ANNUAL ACTIVITY REPORT 2018

EURO-ARGO
Research Infrastructure

ANNUAL ACTIVITY REPORT 2018

PREFACE

Welcome Euro-Argo ERIC Annual Activity Report for 2018!

Euro-Argo ERIC is now in its sixth year and continues to provide valuable contribution to the wider international Argo programme. On behalf of the management board, I would like to take this opportunity to thank the Euro-Argo ERIC staff as well as member state representatives for their continued support and hard work which have contributed to a highly successful 2018. Euro-Argo ERIC membership grew in 2018 with Bulgaria and Norway progressing respectively from candidate and observer status to full members of the ERIC, we would like to welcome both countries and look forward to working closely with their member representatives.

Throughout 2018, Euro-Argo directly contributed 33% (279 registered deployments) to the global fleet while maintaining an operational fleet of 835 floats (21% of the global figure that is gradually climbing toward Euro-Argo ERICs' 25% target). These long-term, quality, in-situ observations provided by Argo floats are crucial in better quantifying climate change, understanding the role of the oceans on our climate and assisting decision-makers in making informed decisions.

Euro-Argo ERIC continues to provide a centralised procurement service for its members, ensuring that member states (and observers) can avail of highly competitive prices per float. This essential service allows for increased procurement of floats as well as a higher standard of float in terms of on-board communications and equipment.

One of the main highlights of 2018 was the announcement that the EA-RISE project proposal has been successful. The score of 15/15 from the H2020 evaluation panel illustrates the exemplary effort that went into the submission at proposal phase, led by the Euro-Argo ERIC office with contributions from member representatives. EA-RISE will begin in 2019 for a duration of 48 months with the aim of improving the current network as well as extending Argo observations towards bio-geochemistry, greater depth, partially ice-covered and shallower water regions within a long-term sustainability plan supported by Member States and funding agencies. 2018 has also seen Euro-Argo ERIC as a successful partner in two other EU funded projects 1) ENVRI FAIR, which aims to develop and implement tools in Research Infrastructures for data life cycle, curation and service provision and 2) ERIC Forum, which aims to strengthen coordination and networking between ERICs - both projects will begin in early 2019.

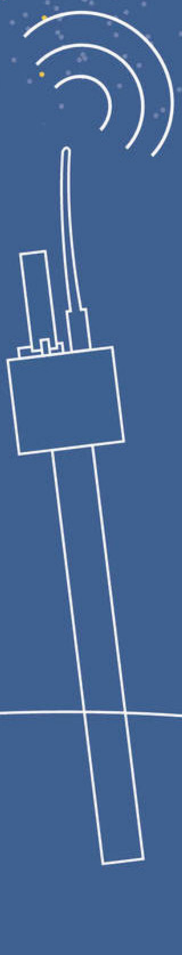
Euro-Argo ERIC continues to deliver high-quality deliverables in the MOCCA, ENVRI+ and AtlantOS projects. The MOCCA project has seen the deployment of ~150 floats (10,289 MOCCA specific observations!) as well as the development of a float 'monitoring tool', which provides a dashboard of relevant on-board technical data. Within the AtlantOS project, Euro-Argo ERIC continues to provide input into the European Strategy for the Atlantic Observing System and is currently working on an implementation document for this strategy. Within ENVRI+, Euro-Argo contributes to enhanced collaboration between European Environmental Research Infrastructures.

In 2018, a number of workshops on data management took place with participants focused on the provision of the best possible Argo quality data (in both real-time for operational activities and delayed mode for climate and scientific studies) for temperature, salinity and biogeochemical data.

2018 ends the first 5-year period of the ERIC and 2019 will define the plans for the next 5-year period, through an evaluation process between the Scientific and Technical Advisory Board and the Council.

Diarmuid Ó Conchubhair

Vice Chair of the Euro-Argo ERIC Management Board



EURO-ARGO

EUROPEAN RESEARCH INFRASTRUCTURE CONSORTIUM FOR OBSERVING THE OCEANS

EXECUTIVE SUMMARY

2018 has been an intense year with a lot of activities carried on in partnership with the Members and Observer, an important involvement in key European projects and the development of new proposals that were all successful.

This year Euro-Argo ERIC welcomed Bulgaria as a new Member, as well as Norway, who changed its status from Observer to Member. The ERIC office team has also grown with the arrival of Andrea Garcia Juan in October, to work on Argo data and at sea monitoring activities in the framework of the MOCCA project.

The total number of floats deployed by the members and the ERIC in 2018 (279), although still below 350, represents more than 25% of the global contribution, with NKE European manufacturer becoming the first provider, for the first time in Argo's history.

In terms of Argo data, more profiles and floats data are available this year on the Global Data Assembly Centre, with an increase of more than 25% compared to 2017. In addition to the Real Time data processing of Argo floats deployed in 2018, activities were carried out within the MOCCA project to improve the overall Argo data quality, such as improvements of regional reference databases (Mediterranean & Black Seas) used to correct Argo data by experts. An effort was made in training the European Argo community, with the organisation of a successful workshop on "Delayed Mode Quality Control", much appreciated by participants.

Last MOCCA floats were deployed in 2018, and the Delayed Mode Quality Control process started for floats deployed earlier (100 floats already available in DMQC). All the AtlantOS floats (Biogeochemical and Deep) have also been deployed and data decoded. An important document on the sustainability of the Argo network in the Atlantic Ocean was also written, contributing to an Atlantic Blueprint document which lays out the principles and plans for a sustained Atlantic observing system for 2030. In the context of ENVRI-plus, in addition to its participation in discussions regarding the sustainability of the ENVRI community, Euro-Argo successfully carried out deployment tests of an Argo float equipped with a pCO2 sensor.

Communication activities were pursued, for instance through the production of exhibition material and the publication of news. The new material was first used for the EOOS (European Ocean Observing System) conference in November, a major event building on three years of community action to strengthen coordination of Europe's capability in ocean observation, monitoring and data collection. The number of twitter followers has continued to increase, reaching 573 followers at the end of the year (increase of 232).

In 2018, Euro-Argo continued seeking additional funds, through the setting up of several proposals in response to H2020 calls issued by the European Commission. The ERIC was involved in the EuroSea, ERIC Forum and ENVRI-FAIR proposals, the latest two granted during summer 2018. More importantly, the ERIC also put especially strong efforts in leading a proposal involving 19 partners (mainly Euro-Argo partners) to move forward Euro-Argo in all its aspects (technology, strategy, links with users, data, etc.) which was also granted in August 2018 (Euro-Argo RISE project). The Grant agreements of the 3 new projects were prepared during the autumn, for a start of projects on 1st of January 2019.

This year, the report highlights two scientific results published in 2018 in which Argo data play a critical role: the study of Conan et al. (2018) on deep convection in the Mediterranean Sea and the study of Keppler et al. (2018) on the characterization of the vertical structure of eddies in the South-West Tropical Pacific.

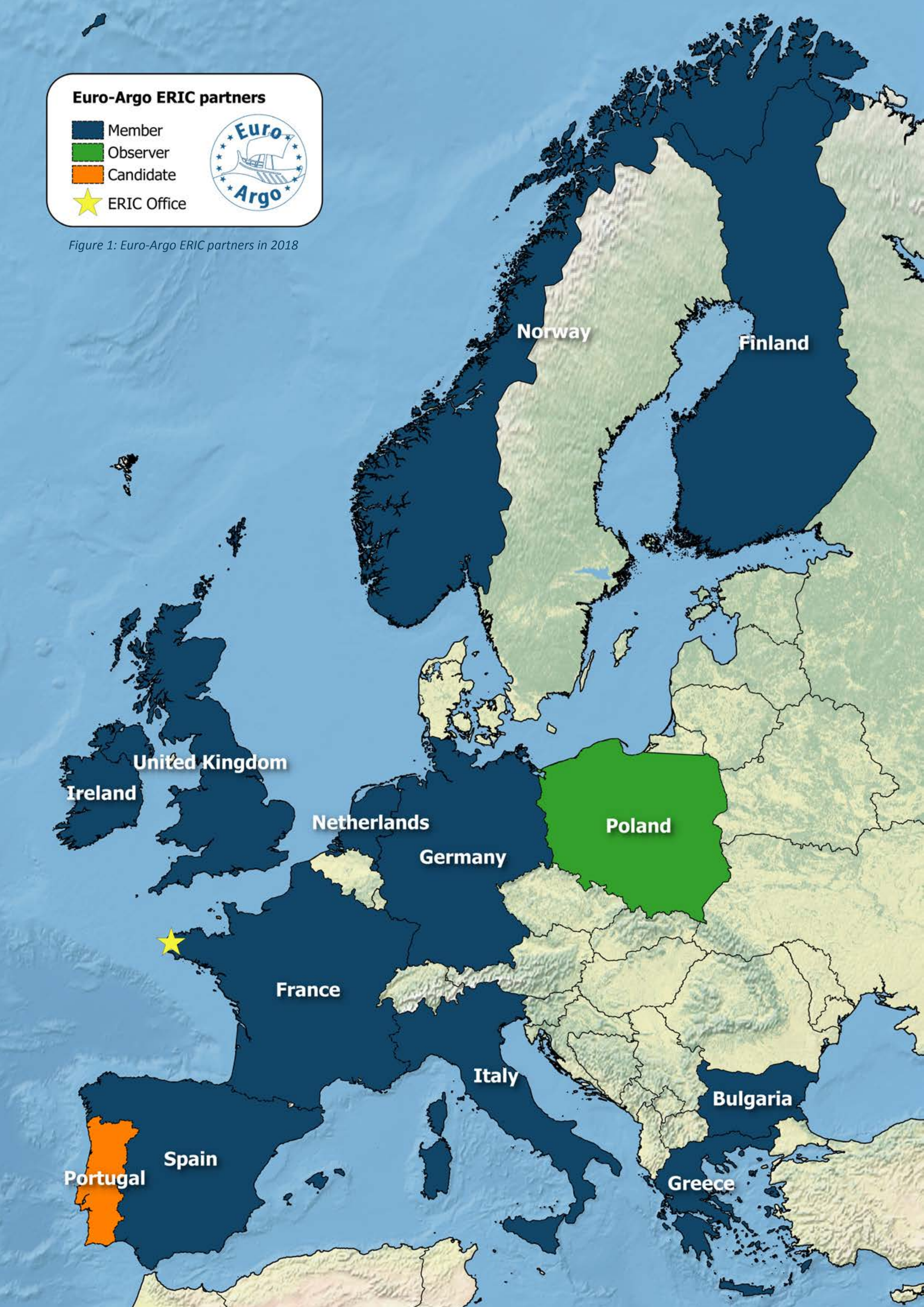


Figure 1: Euro-Argo ERIC partners in 2018

1 MAIN OPERATIONAL OUTCOMES IN 2018

1.1 Euro-Argo ERIC partners

Bulgaria became a new member Milena Damyanova from the Bulgarian Ministry of Education and Science signed the Adherence Agreement that formalises the status of Bulgaria as a full member of the Euro-Argo ERIC.

Figure 2: M. Damyanova (Euro-Argo ERIC Council meeting, Paris, April 2018).

Atanas Palazov and Violeta Slabakova from IO-BAS will represent Bulgaria at Euro-Argo ERIC Council and Management Board respectively.

Figure 3: A. Palazov and V. Slabakova, Bulgarian representatives at the Council and Management Board.

ARGO Bulgaria website

https://www.io-bas.bg/index_en.html

Norway became a new member Odd Ivar Eriksen from the Research Council of Norway signed the Adherence Agreement that formalises the status of Norway as a full member of the Euro-Argo ERIC. Norway has been involved in Euro-Argo activities since 2014 as an observer.

Figure 4: O.I. Eriksen, S. Pouliquen and J-M. Flaud (Euro-Argo ERIC Council meeting, Paris, November 2018).

ARGO Norway website

https://norargo.hi.no/

1.2 Euro-Argo ERIC Office team

Andrea Garcia-Juan has been hired to assist the Euro-Argo ERIC Office team in Argo fleet at sea monitoring activities, in the frame of the MOCCA project. She has been working on capturing the results of the Delayed-Mode Quality Control (DMQC), and investigating possible relationships between weather conditions and floats behaviour and performances (data transmission, positioning, etc.).

Figure 5: Andrea Garcia- Juan, hired on the MOCCA project.

Figure 6: The Euro-Argo ERIC Office team, Dec. 2018

1.3 Management of the Euro-Argo ERIC

In 2018, the Euro-Argo ERIC worked along six main activities:

- Management of the ERIC;
- Coordination of Euro-Argo float deployments and float monitoring activities;
- ERIC Office activities in EU projects (MOCCA, AtlantOS, ENVRIplus) and other networks (ERIC Forum, ESFRI, etc.);
- Communication and outreach;
- Continuing seeking for additional long-term support from the European Commission.

