€ with 11 Member countries and 1 observer.

Salary expenses are around 377K€ (159K€ on ERIC and about 218K€ on projects) and other expenditures of 160K€ with a decrease in business travel due to COVID19 pandemic situation. No floats were purchased this year on the ERIC budget as we preferred to delay it to 2021 when research vessels are operating more routinely. A positive balance of 423K€ (97K€ on the ERIC, 325K€ on projects) is reached at the end of the year 2020.
As far as projects are concerned, the AtlantOS, ENVRIplus, JERICO-next and MOCCA projects ended in 2019 for the first three and in August 2020 for MOCCA and the final payment was received in 2020. The positive balance on these projects correspond to the overheads that are used to pay the satellite telecommunications of the floats that are still alive as well as some communication material to highlight the main achievements. For the four projects that started in 2019, the budget execution is as planned and the payment for the first 18-months period has been received for three of them.

EURO-ARGO 2020 FINANCIAL STATUS

TYPE	DEBIT	CREDIT	TOTAL
INITIAL BALANCE			**781 023**
SG: Sales of goods		806 295	806 295
GC: Grants & Contracts		778 240	778 240
MF: Membership fees		340 000	340 000
II: Interest income		0	0
PG: Purchases of Goods	812 691		-812 691
PE: Personnel costs	376 993		-376 993
TV: Travel costs	10 363		-10 363
MA: Material costs	1 492		-1 492
AC: Accounting fees	8 989		-8 989
BS: Bank services	460		-460
SC: Other subcontracts	117 799		-117 799
DP: Depreciation	172 493		-172 493
TOTAL FLOWS	**1 501 280**	**1 924 535**	
END BALANCE			**1 204 278**

Table 5: Financial status – Summary 2020 – Grand Total.

EVOLUTION OF THE BUDGETS

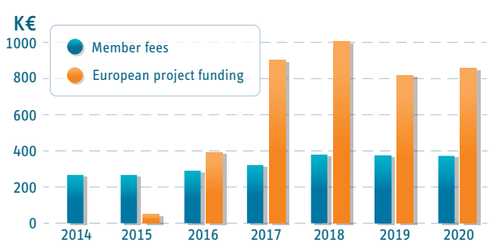


Figure 20: Evolution of the Euro-Argo ERIC budget.

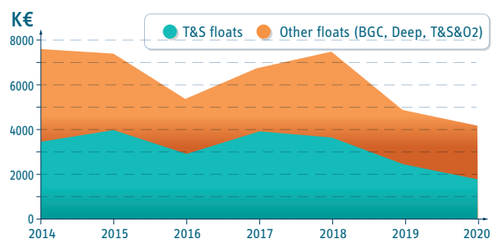


Figure 21: Euro-Argo ERIC float budget evolution.

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ANALYSIS PER PROJECT

	ERIC	ATLANTOS	MOCCA	ENVRI+	JERICO	ENVRI-FAIR	EA RISE	ERIC FORUM	EUROSEA	TOTAL
Purchases of Goods for resale	794 993									794 993
Other cost	52 735		364				522		868	54 489
Insurance			6 060							6 060
Personnel costs	159 167		92 887			18 849	97 239		8 851	376 993
Studies	4 700									4 700
Business travel	-2 584		3 481			2 013	7 453			10 363
Depreciation	17 387	6 196	55 777				2 917		1 639	83 916
Subcontract	24 652		140 710						7 131	172 493
Subtotal	1 051 050	6 196	299 279	0	0	20 862	108 131	0	18 489	1 504 007

	ERIC	ATLANTOS	MOCCA	ENVRI+	JERICO	ENVRI-FAIR	EA RISE	ERIC FORUM	EUROSEA	TOTAL
Sales of goods for resale	806 295									806 295
Operating Grants			593 891			26 077	135 162		23 110	778 240
Subscription members et observers	340 000									340 000
Others income	2 727									2 727
Accounting result	97 972	6 196	294 612	0	0	5 215	27 031	0	4 621	423 255

Table 6: Financial analysis for each project Euro-Argo is involved in.