Two Council and three Management Board (MB) meetings were organised during 2018:

- The 12th MB meeting on 27-28 February in Liverpool;
- The 9th Council meeting on 5 April in Paris;
- The 13th MB meeting on 26-27 June in Bergen;
- The 14th MB meeting, on 30-31 October in Lisbon. A side meeting was organised with Portuguese ministries, as Portugal is working at becoming a member of the ERIC.
- The 10th Council meeting on 15 November in Paris.

1.4 Float procurement and deployment: status and plans

1.4.1 Euro-Argo ERIC purchases floats for its members

Since 2017 a service for float procurement is available for Euro-Argo partners. This concerns standard Temperature and Salinity (T/S) core Argo floats, as well as Deep floats. Options for Dissolved Oxygen (DO) measurements, and Ice Sensing Algorithm (ISA) for deployments in high-latitude regions can also be purchased.

NKE float manufacturer is currently awarded (from the pluri-annual calls for tender set up in 2016 and 2017) for the framework agreements.

For floats purchased through this contract, Euro-Argo Office technical team proposes to its members to deal with the inbounding logistics (follow-up of the manufacturing process, delivery dates, coordination of the telecommunication contracts opening), to handle the acceptance tests in the Ifremer testing facilities (sea-water basin for real profiling down to 20 metres) and finally to ship the material either to the purchasing institutes, or directly to the deployments ports of call. Assistance for the handling of float metadata for the data centre, as well as at sea monitoring is also dispensed.

The details of the **42 floats purchased in 2018**, for a total of nearly seven hundred thousand euros, are provided below.

BATCH	COUNTRY	NB FLOATS	TYPE AND OPTIONS
ORDER 1	NORWAY	4	T/S + ISA
	POLAND	1	T/S + DO
	POLAND	3	T/S + ISA
	ITALY	8	T/S
	ITALY	7	T/S + ISA
	ITALY	5	T/S + DO
ORDER 2	IRELAND	4	T/S
	IRELAND	2	T/S + DO
	NORWAY	5	T/S + ISA
ORDER 3	ITALY	3	DEEP + DO
TOTAL 2018		42 floats	695 k€

Table 1: Common float procurement in 2018, on behalf of Euro-Argo members.

1.4.2 Partnership between Euro-Argo and Orange Marine

Initiated in 2017, the collaboration between the submarine telecommunications company Orange Marine and Euro-Argo has been further enhanced this year. Orange Marine is eager to take part in the international Argo programme for observing the Ocean, making available - when possible - its fleet of cable ships to deploy some floats during transit routes. This has been a great opportunity to launch 4 floats in a scarcely frequented area in the South Pacific, during the voyage of C/S René Descartes between French Polynesia and Patagonia.

1.4.3 Contribution to the Argo international programme

The geographical repartition of Euro-Argo national contributions in 2018 is shown per countries in figure 9, and European deployments for 2018 are compared to the global ones in Figure 8.

1.4.4 Implementation of the Euro-Argo strategy for the next decade

Euro-Argo continued to implement the new phase of Argo, following the "Strategy for evolution of Argo in Europe" (Euro-Argo ERIC, 2017[1]). This reference document, which will be regularly revised to consider both technological developments and the international Argo strategy, provides recommendations on Argo floats deployments, including insights on the European contribution to the core Argo programme (T&S), and targets in terms of the number of floats to deploy for the new components of Argo: BGC and Deep Argo, marginal seas and high-latitude regions.

The European partners aim at sustaining about ¼ of the entire Argo array which requires the capacity to procure and deploy about 350 floats (250 T&S, 50 Deep and 50 BGC) per year, to monitor these floats properly and to ensure all data can be processed and delivered to users in a timely manner. Euro-Argo ensures that the European deployments fulfil both the international Argo programme requirements in terms of geographical repartition and the European scientific and operational oceanography community's needs.

Figure 7: Deployment of an Argo float from cable ship René Descartes in Dec. 2018 (© Orange Marine).

[1] Euro-Argo ERIC (2017). **Strategy for evolution of Argo in Europe**. EA-2016-ERIC-STRAT. *http://doi.org/10.13155/48526*

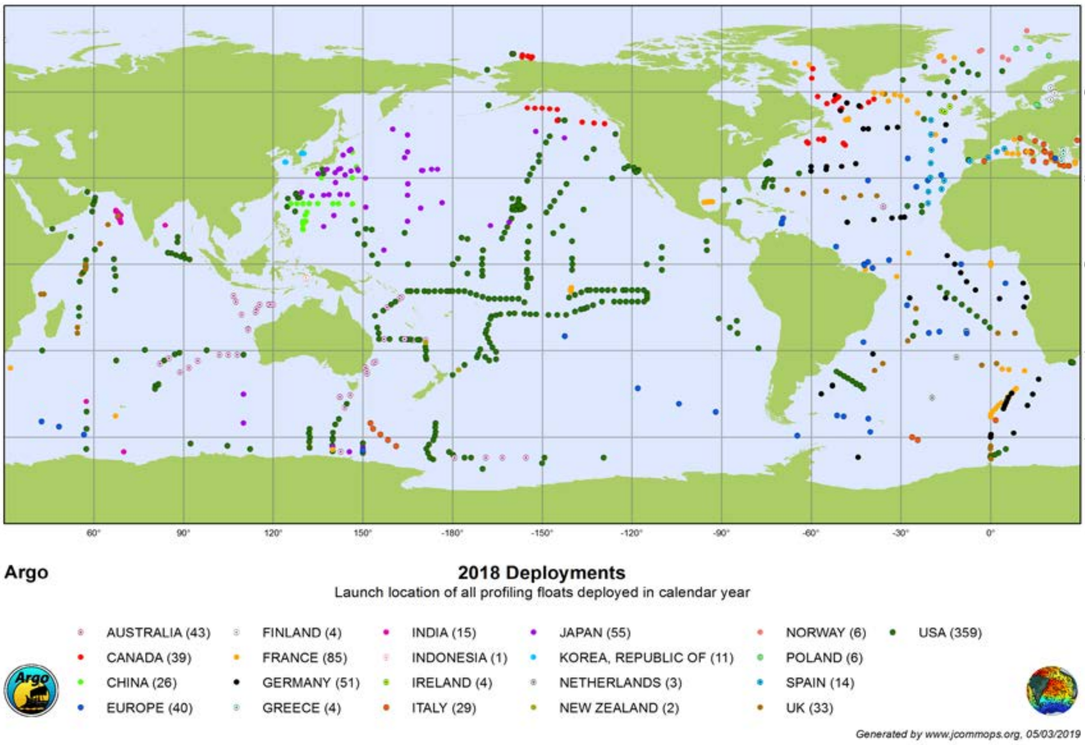


Figure 8: Argo 2018 deployments: 279 Euro-Argo floats among the 830 deployed in 2018, representing 33% of the deployments (© JCOMMOPS/AIC).

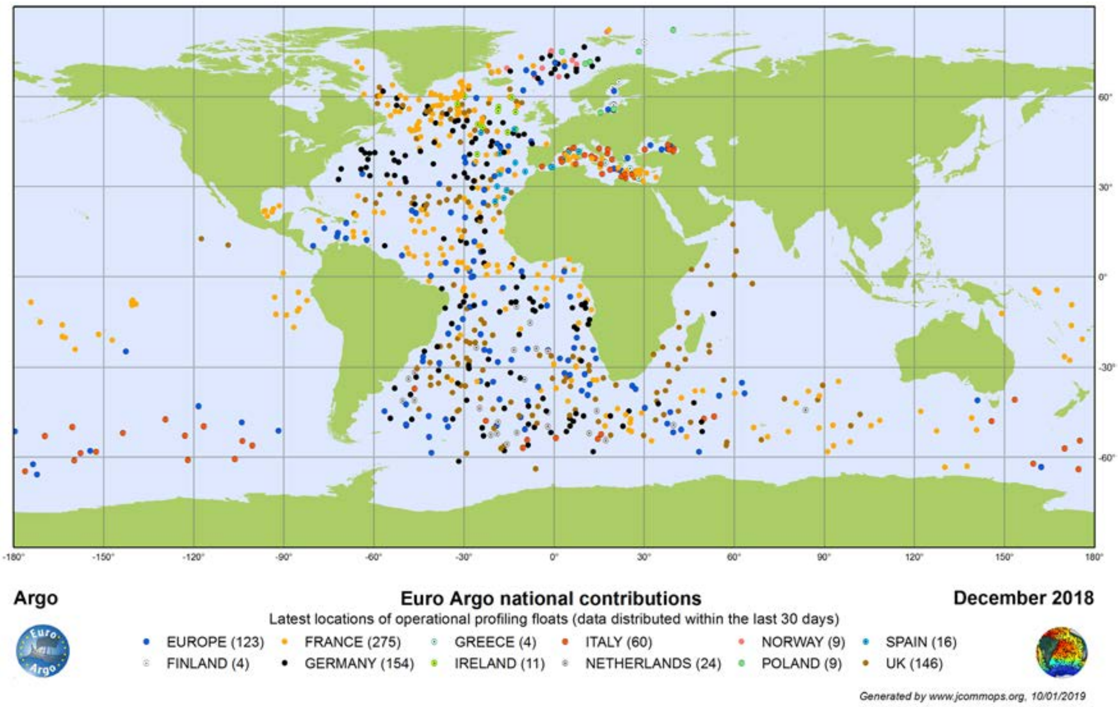


Figure 9: Euro-Argo national contributions per country: 835 active floats among the 3895 active floats, about 22% of the network (© JCOMMOPS/AIC).

Status of European floats for 2018	T/S Core			T/S/O2			BGC			Deep			Total (any float type)		
	Target	Deployed	Gap	Target	Deployed	Gap	Target	Deployed	Gap	Target	Deployed	Gap	Target	Deployed	Gap
Nordic Seas	7	11	4	5		-5	3		-3				15	**11**	-4
Mediterranean Sea	15	26	11	8	6	-2	7	14	7		1	1	30	**47**	17
Black Sea	2		-2	1		-1	2	1	-1				5	**1**	-4
Baltic Sea		4	4	1	3	2	3	1	-2				4	**8**	4
Southern Ocean	15	8	-7				10	2	-8		3	3	25	**13**	-12
Arctic Ocean		2	2					2	2					**4**	4
Global Ocean	135	162	27	61	10	-51	25	8	-17	50	15	-35	271	**195**	-76
Total	174	**213**	**39**	76	**19**	**-57**	50	**28**	**-22**	50	**19**	**-31**	350	**279**	**-71**

Table 2: European float deployments in 2018, broken down by per type of float and region, compared to Euro-Argo targets identified in the strategy document.

	2015			2016			2017			2018			2019 (estimates)		
	core-Argo	*BGC & Deep*	total	*core-Argo*	*BGC & Deep*	total	*core-Argo*	*BGC & Deep*	total	*core-Argo*	*BGC & Deep*	total	*core-Argo*	*BGC & Deep*	total
E.U.	1	4	5	36		36	52	5	57	31	9	40	18	5	23
Bulgaria													1	1	2
Finland		2	2	2	1	3	2	3	5	3	1	4	2	2	4
France	101	30	131	34	23	57	46	23	69	55	30	85	60	23	83
Germany	76		76	39		39	50		50	48	3	51	52	3	55
Greece	4	1	5	2	1	3	3		3	3	1	4	3	2	5
Ireland	2		2	3		3	3		3	4		4	2	1	3
Italy	21	5	26	22	8	30	21	5	26	19	10	29	21	7	28
Netherlands	2		2	3		3	12		12	3		3	2		2
Norway				1	1	2				6		6	4	10	14
Poland	3		3	3		3	3		3	3	3	6	2	1	3
Spain	1		1		1	1	3		3	14		14	13		13
U.K.	26	6	32	27	7	34	43	10	53	24	9	33	25		25
TOTAL	**237**	**48**	**285**	**172**	**42**	**214**	**238**	**46**	**284**	**213**	**66**	**279**	**205**	**55**	**260**

Table 3: Float deployments 2015-2018 and plans for 2019.

Table 2 shows the number of floats deployed in 2018 compared to the targets fixed in the strategy (Euro-Argo ERIC, 2017), both in terms of location and float type, to achieve an appropriate number of operational floats in each region. Table 3 indicates the deployment status compared to previous years (2015-2017) and the estimation for 2019.

In 2018 a total of 279 floats were deployed (figure 8), slightly less than in 2017 (284), mainly due to the end of MOCCA and AtlantOS deployments (floats funded by EC), that have complemented the national contributions that stayed stable (for the evolution on a longer period and as a percentage of international numbers, see section 4).

1.5 Data Processing

Euro-Argo plays an active role in Argo data management, through 3 elements:

• **One Global Data Assembly Centre (GDAC),** Coriolis, in France, proposing services to the operational and research communities;

• **Two Data Assembly Centres (DACs)** in Europe: The French DAC (Coriolis) processes float data deployed by France and 10 European countries (Bulgaria, Finland, Germany, Greece, Italy, Finland, Netherlands, Norway, Poland and Spain). The UK DAC (BODC) handles all UK and Irish float data. EU-funded floats are managed by Coriolis and/or BODC, depending on projects.

• For the **Delayed-Mode Quality Control (DMQC)**, Euro-Argo partners contribute with 4 DM operators (BSH, Coriolis, OGS and BODC) and the coordination of **3 Argo Regional Centres (ARCs)**: the Atlantic ARC (NA-ARC), the Mediterranean and Black Seas ARC (Med-ARC) and the Southern Ocean ARC (SO-ARC). In 2018, the **first European DMQC workshop** took place (see chapter 1.6.2), providing a springboard for further collaborations at European level.

Thanks to the Euro-Argo ERIC, the European Argo data system is strengthened to ensure it is able to process all European floats and deliver the data to users, thus improving Europe's ability to meet its data processing commitments to the global Argo programme (Coriolis GDAC, NA-ARC, Med-ARC and SO-ARCs).

Every effort is made to deliver data with delays as short as possible and with extensive quality control. Both Real-time (less than 24 hours) and delayed mode delivery systems are addressed. The quality control procedures are the most stringent for the delayed-mode data stream which is designed to deliver data for climate studies.

In 2018, 4 740 active floats have been processed on Argo GDAC, which represents more than 170 000 profiles collected during the year (Figure 11).

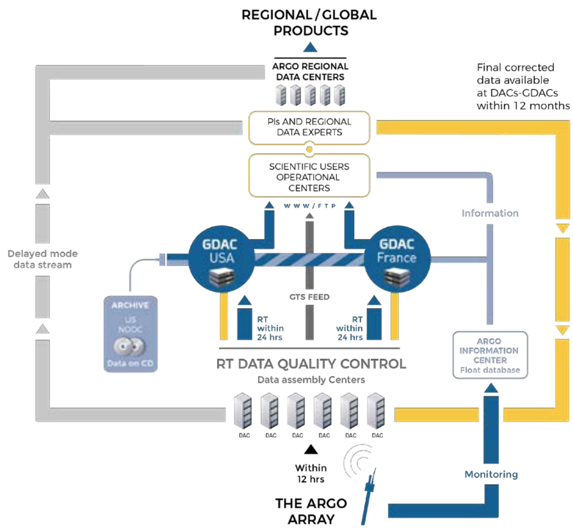


Figure 10: Argo Data Flow.

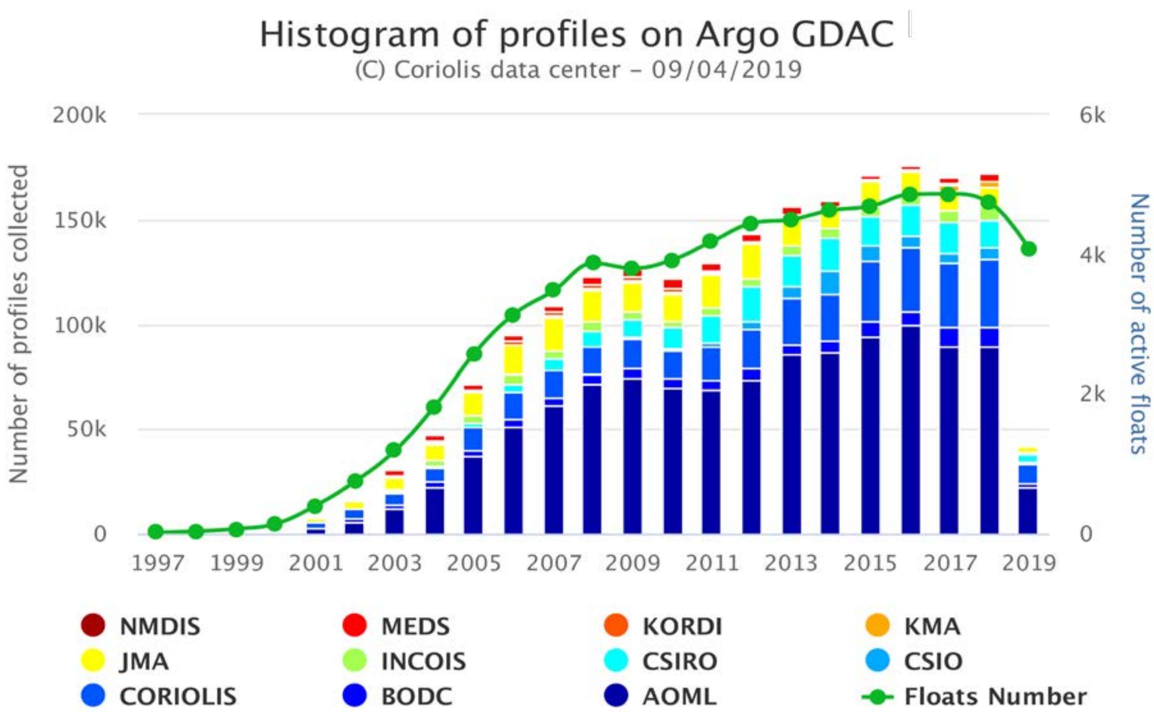


Figure 11: Histogram of active floats and profiles collected on Argo GDAC. Colours indicate the contribution of each National Data Centre (© Coriolis Data Centre - 09/04/2019). Warning: the green line displays the total of floats that are active during a year. This total is different from the number of floats active on a particular day.

In 2018 and in the frame of the MOCCA project, a great improvement of the CTD and Argo reference databases in the Mediterranean and Black seas has been attained, thanks to OGS. Datasets collected from different sources (CMEMS, ship cruises, etc.) have been merged (see Figure 13), and led the possibility to fill some gaps both in time and space. This has notably benefited to the DMQC of the floats in the region. Furthermore, OGS started DMQC training activity with people from IO-BAS (Bulgaria) for operations in the Black Sea.

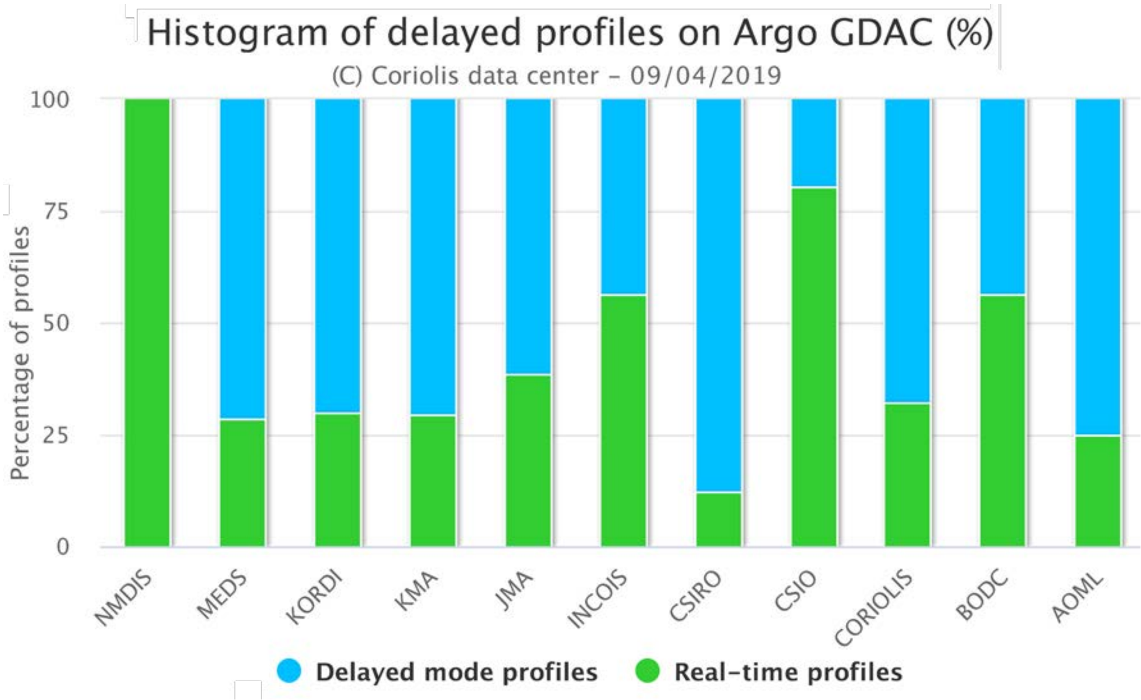


Figure 12: Status of DMQC processing for Argo (Coriolis and BODC are related to the European fleet).

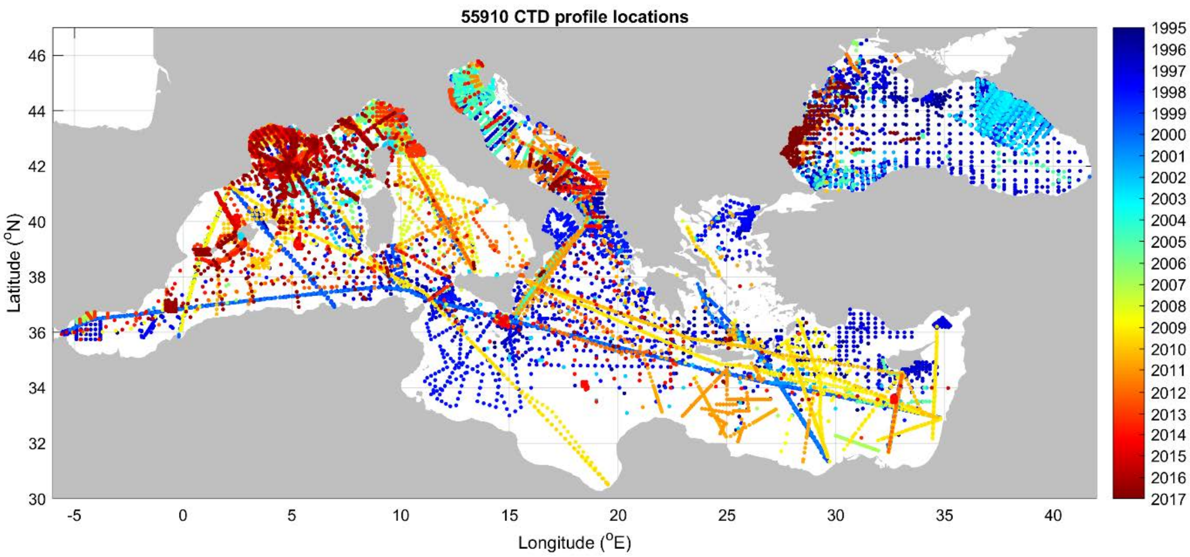


Figure 13: Spatial distribution, color-coded for time, of the CTD profiles in the final version of the CTD reference dataset of the Mediterranean and Black Seas (© OGS).

1.6 Communication and Outreach

1.6.1 Communication plan and tools

The Euro-Argo ERIC maintains its informational materials up to date and keep them attractive for the various kinds of attendance (public, scientists, educational world, stakeholders, manufacturers, etc.).

1. Booth materials (transparent demo floats, rolling posters, goodies) within a carry-on box have been made available for Euro-Argo partners in 2018.
2. A general one-page A4 leaflet (electronic format) was translated, when desired, by each country in its native language.

Two Euro-Argo News Briefs were released in 2018. *https://www.euro-argo.eu/News-Meetings/News/News-Briefs.*

Figure 14: Booth materials at EOOS Conference, Brussels, 2018

1.6.2 1st European Argo DMQC workshop

The event was jointly organised in Brest, France, 17-18 April, by the Euro-Argo ERIC and participants to the MOCCA project, to start answering requirements from European partners to develop understanding of Argo DMQC and possibly – in the longer term – DMQC capabilities for their own floats.

Figure 15: 1st EU DMQC workshop. 1st day: Argo Data Flow presentation (© Euro-Argo ERIC).

The workshop gathered **32 persons from 12 countries**, including Argo DMQC beginners and 7 experts in DMQC among whom Breck Owens, from WHOI (USA), Argo Director, who honoured us with his presence (Figures 15 and 18).

1.6.3 Other events

Table 4 lists all events attended by the ERIC office or Members representatives in 2018. Some are detailed hereafter.

- **4th GEO Blue Planet Symposium** on July 4-6 in Toulouse, was organised by GEO BLUE PLANET and MERCATOR OCEAN, operator of the Copernicus Marine Service of the European Union. It served as a forum for discussion of ocean and coastal information needs for sustainable development, Blue Growth and societal awareness. The Euro-Argo ERIC presented a poster highlighting the European strategy for the next decade and the potential of Argo in support to research and operational oceanography. Argo is a key observing system intensively used by the Copernicus Marine Service in support of downstream services development and Blue economy.

https://geoblueplanet.org/

BLUE PLANET Oceans and Society a GEO Initiative

- **Argo and the Space Week in Ireland**

This Ireland's newest national STEM week, in parallel with World Space Week, takes place every first week in October. Students, families, community groups come together with the space community, the broader educational community, artists, and space scientists to use the powers of creativity, critical thinking, science, technology, engineering and maths to focus on the wonders and realities of the Universe around us. An opportunity to recall that the Argo programme relies on satellites for data transfer with a poster (Figure 16).