EURO-ARGO MEMBERS AND OBSERVER 2020 BUDGET

COUNTRY	FLOATS PURCHASED	FLOATS DEPLOYED FROM AIC	FULL TIME EMPLOYEE
Bulgaria	3	2	0.1
Finland	0	3	0.21
France	49	45	10.2
Germany	49	27	2.5
Greece	6	4	0.3
Ireland	3	3	0.1
Italy	22	24	2
Netherlands	5	0	0.08
Norway	15	12	1.8
Poland	0	3	0.75
Spain	4	4	1
UK	17	23	5.3
Total	173	153	24.34

Table 7: Euro-Argo Members and Observer 2020 budget.

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ANNEXES

ANNEX 1 - RISKS & ECONOMIC IMPACTS OF SCIENCE ASSESSED BY BGC & DEEP ARGO

→Assessed by Deep floats

Research that will be supported by the global, full-depth and interdisciplinary Argo array in Europe	ASSOCIATED RISK / ECONOMICAL IMPACT	WHAT WE NEED TO KNOW	HOW DEEP & BGC ARGO WILL HELP ANSWERING THESE QUESTIONS
SEA LEVEL RISE	- coastal flooding - coastal erosion - permanent submergences - loss and change of coastal ecosystems - salinization of soils, ground and surface water - impeded drainage	Reduce the uncertainty in late 21st century SLR (IPCC, Chap 4, WRCP Global Sea Level Group, 2018) Predict the direction & general magnitude of changes in the level of the sea (Commission staff working document, European Marine Observation and Data Network, Impact assessment, 2010) We need to study the sea level budget in terms of time series and not just trends (WRCP Global Sea Level Budget Group, 2018)	Dieng et al 2015: "Priority in terms of observing systems is definitely the development of a deep Argo program and improved coverage of the upper ocean temperature and salinity measurements" Abraham et al. 2013: « given its role in heat content and sea level, special attention should be given to the deep ocean»
EARTH ENERGY BUDGET	climate imbalance / extreme events & associated consequences on built environment	Assure a continuous monitoring of the Earth heat inventory and to reduce the uncertainties (von Schuckmann et al. 2020), with extensions of Argo measurements into the deep ocean layers (Desbruyères et al. 2017, Johnsson et al. 2015)	"A global Deep Argo array of 1200 floats will significantly constrain the deep ocean by reducing temperature and salinity errors by around 50%. Our results also show that such a deep global array will help ocean reanalyses to reduce error in temperature changes below 2000 m, equivalent to global ocean heat fluxes from 0.15 to 0.07Wm22, and from 0.26 to 0.19Wm22 for the entire water column" Gasparin et al. 2019 "Deep Argo floats are capable of accurately measuring regional changes in the deep ocean. The ocean is the largest sink of heat on our warming planet. A global array of Deep Argo floats would provide data on how much Earth's climate system is warming and possibly improve predictions of future warming" Johnson et al. 2019

→Assessed by BGC floats

Research that will be supported by the global, full-depth and interdisciplinary Argo array in Europe	ASSOCIATED RISK / ECONOMICAL IMPACT	WHAT WE NEED TO KNOW	HOW DEEP & BGC ARGO WILL HELP ANSWERING THESE QUESTIONS
EFFECT OF WARMING OCEAN	changes & shifts in nutrients cycling & primary production consequences on food production	More in situ time series datasets to take into account region-specific microbial production drivers in open ocean production trends (IPCC, Chap 5)	"Because physical forcing determines the response of the biological and biogeochemical system, it is possible and highly desirable for maximum utility that the new technology will allow the measurement of physical and biological variables to be conducted at the same resolution" Claustre et al. 2010 (OceanObs09)
DEOXYGENATION		Better assess the overall oxygen loss in the first 1000m of the open ocean (IPCC Chap 5)	"The introduction of oxygen sensors onto Argo floats adds important constraints to our understanding of the temporal and spatial variability of the ocean oxygen cycle" Bushinsky et al. 2017
ACIDIFICATION		Optimise modeling for future projections of ocean acidification (Newton et al. 2012)	"There are currently [2019] 156 floats equipped with pH sensors, producing more than five times as many pH profiles annually as ship-based measurements." Claustre et al. 2020 "To improve the capacity of existing models to yield widespread information on global/basin scale ocean acidification status and trends, the following recommendations are made: [...] Include bio-optical and chemical sensors (e.g., nitrate, oxygen, and pH) on more Argo floats, with temporal sampling frequencies appropriate to establishing interconnections of water masses" Newton et al. 2015
OCEAN CARBON BUDGET	Climate imbalance and feedback loop on above boxes	Reduce uncertainties necessary to constrain the CO2 emissions at regional level (Durant et al. 2011) Quantify the interanual & seasonal variability of ocean CO2 concentration (Le Quéré et al. 2015)	"More data, from all sources, will be required to determine whether these signals are, in fact, illustrating the forced trend in ocean carbon uptake" McKinley at al. 2016 "These new observations [from Argo floats] can also decrease uncertainties in the global carbon budget by providing persistent observations of the carbonate system over a wide range of spatial and temporal scales that shipboard surveys alone cannot offer" William et al. 2018