Figure 16: Marine Institute Argo Poster

- **European Ocean Observing System (EOOS) Conference**

On November 21-23, ocean observing and monitoring communities from across Europe gathered at the EOOS Conference 2018 in Brussels to showcase existing efforts in ocean observation, connect across communities and make progress towards stronger coordination and sustainability in Europe.

Figure 17: Birgit Klein - EOOS Conference (© Euro-Argo ERIC).

The Conference received financial support from the European Commission (DG MARE) and was co-organized by the EMODnet, European Marine Board and EuroGOOS Secretariats. With over 350 registrations, participants ranged from marine research and infrastructure communities to hydrographic offices, environmental monitoring and ocean industry sectors including aquaculture, fisheries, renewable energy. International experts also provided key inputs on regional efforts worldwide, including presentations from Canada, the U.S.A. and China. In addition to Plenary sessions, ideas and inputs from all participants were encouraged through Breakout discussions, poster pitch presentations and exhibit booths.

In addition to the Euro-Argo booth, a poster on the Euro-Argo strategy for the future was displayed and presented by Birgit (Chair of the Management Board).

Figure 18: 1st European DMQC workshop participants. Brest, April 2018 (© Euro-Argo ERIC).

Description	Location	2018
INTAROS General Assembly	Helsinki, Finland	9-12 January
19th Argo Steering Team meeting	Sidney, Canada	12-15 March
EGU General Assembly 2018	Vienna, Austria	8-13 April
1st European Argo DMQC workshop	Brest, France	17-18 April
6th ENVRI week	Zandvoort, Netherlands	14-18 May
EuroGOOS General Assembly	Brussels, Belgium	23-24 May
European Strategy for Atlantic Observing System	Brussels, Belgium	4-5 June
POLAR 2018 Open Science Conference	Davos, Switzerland	15-26 June
CMEMS in situ requirements Workshop	Toulouse, France	3 July
4th GEO Blue Planet Symposium	Toulouse, France	4-6 July
OCB Biogeochemical Profiling Float Workshop	Seattle, USA	9-13 July
Space Week Ireland	Ireland	8 October
6th Argo Science Workshop	Tokyo, Japan	22-24 October
TAOS meeting	Marseille, France	24-26 October
European Strategy Forum on ESFRI	Milan, Italy	19-20 November
European Ocean Observing System (EOOS) Conference	Brussels, Belgium	21-23 November
ERIC forum	Malaga, Spain	26-30 November
Conference of the Research Infrastructures and the Paris Agreement on Climate	Brussels, Belgium	20-21 November
19th Argo Data Management Team meeting	San Diego, USA	2-7 December
7th MonGOOS Meeting & Workshop	Genoa, Italy	5-6 December

Table 4: Chronological list of workshops 2018 in which Euro-Argo ERIC were involved.

2. PROJECTS WHERE EURO-ARGO WAS INVOLVED IN 2018

2.1 MOCCA (2015-2020)

The MOCCA project (Monitoring the Oceans and Climate Change with Argo, DG-MARE EASME/EMFF) started in June 2015 and is scheduled for a 5-year period. With a EU contribution of 4M€, the ERIC with its members added an additional 20% (i.e. 1M€) that generated a total of 5M€, allowing three actions:

- Procurement of 150 T&S Argo floats (core) during 2015-2016,
- Arrangements for their deployment in 2016-2018, including at sea monitoring activities,
- Data processing in real-time and delayed-mode, during the period 2016-2020.

In 2018 MOCCA activities were organised around 3 actions: coordination (ERIC Office), deployments & at sea monitoring (ERIC Office with MOCCA partners) and Data Management (BSH, BODC, OGS and Ifremer). The year 2018 saw the **end of the MOCCA deployments** phase, with the last launch on 30 December in the Southern Pacific (51°S). With the 31 floats deployed in 2018, the fleet of 150 MOCCA acquired more than 11,500 CTD profiles so far.

MOCCA deployment locations were well in line with the Euro-Argo strategy, with a focus in 2018 towards the **Southern Ocean** (South-Atlantic, South Pacific, South-Indian, Drake Passage), **marginal seas** (Baltic) and **equatorial regions.**

At sea monitoring refers to a system that allows to monitor (e.g. through dashboards and alerts) a float and the evolution of its technical parameters (e.g., battery voltage, grounding, data transmission by satellite, etc.) after deployment. Euro-Argo has developed such a system as part of the MOCCA project to monitor the behaviour of the MOCCA fleet. It consists of a website page (www.ifremer.fr/argoMonitoring/floatMonitoring/632), that for each float displays all available information, ranging from metadata, float trajectory and scientific data collected, to its technical parameters evolution in time.

Additionally, in-depth studies of float behaviour in sensitive environments (shallow waters like the Baltic Sea, seasonally ice-covered areas, etc.) have been conducted.

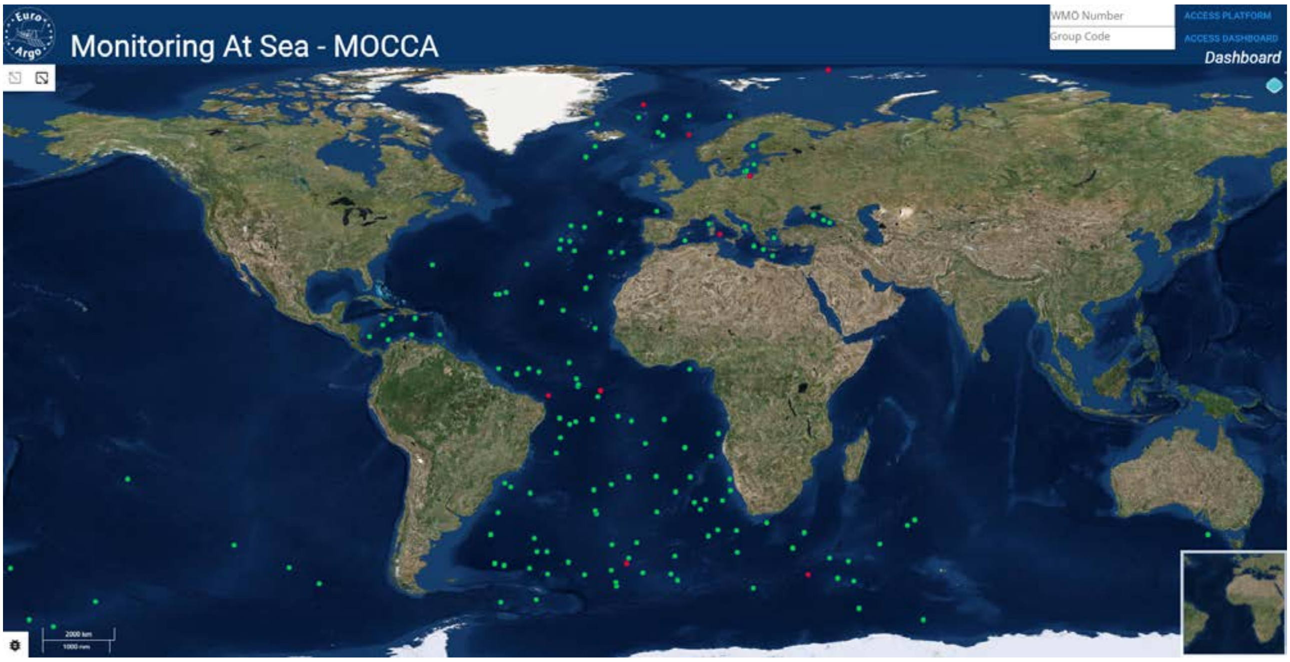


Figure 19: Last positions of MOCCA floats. Green dots indicate active floats and red dots dead or recovered Argo floats. (© ERIC Office – April 2019)

The different tools have been used all together to produce an extensive report on the monitoring of MOCCA floats. Globally the fleet is operating well. 6 floats were lost without any evident reason. 2 floats were recovered (sensors and hull issues) and have been redeployed after factory check. 1 is still malfunctioning (pressure sensor issue) and drifting at the surface.

The at sea monitoring system developed within MOCCA will be further enhanced to cover most of the European fleet.

Real-time processing is going on at both BODC and Ifremer and data are delivered in a timely manner. Delayed-Mode processing has been a prominent activity in 2018, with more than 100 floats DMQC'ed between the partners (BODC, BSH, IFREMER, OGS). The investigation of potential fast salinity drift (major problem affecting some Sea-Bird CTDs in the Argo array) was in direct line of sight. It happened that about 10% of the MOCCA fleet is concerned.

The **1st DMQC Workshop** at EU level has been organised in April, to share best practices and train new teams to this activity. Other **data management** actions such as CTD reference database updates or thematic studies (e.g. determination of ice-sensing algorithms thresholds for deployments in the Nordic Seas) have also been conducted.

MOCCA website

https://www.EURO-ARGO/EU-Projects-Contribution/MOCCA

Figure 20: Left: MOCCA float deployed during the NICO (Netherlands Initiative Changing Oceans) cruise in the Caribbean Sea. Measurements helped to document the background hydrography of the Caribbean Sea as well as the hydrographic and velocity structure of a Caribbean anticyclone (© NIOZ).
Top right: 3 MOCCA floats launched close to 60°S during a circumnavigation of the Antarctica by Katharsis II sailing vessel crew (©Piotr Kukliński, IOPAN).
Bottom right: Synergies between Euro-Argo and EMSO (European Multidisciplinary Seafloor and Water Column Observatory) ERICs in the Eastern Mediterranean Sea, with the deployment of at MOCCA float at the location of the EMSO Hellenic Arc node (© HCMR).

2.2 AtlantOS H2020 project (2015-2019)

Contributing to the AtlantOS H2020 project (2015-2019), coordinated by the GEOMAR, Kiel (Germany), the Euro-Argo ERIC leads the Argo task (task 3.1) from autonomous platform WP (WP3) activities. With contributions from Ifremer, LOV, GEOMAR and its partners, the Euro-Argo ERIC contributed to the progressive extension of the Argo core mission towards the deep ocean and biogeochemistry, and develops long-term plans:

- Deploy 7 deep oxygen and 6 BGC-Argo floats in the North-Atlantic,
- Work on improving BGC-Argo float capabilities, especially to adapt new biogeochemical sensors, and integrating a pCO2 sensor on autonomous platforms,
- Refine DMQC processing and achieve the objective to deliver a consistent Argo and BGC-Argo dataset for the Atlantic,
- Work on the long-term sustainability issues for BGC-Argo and Deep-Argo after the AtlantOS pilot project.

Figure 21: Deployment cruises and positions for AtlantOS Biogeochemical and Deep floats

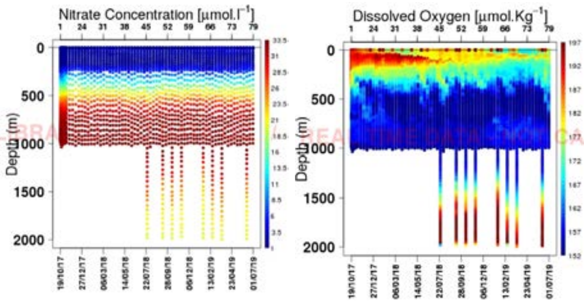


Figure 22: First year of data acquired by the AtlantOS biogeochemical float # 3902125

http://www.oao.obs-vlfr.fr/bioargo/PHP/eribio006b/eribio006b.jpeg

In 2018, all deployments of both Biogeochemical and Deep Argo floats purchased by Euro-Argo under the AtlantOS project have been completed successfully.

A dedicated group has been set on the Euro-Argo at-sea monitoring web tool allowing to manage all technical aspects of the AtlantOS fleet. Data are sent in real time to the Coriolis Data Assembly Centre where corresponding decoding chains have been implemented including the Real Time quality control for Biogeochemical parameters following the specifications of Argo Data Management Team working groups.

Euro-Argo has also contributed for the Argo network to the vision of a sustained Atlantic observing system for 2030, ending in the Atlantic Blueprint document which lays out the principles and plans for sustained ocean observations in the North and South Atlantic Ocean.

Three deliverables have been completed concerning:

- the enhancement of the Argo network in Atlantic ocean – technical improvements and deployments,
- the assessment of a qualified AtlantOS dataset in both Real Time and Delayed mode,
- the sustainability of the Argo network in the Atlantic Ocean.

As part of WP1, Observing System Simulation Experiments (OSSEs) have been performed using four different global eddy-permitting systems to assess the impact of existing elements as well as further evolutions of the Integrated Atlantic Ocean Observing System in constraining the ocean model state from a CMEMS (Copernicus Marine Environment Monitoring System) monitoring and forecasting perspective. This work, detailed in Gasparin et al. (2019) shows that the doubling of Argo in Western Boundary Currents and along the equator significantly improves both temperature and salinity for the entire Atlantic Ocean (between 5 and 10% error reduction compared to the backbone design). Similarly, the implementation of a deep Argo array (1 float every 5°x5° square), which reports monthly measurements of the water column down to 4,000 m or to the bottom, shows a significant impact in controlling the temperature and salinity biases in the deep ocean basins. One of the 4 systems even showed an improvement of up to 20% of error reduction in a limited area. These encouraging results should be confirmed by performing experiments on a longer period (around a decade) to assess the reduction in error of the long-term trends in the deep ocean due to the deep Argo array.