ANNEX 2 - GLOSSARY

ADMT
Argo Data Management Team

AIC
Argo Information Centre

ARC
Argo Regional Centre

AST
Argo Steering Team

AtlantOS
All-Atlantic Ocean Observing System

BGC
Biogeochemical

BIO
Biogeochemical floats with only 1 to 5 variables

BODC, NOC
British Oceanographic Data Centre, National Oceanography Centre

BOOS
Baltic Operational Oceanographic System

BSH
Bundesamt für Seeschifffahrt und Hydrographie

CDOM
Colored dissolved organic matter

Chla
Chlorophyll a

CMEMS
Copernicus Marine Environment Monitoring System

Core
Standard Argo float measuring temperature and salinity (T/S)

CTD
Conductivity, Temperature, Depth

DAC / GDAC
Data Assembly Centre / Global Data Assembly Centre

DEEP
Argo floats diving to greater depths than 2000 meters

DO
Dissolved Oxygen

DOORS
Developing an Optimal and Open Research Support

DMQC
Delayed Mode Quality Control

EASME / EMFF
Executive Agency for SMEs / European Maritime and Fisheries Fund

EGU
European Geophysical Union

EMODnet
European Marine Observation and Data Network

EMSO
European Multidisciplinary Seafloor and water column Observatory

ENVRI
Environmental and Earth System Research Infrastructures

ENVRI-FAIR
ENVRI- Findable, Accessible, Interoperable and Reusable services

ENVRIplus
ENVRI- Providing Shared Solutions for Science and Society

EOOS
European Ocean Observing System

EOSC
European Open Science Cloud

EOV
Essential Ocean Variables

ERIC
European Research Infrastructure Consortium

ERIC Forum
Network of ERICs to strengthen their coordination and interact effectively with the EC

ESFRI
European Strategy Forum on Research Infrastructures

EU
European Union

Euro-Argo RISE
Euro-Argo Research Infrastructure Sustainability and Enhancement

EuroGOOS
European Global Ocean Observing System

EuroSea
European Ocean Observing and forecasting systems

FMI
Finnish Meteorological Institute

FZJ
Forschungszentrum Jülich

GDAC
Global Data Assembly Centre

GeoEcoMar
The national Institute for Research and Development of Marine Geology and Geoecology of Romania

GEOMAR
Helmholtz-Zentrum für Ozeanforschung Kiel

GOOS
Global Ocean Observing System

HCMR
Hellenic Centre for Marine Research

ICOS
Integrated Carbon Observation System

IEO
Instituto Español de Oceanografía

Ifremer
Institut Français de Recherche pour l'Exploitation de la Mer

IMR
Institute of Marine Research

INTAROS
Integrated Arctic observation system

IOPAN
Institute of Oceanology of the Polish Academy of Sciences

IO-BAS
Institute of Oceanology – Bulgarian Academy of Sciences

IOC
Intergovernmental Oceanographic Commission

IPMA
The national meteorological, seismic, sea and atmospheric organization of Portugal

ISA
Ice Sensing Algorithm

JETZON
Joint Exploration of the Twilight Zone Ocean Network

KNMI
Koninklijk Nederlands Meteorologisch Instituut

LOV
Laboratoire d'Océanographie de Villefranche

MB
Management Board

MI
Marine Institute

MOCCA
Monitoring the Oceans and Climate Change with Argo

MOONGOOS
Mediterranean Operational Network for the Global Ocean Observing System

NAOS
Novel Argo Ocean observing System

NERSC
Nansen Environmental and Remote Sensing Center

NVS
NERC Vocabulary Server

OceanOPS
Meteorology in situ Ocean Observing System Monitoring and Coordination Centre (JCOMMOPS) became OceanOPS in 2019.