References

Gasparin F, Guinehut S, Mao C, Mirouze I, Rémy E, King RR, Hamon M, Reid R, Storto A, Le Traon P-Y, Martin MJ and Masina S (2019), Requirements for an Integrated in situ Atlantic Ocean Observing System From Coordinated Observing System Simulation Experiments. Front. Mar. Sci. 6:83. doi: 10.3389/fmars.2019.00083.

AtlantOS website

https://www.atlanteos-h2020.eu

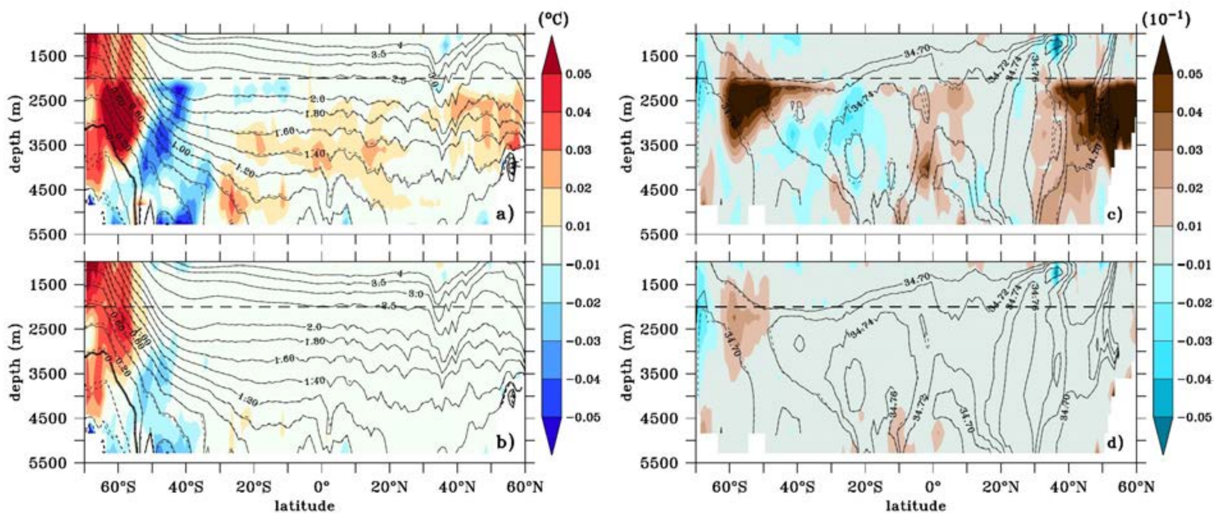


Figure 23: Zonally averaged 2009-2013 mean temperature and salinity errors versus depth. Gasparin et al., (2019). Under Review in Journal of Climate.

Gasparin, F., M. Hamon, E. Remy, P.Y. Le Traon, (2019) How deep Argo will improve the deep ocean in an ocean reanalysis, In revision in Journal of Climate.

2.3 ENVRIplus (2015-2019)

The ENVRIplus H2020 project aims at bringing together Environmental and Earth System Research Infrastructures, projects and networks together with technical specialist partners to create a more coherent, interdisciplinary and interoperable cluster of Environmental Research Infrastructures across Europe. ENVRIplus has 37 partners from 13 European countries.

The Euro-Argo ERIC is involved in 2 of 6 themes ("Technological innovations" and "Data for Science") with some activities in communication/ outreach. It is also member of the BEERI (Board of European Environmental Research Infrastructures) which is the advisory body for the ENVRIplus coordination.

Within the work package 1.3, the Euro-Argo ERIC has monitored the completion of a development task concerning the implementation of a pCO2 sensor on an Argo profiling float. All developments have been carried out in collaboration with IFREMER RDT team, the float has been tested in the acceptance basin, and then deployed in the Mediterranean Sea for a validation campaign.

First results show that the float is operating accordingly to the expectations, some work has still to be carried out to better calibrate the pCO2 data and the sampling strategy. A new validating campaign is foreseen for spring 2019, with a longer deployment and a collaboration with the sensor's manufacturer to improve the scientific quality of the pCO2 concentration data throughout the entire water column.

Two deliverables are in preparation concerning this development task, and Euro-Argo contributed also to two additional deliverables:

- for the continuity of measurements from satellite measurements to in-situ data,
- for the sustainability of environmental RIs after the project completion.

Figure 24: The ERIC is involved in 2 of 6 ENVRIplus themes

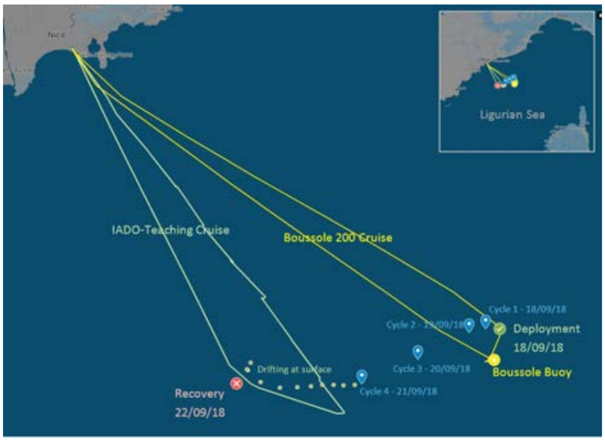


Figure 25. Deployment and recovery of the pCO2 profiling float prototype in the Ligurian Sea – Sept. 2018

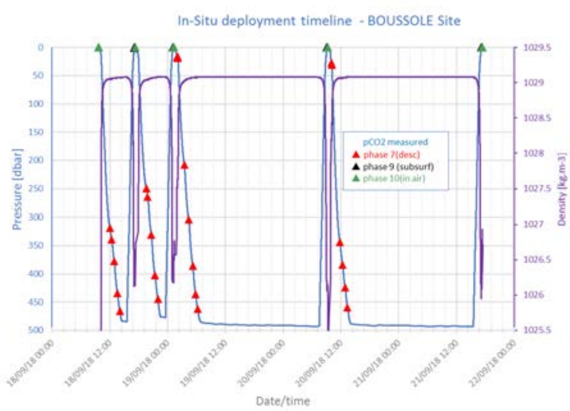


Figure 26: the first four in-situ cycles during the validation field campaign.

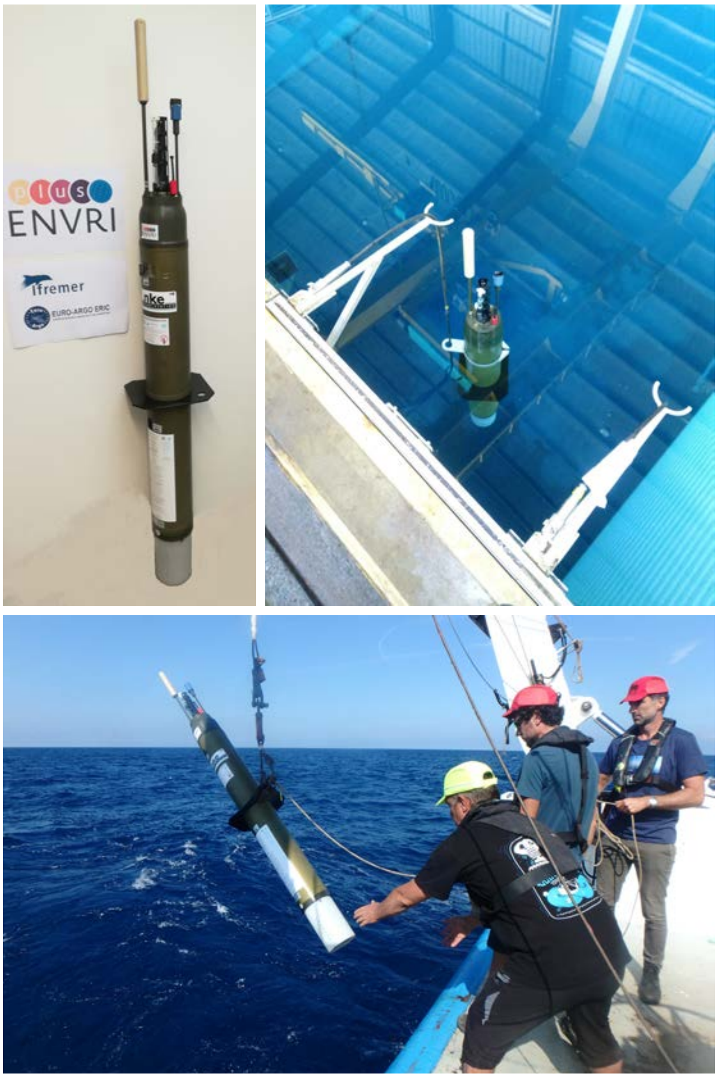


Figure 27: The pCO2 profiling float prototype, tested in IFREMER basin and at deployment in the Ligurian Sea

ENVRI+ website

https://www.envriplus.eu/

3. SCIENTIFIC HIGHLIGHTS

3.1 Impact of deep convection on the ecosystems in the northwestern Mediterranean Sea

Conan P., Testor P., Estournel C., D'Ortenzio F., Pujo-Pay M., Durrieu De Madron X. (2018). Preface to the Special Section: Dense water formations in the North Western Mediterranean: from the physical forcings to the biogeochemical consequences. JGR, 123(10), 6983-6995.

https://doi.org/10.1029/2018JC014301

Context

Subject to a strong anthropogenic pressure and particularly sensitive to climate change, the Mediterranean Sea is a major place of environmental, social and economic interests.

Both of the western and eastern parts of the Mediterranean Sea are known to be oligotrophic, with areas of low biological productivity which negatively influences higher trophic levels. Only the northwestern Mediterranean Sea (NWM) exhibits a repetitive significant spring phytoplankton bloom, which seems to be linked with large winter deep convection episodes in this area.

In reality, both bloom and deep convection events seem to be the result and consequence of processes that take place over the previous 6-8 months. In order to investigate more precisely the links between the key bloom episodes to the mechanisms of forcing occurring in the NWM, a large experiment called DEWEX (DEep Water formation EXperiment, Testor et al., 2018) has been set up during winter 2012-2013 in the framework of the MISTRALS-Mermex programme. The objective was to reconstruct the physical and biogeochemical "history" of the NWM water bodies and their potential evolution in the climatic change context.

Thanks to a multiplatform approach lead during a complete seasonal cycle, a new reference dataset has been collected that was used as a benchmark for advancing the modeling of the surface fluxes, convective processes, dense water formation rates and physical-biogeochemical coupling processes.

Data and Method

Deep convection in the Gulf of Lion was first described by the MEDOC-Group (1970) in three phases:

1. the preconditioning of the area by a cyclonic gyre circulation in the whole northwestern Mediterranean Sea producing a doming of isopycnals toward the surface centered at about (42°N, 5°E), exposing a large body of weakly stratified waters to local cooling and evaporation, due to dry and cold Mistral and Tramontane winds blowing over the Gulf of Lion;
2. the vertical mixing due to buoyancy loss generated by intense surface cooling and evaporation reaching about 1,000 W m-2 for short periods and allowing overturning of the water column;
3. the spreading/restratification phase with newly formed deep waters propagating away from the formation site while stratified waters around invade the deep convection area.

The sampling strategy for the DEWEX experiment (Figure 28) was based on a collection of in situ data from the DEWEX cruises, scheduled to cover the 3 phases of open-sea convection, as well as from gliders, moorings, profiling floats, surface drifters and four intensive oceanographic cruises (Table 5), carried out between July 2012 and July 2013 in the NWM in completion to MOOSE and HYMEX, thus resolving a complete annual cycle. The data collected include temperature, salinity, fluorescence of Chlorophyll-A profiles, as well as currents and depth-average currents estimates.

A total of 119 ship days and 500 CTD stations have been operated during one year of the study. 13,000 profiles were collected over the year by gliders (30 missions) and 1,500 T/S profiles by 8 bio-Argo floats.

Lastly, a coupled physical-biogeochemistry numerical model has been set up both to allow real-time monitoring of conditions and to improve modelling parameters using the in-situ data collected.

Main results

Thanks to a multiplatform approach enriched with new autonomous platform technologies (gliders and Argo profiling floats in particular), the DEWEX experiment provided a unique data set collected during one year in the Gulf of Lion. It has led to a better description of the underlying hydrodynamic processes at work before, during and after deep ocean convection events in the NWM Sea, and its link with an important spring phytoplankton bloom in this area.

- Even if convection takes place at small spatial scales (a few kilometers) and at high frequency (typically a day), the resulting spring high productivity stimulates a significant biological response in the upper trophic levels. The interplay between the large scales, mesoscales, sub-mesoscales and convective scales has been particularly investigated. Small-scale circulation features have been highlighted and play a key role on deep convection and subsequent bloom.
- For the first time, not only qualitative but also quantitative aspects concerning deep convection has been obtained thanks to this experiment, like estimates of mass and energy fluxes over a period of a year in the deep convection area and deep water formation rates.
- Significant insights has been made, particularly with regard to the biodiversity of microbial organisms involved in the spring bloom and the export fluxes of matter to the deep layers linked to biological activities.