OceanOPS
The WMO-IOC Joint Technical Commission for Oceanography and Marine

OGS
Istituto Nazionale di Oceanografia e di Geofisica Sperimentale (National Institute of Oceanography and Applied Geophysics)

OSEs
Observing System Experiments

OSSEs
Observing System Simulation Experiments

OWC
OWC method (Owens and Weng, 2009; Cabanes et al, 2016)

REFINE
Robots Explore plankton-driven Fluxes in the marine twllight zoNE.

R/V
Research vessel

SOCIB
Sistema d'observació i predicció costaner de les Illes Balears (Balearic Islands Coastal Observing and Forecasting System)

STAG
Scientific and Technical Advisory Group

T/S
Temperature/Salinity

WMO
World Meteorological Organization

ANNEX 3 - PARTNERS OF EURO-ARGO ERIC

Country	Statute	Representing Organisation
Bulgaria	Member	IO-BAS
Finland	Member	FMI
France	Member	Ifremer
Germany	Member	BSH
Greece	Member	HCMR
Ireland	Member	MI
Italy	Member	OGS
Netherlands	Member	KNMI
Norway	Member	IMR
Spain	Member	SOCIB, IEO
United Kingdom	Member	Met Office
Poland	Observer	IOPAN

*** The listed institutes represent the Member States, but other institutes in the country can also participate to the Euro-Argo activities.**

ANNEX 4 - EURO-ARGO ERIC GOVERNANCE BODIES

	Profession / Position
Council Members	
Jean-Marie Flaud	*Chair* - MESR France
Pierre-Marie Poulain	OGS – Italy
Jon Turton	Met Office – UK
Aristomenis Karageorgis	HCMR – Greece
Sibren Drijfhout	KNMI – Netherlands
Mikko Strahlendorff	FMI – Finland
Kerstin Jochumsen	BSH – Germany
Marta Tarnogrodzka	Ministry of Science and Higher Education – Poland
Christine Daae Olseng	Research Council of Norway - Norway
Joaquin Tintoré	SOCIB – Spain
Michael Gillooly	Marine Institute - Ireland
Atanas Palazov	Institute of Oceanology - Bulgarian Academy of Sciences - Bulgaria
Pierre-Yves Le Traon	Special Advisor to the French representative - France
Management Board Members	
Birgit Klein	*Chair* – BSH – Germany
Laura Tuomi	*Vice-Chair* – FMI – Finland
Alan Berry	Marine Institute – Ireland
Gerasimos Korres	HCMR – Greece
Pedro Vélez-Belchi	IEO – Spain
Guillaume Maze	Ifremer – France
Kjell Arne Mork	IMR – Norway
Waldemar Walczowski	IOPAN – Poland
Andreas Sterl	KNMI – Netherlands
Matt Donnelly	BODC-NOC – United Kingdom
Giulio Notarstefano	OGS – Italy

	Profession / Position
Euro-Argo ERIC Central Research Infrastructure	
Sylvie Pouliquen	Programme Manager – Ifremer France
Francine Loubrieu	Administrative Assistant – Ifremer France
Romain Cancouët	Operational Engineer – Euro-Argo ERIC
Claire Gourcuff	Science Officer – Euro-Argo ERIC
Estérine Evrard	Euro-Argo RISE Project Manager – Euro-Argo ERIC
Andrea García Juan	Research Engineer
Marine Bollard	Communication Officer
Luca Arduini Plaisant	Research Engineer
Scientific & Technological Advisory Group (STAG)	
Arne Körtzinger	*Chair* – GEOMAR Germany – Research
Inga Lips	EuroGOOS Secretary General – EOOS
Susan Wijffels	WHOI USA – Argo International
Johnny Johannessen	NERSC Norway – Copernicus Marine Service
Philip Browne	ECMWF UK – weather forecasting and Coupled Data Assimilation
One Euro-Argo ERIC expert assists the STAG	
Hervé Claustre	LOV France – Bio-Argo

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Euro-Argo ERIC
Campus Ifremer
Technopôle Brest Iroise
1625 Route de Sainte-Anne
29280 Plouzané
France

Tel.: +33 (0)2 98 22 44 83 | www.euro-argo.eu | contact@euro-argo.eu | @EuroArgoERIC