Cruises names	Ships	Dates
MOOSE-GE 2012	R/V Le Suroît	July 2012
DOWEX 2012	R/V Tethys II	September 2012
HyMex SOP1	R/V Urania	September 2012
	R/V Le Provence	October 2012
DEWEX – Leg 1	R/V Le Suroît	February 2013
HyMex SOP2	R/V Tethys II	January – March 2013
	R/V Le Provence	February, March and May 2013
DEWEX – Leg 2	R/V Le Suroît	April 2013
MOOSE-GE 2013	R/V Tethys II	June 2013
DOWEX 2013	R/V Tethys II	September 2013

Table 5: List of Cruises carried out in the Framework of the DEWEX Experiment

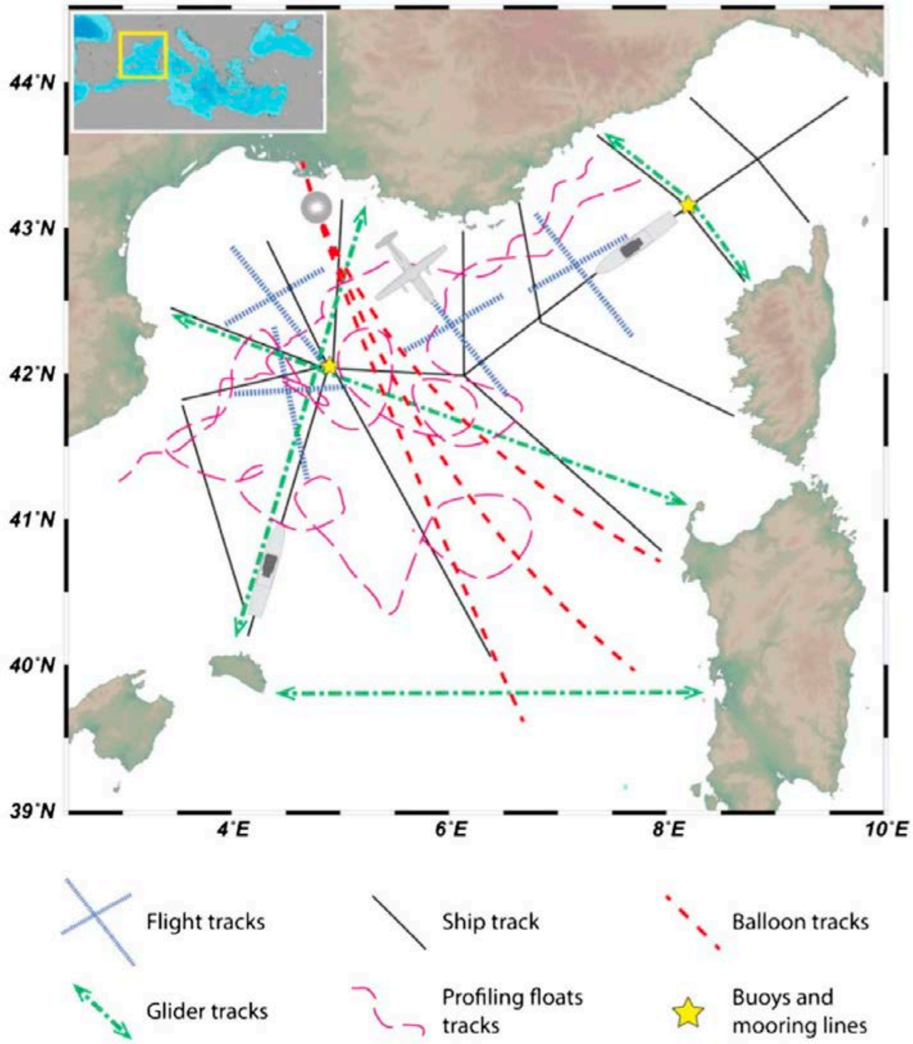


Figure 28. Sketch of sampling strategy and examples of trajectory for airborne and oceanic platforms during the Deep Water formation Experiment (DEWEX) in the north-western Mediterranean.

- Thanks to this unique data set, a coupled hydrodynamic-biogeochemistry model has been calibrated and validated. Simulations on interannual variations in deep water formations and planktonic ecosystem response have been successful. The numerical model gives a good reproduction of winter mixing, water column restratification, as well as the nutrient stock in the surface layer and the structure and productivity of the phytoplankton ecosystem.

Finally, the DEWEX experiment motivates to develop the same multiplatform/multiscale strategy for other areas/processes. It also underlines the need for national and european collaborations to achieve such an experiment which allows a great step forward knowledge improvements.

3.2 Observed Characteristics and Vertical Structure of Mesoscale Eddies in the SouthWest Tropical Pacific

Keppler, L., Cravatte, S., Chaigneau, A., Pegliasco, C., Gourdeau, L., & Singh, A. (2018). Observed characteristics and vertical structure of mesoscale eddies in the southwest tropical Pacific. Journal of Geophysical Research: Oceans, 123, 2731–2756.

https://doi. org/10.1002/2017JC013712

Context

In the heart of the Southwest Tropical Pacific Ocean, an important area of the Coral Sea shelters a large part of marine life with an exceptional biodiversity, and has been classified as a Protected Marine Area. Better documenting and understanding the oceanic circulation and its variability, the connectivity of the ecosystems is thus essential.

The Coral Sea is dotted with a vast number of islands and is a region where different water masses meet and interact. This study aims to describe the main surface characteristics of mesoscale eddies in the Southwest Tropical Pacific Ocean thanks to satellite altimetry data and their vertical structure reconstructed by Argo floats. The objective is to investigate the generation, propagation and surface properties of eddies and to examine their vertical extent in terms of temperature, salinity and swirl velocity to evaluate how deep they affect the mean currents and the physical properties of the water column. In the summary presented here we focus on the results regarding the vertical structure of the eddies.

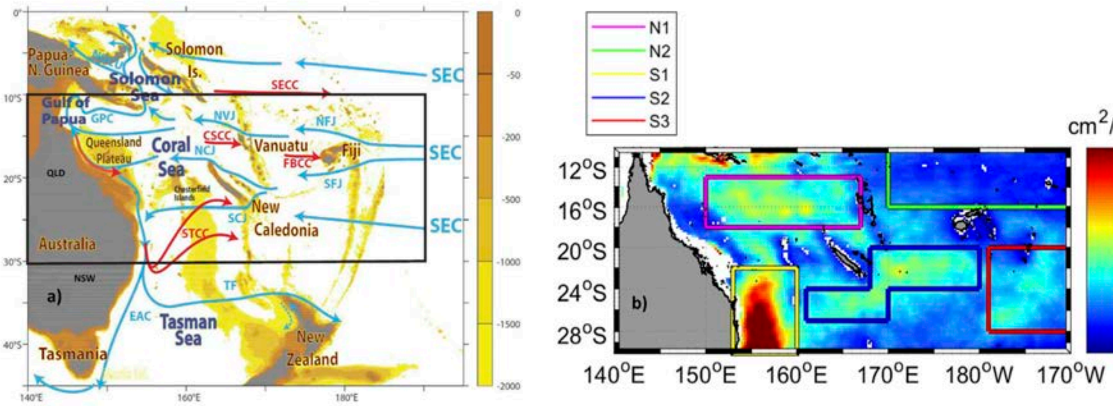


Figure 29: Schematic large-scale circulation and eddy kinetic energy in the Southwest Pacific. (left) Bathymetry (in meters, color shading), showing only depths less than 2,000 m. The Queensland (QLD) and New South Wales (NSW) coasts are shown, in addition to the main currents integrated from 0 to 1,000 m (blue arrows) and surface-trapped counter-currents, only shown when they are different from the subsurface currents (red arrows). The study region is delimited by a black rectangle. The main currents are the SEC: South Equatorial Current; NVJ: North Vanuatu Jet; NCJ: North Caledonian Jet; SCJ: South Caledonian Jet GPC: Gulf of Papua Current; NGCU: New Guinea Coastal Undercurrent; EAC: East Australia Current; TF: Tasman Front and the surface-only currents are the STCC: South Pacific Subtropical Counter Current; CSSC: Coral Sea Counter Current; FBCC: Fiji Basin Counter Current; and SECC: South Equatorial Counter Current. (right) Map of the mean total EKE (in cm^2 s^{-2}), filtered with a high-pass Hanning filter at 180 days. White regions are shallower than 200 m. Five dynamically different sub-regions used in this study are demarked with colored shapes

Data and method

At the surface, Daily Sea Level Anomaly (SLA) maps from Aviso Ssalto-Duacs 2014 altimetry product between January 1993 and May 2014 are used to automatically identify and characterize meso-scale eddies (about 50 km to several hundred kilometres). Mesoscale eddies are detected on these SLA maps using the SLA-based eddy detection algorithm developed by Chaigneau et al., 2009. The retained eddies are temporally tracked from their genesis to their dissipation using the algorithm developed by Pegliasco et al., 2015. Finally, about 14,000 eddy trajectories are detected for this period in the study region 5 (Figure 29).

The eddies' vertical structures are then determined from about 28,682 Argo floats profiles located within anticyclonic (AE) or cyclonic (CE) eddies between 1 January 2003 and 1 May 2014. From their vertical temperature and salinity profiles collected between the surface and 2000 meters deep, anomalies relative to the seasonal climatology by Roemmich and Gilson (2009) are computed for each profile.

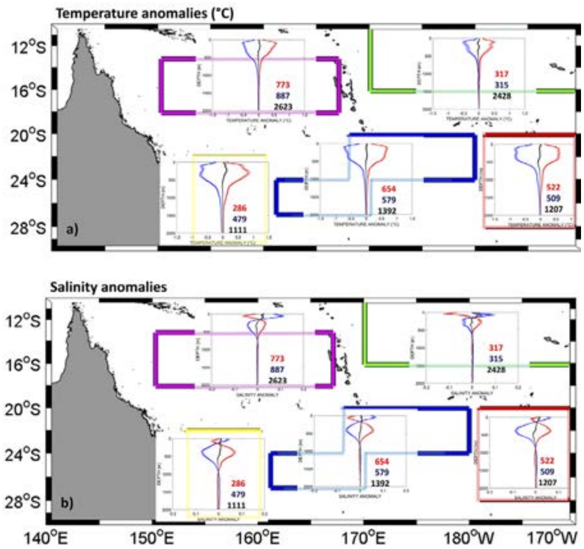


Figure 30: Vertical composite structures of temperature and salinity anomalies in the study region for each of the 5 subregions (demarked with colored shapes in Figure 28). Mean anomalies within AE (red), CE (blue) and OE (black) are shown as solid lines for (top) temperature and (bottom) salinity. The integers indicate the number of floats used to calculate each mean profile in the corresponding colors for AE, CE, and OE.

Main results on Eddy vertical structure

From Argo vertical profiles, the observation is that ~ 17% surfaced into AE, ~ 17% into CE and ~ 66% surfaced outside of eddies (OE) (Figure 29).

Eddies in the five sub-regions (defined in Figure 29: have a vertically anti-symmetric structure when comparing AE and CE with typical temperature (salinity respectively) anomalies of +/- 0.5°c (0.1) and they tend to extend deeper South of 20°S. When eddies swirl faster than they propagate, they can trap and transport water masses along their trajectory:

- In the tropical area north of Fiji, eddies are sparse and short-lived, impacting only the top 200 meters of water. They do not appear to be able to trap and transport waters in this region.
- In the Coral Sea, a region of lateral shear between currents transporting waters of different origins, eddies are numerous and energetic. They affect the water properties down at least 500m depth, and anticyclonic eddies trap and transport waters to about 200m, contributing to the upper thermocline waters mixing and transport.
- South of New Caledonia, mesoscale eddies are ubiquitous and long-lived, with typical lifetimes longer than 5 months. They affect the temperature, salinity, and velocities down to about 1,000 m depth, and weakly contribute to the mixing of lower thermocline waters.

The observations show that eddies can affect water properties down to about 100m in the North (10°S to 20°S) and about 300m in the South (20°S to 30°S); anticyclonic eddies in the Coral Sea participate in the redistribution of tracers and water-masses along their trajectories in the upper 200m.

Conclusion and perspectives

This work takes advantage of the complementarity of two widely used data sets: Sea Level Anomaly (SLA) data from satellite altimetry allowing detection of mesoscale eddies at the surface, together with vertical temperature and salinity profiles from Argo floats surfacing into eddies.

It highlights the high variability of small oceanic structures in this key area of the Coral Sea. Even with thousands of vertical Argo profiles sampling AE and CE properties, vertical temperature and salinity anomalies inside eddies are scattered around the mean composite. Whether such dispersions are linked to the diversity of eddy vertical structures, to errors in the interpolated altimetric fields, in the detection method, or to other sources of variability such as interannual variability or internal waves is not known and could also be investigated using oceanic model simulations.

References

Chaigneau, A., Eldin, G., & Dewitte, B. (2009). Eddy activity in the four major upwelling systems from satellite altimetry (1992–2007). Pro- gress in Oceanography, 83(1–4), 117–123.

https://doi.org/10.1016/j.pocean.2009.07.012

Pegliasco, C., Chaigneau, A., & Morrow, R. (2015). Main eddy vertical structures observed in the four major Eastern boundary upwelling sys- tems: Eddy vertical structure in the EBUS. Journal of Geophysical Research: Oceans, 120, 6008–6033.

https://doi.org/10.1002/ 2015JC010950

Roemmich, D., & Gilson, J. (2009). The 2004–2008 mean and annual cycle of temperature, salinity, and steric height in the global ocean from the Argo Program. Progress in Oceanography, 82(2), 81–100.

https://doi.org/10.1016/j.pocean.2009.03.004

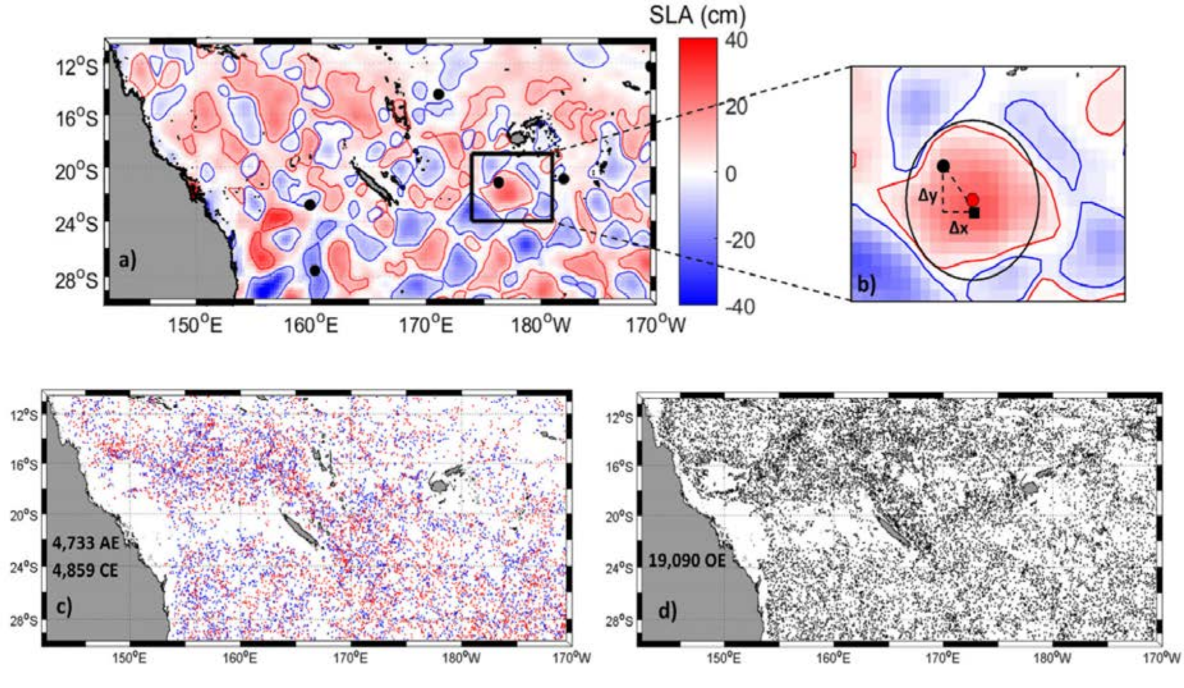


Figure 31: Eddy detection algorithm, definitions, and classification of Argo profiles. (top left) SLA on 07th January 2005 from Aviso on a 0.25° x 0.25° grid. Detected eddy edges are shown in red (AE) and blue (CE) contour lines and Argo floats that surfaced on the same day are shown as black filled circles. (top right) Illustration of the eddy characteristics and floats' positions (black filled circle) relative to the corresponding eddy centers (black filled square); the eddy centroid (red filled circle) and the equivalent circle of radius (black solid line) are also shown. The relative positions of the floats to the eddy center are shown with Δx and Δy. (bottom left) Location of Argo floats that surfaced into AE (red) and CE (blue) between 1st January 2003 and 1st May 2014. (bottom right) Same as (bottom left) but for Argo floats surfacing outside eddies (OE). The numbers of profiles that surfaced into AE, CE, and OE are indicated over Australia.

4. KEY PERFORMANCE INDICATORS

The Euro-Argo ERIC Office team is also working on Key Performance Indicators (KPIs) to document European contribution to the international network. The novel and enhanced role of the EU in the international Argo programme and the heightened Europe-wide visibility of the research is monitored each year through two types of indicators: KPIs on floats and KPIs regarding users.

4.1 KPIs regarding floats

The overall objectives of the Euro-Argo ERIC in terms of float deployments are to provide, deploy and operate an array of around 900 floats contributing to the global array - a European contribution of ¼ of the global array with enhanced coverage in the European regional seas.

During 2018, the deployment plans were reviewed for 2018 and 2019. In 2018, 279 European floats were deployed including 66 floats on the extension to biogeochemical and deep oceans. This is still below the target of 350 new floats/year, but above the 25% mark (see Figure 32) of the global effort.

In December 2018, a total of 835 Euro-Argo floats were active out of a total of 3909 floats (Figure 33).

Figure 34 describes the evolution of the European contribution to the network in terms of active floats, at any time. The number of European Argo floats has been increasing since the beginning of the project. The percentage of European floats has slowly increased from around 15% in 2008 to 21% in 2018.

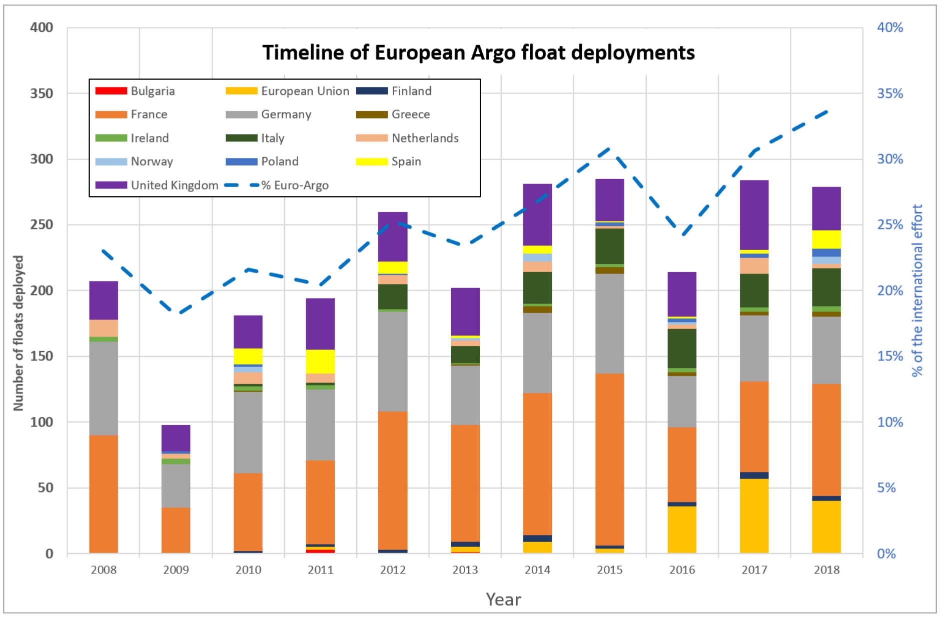


Figure 32: Evolution of European float deployments in float number (colors, left axis) and as a percentage of the international effort (blue dashed line, right axis). (© JCOMMOPS/AIC).

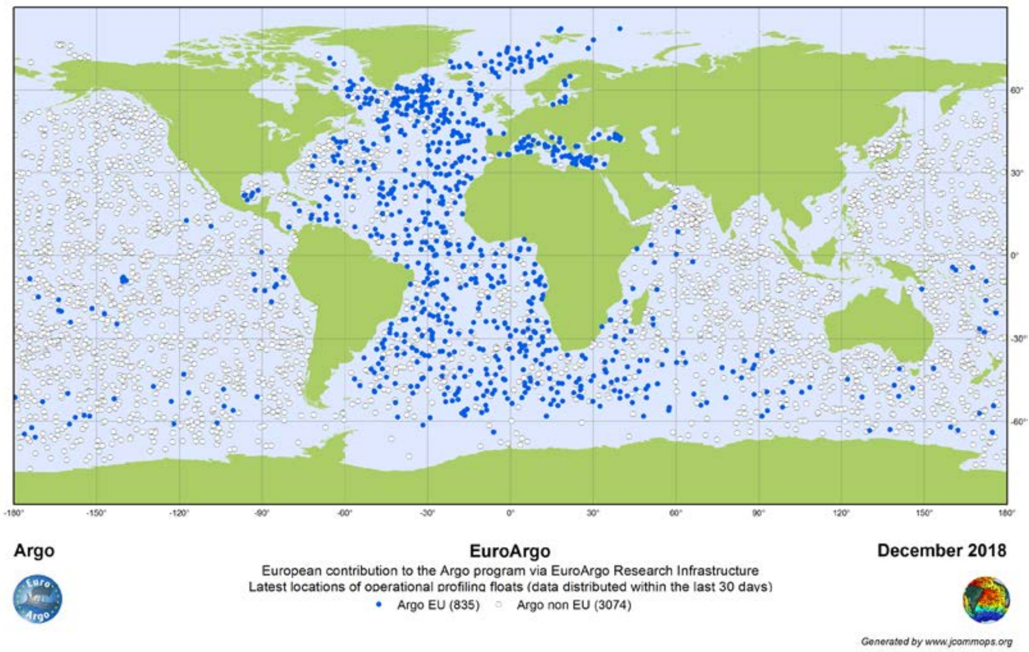


Figure 33: Argo non-EU (white points, 3074 floats) and Euro-Argo (blue points, 835 floats) active profilers in December 2018 (© JCOMMOPS/AIC).

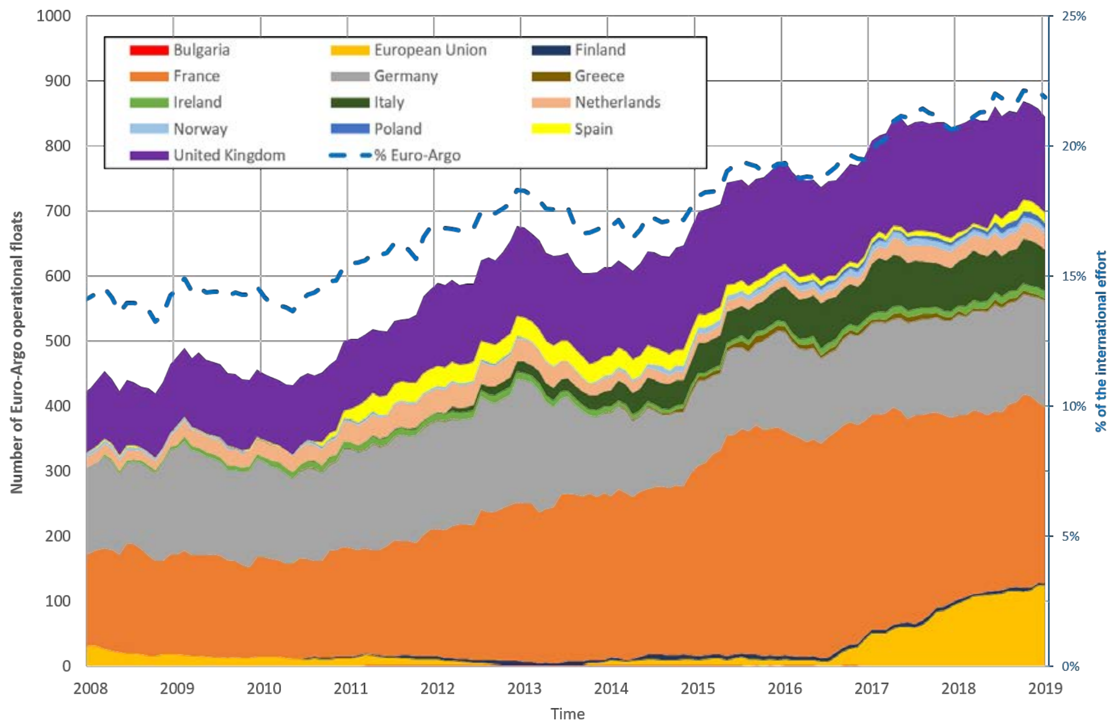


Figure 34: Euro-Argo partner's contribution to the global Argo network in number of operational floats (colour, left axis) and 0in the percentage of the total number of active floats in the array (blue dashed line, right axis) (© JCOMMOPS/AIC).

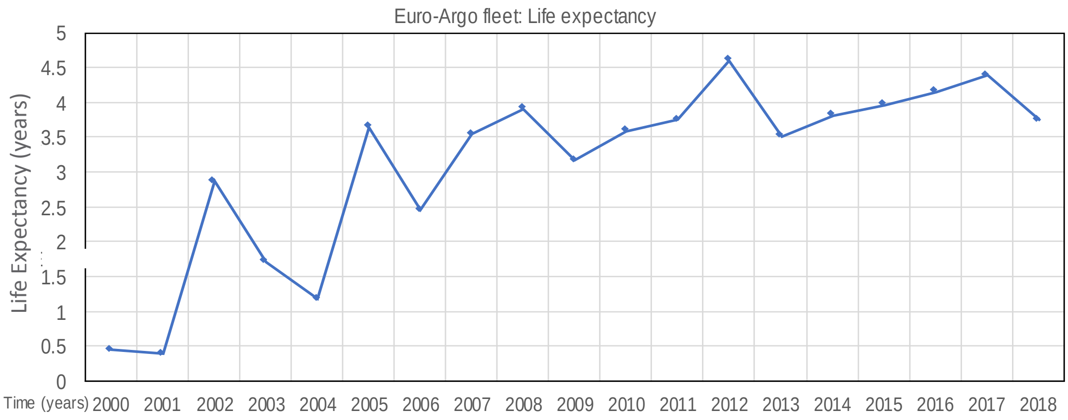


Figure 35: Life expectancy of the Euro-Argo fleet (© JCOMMOPS/AIC).

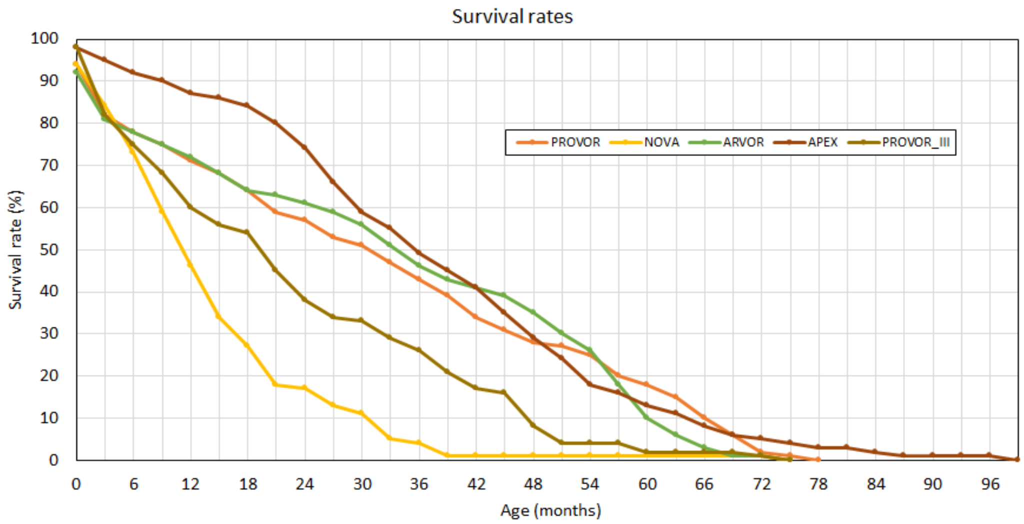


Figure 36: Survival rate for the Euro-Argo fleet per float type (© JCOMMOPS/AIC).

In terms of float performance, as shown in Figure 35, the life expectancy of European floats is improving and the target of 4 years - around 150 cycles for a standard float cycling with a 10 days-period – has been achieved in average. The survival rate is presented in Life Expectancy (years) by float model (for the period [2008-2018]), highlighting the good behaviour of recent floats (Arvor).

Compared to the rest of the Argo fleet, the number of profiles acquired per float by the Euro-Argo fleet is improving (Figure 37). The percentage of floats reaching the 50 cycles target shows (see Figure 37) that on recent deployments the Euro-Argo fleet has a similar score than the rest of the fleet (about 90%). On the 100 cycles target the score of the Euro-Argo fleet has nearly reached the level of Argo fleet and shows impressive progress in past years, hitting the 75% threshold.

The increasing visibility of Europe in the Argo network is also reflected looking at the evolution of the number of floats deployed per float manufacturer (Figure 39). In 2018 for the first time a European manufacturer (NKE, delivering ARVOR and PROVOR float models) is number 1, ahead of US manufacturers (e.g. Teledyne Webb Research TWR providing the APEX).

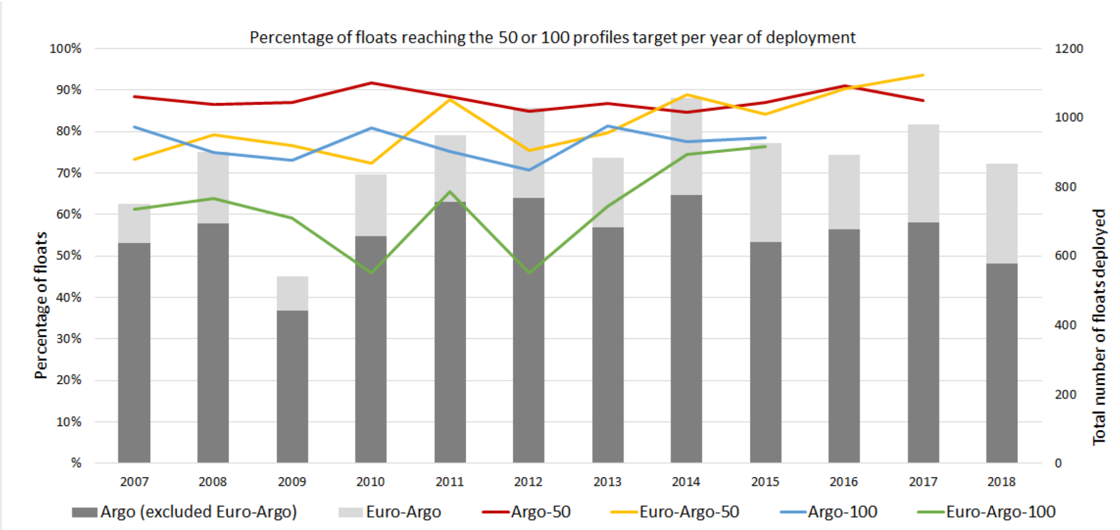


Figure 37: Percentage of floats from the Euro-Argo fleet reaching the 50 cycles or 100 cycles target compared to the rest of the Argo fleet (coloured lines, left axis). In grey, the total number of floats deployed for Euro-Argo and the rest of the fleet (right axis) (© JCOMMOPS/AIC).

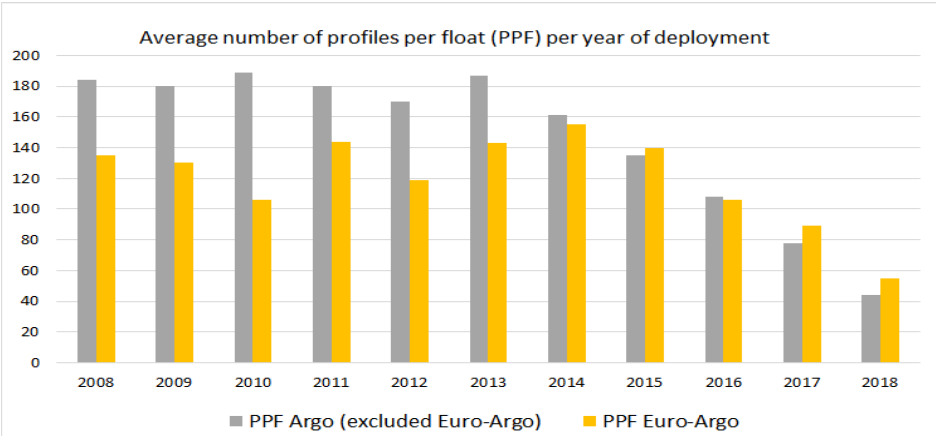


Figure 38: Mean number of profiles acquired by the Euro-Argo fleet and the rest of the Argo fleet, per year of deployment (© JCOMMOPS/AIC). For last generations, numbers are lower since the fleet is not completely dead (e.g. some floats deployed in 2012 are still gathering profiles).

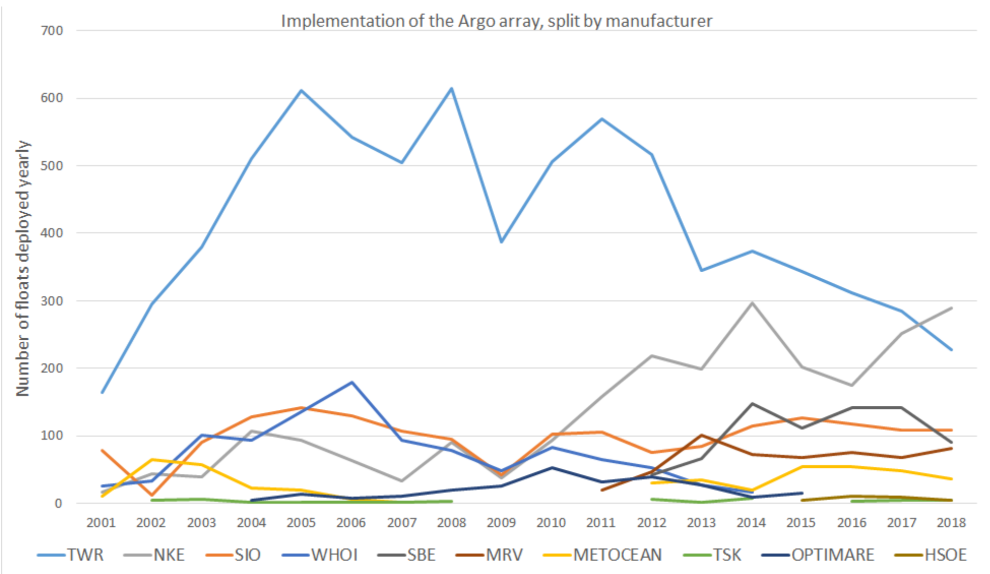


Figure 39: Evolution of number of floats deployed per year, grouped by float manufacturer. (© JCOMMOPS/AIC).

4.2 KPIs regarding users

One of the overall objectives of the Euro-Argo ERIC is to provide quality-controlled data and access to the data sets and data products to the research (climate and oceanography) and operational oceanography (e.g. Copernicus Marine Service) communities.

4.2.1 Euro-Argo bibliography

Euro-Argo monitors each year the number of publications using Argo observations from EU users. Table 6 as well as Figure 39 and Figure 40 represent the partition by year and by country respectively. France is in the top 3 countries contributing to the Argo bibliography with 352 papers, together with UK which ranks 5th thanks to 235 papers. Just below, Germany, Italy and Spain contributed with about 70-120 papers since 1998.

A total of 339 Argo papers were published in 2018. As for Argo international, Argo publications from the Euro-Argo ERIC community reach a plateau with 72 papers published in 2018. However, since 1998, the European contribution has been about 28.4 % of the total number, which is better than the initial target of 25%.

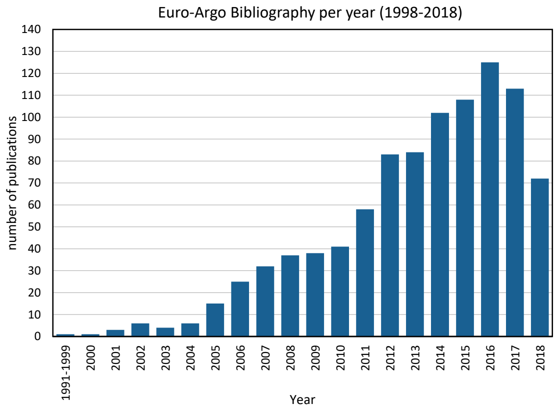


Figure 40: Number of Argo publications from Europe per year since 1998.

	Total	1991-1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
FINLAND	4															1			2		1
FRANCE	352	1		1	3	1	2	3	6	8	15	17	13	23	30	30	47	40	41	44	27
GERMANY	121				2		1	3	4	3	7	5	4	9	9	11	8	15	22	11	7
GREECE	10											1	1	1			3	2	1	1	
IRELAND	1												1								
ITALY	96								5	6	4	4	6	5	7	5	5	9	17	14	9
NETHERLANDS	18													1	2	2	1	1	6	2	3
NORWAY	31										3		1	3	4	3	4	2	5	3	3
POLAND	2																1	1			
PORTUGAL	12														2	2	1	3	3	1	
SPAIN	72						1	3	4	1	1	3	6	3	5	6	4	8	13	10	4
UK	235		1	2	1	3	2	6	6	14	7	8	9	13	24	24	28	27	15	27	18
TOTAL EURO-ARGO	954	1	1	3	6	4	6	15	25	32	37	38	41	58	83	84	102	108	125	113	72
ARGO Bibliography	3354	12	7	13	19	20	26	53	80	93	102	120	191	208	256	284	350	385	395	401	339
% EU vs Argo	28.4	8.3	14.3	23.1	31.6	20.0	23.1	28.3	31.3	34.4	36.3	31.7	21.5	27.9	32.4	29.6	29.1	28.1	31.6	28.2	21.2

Table 6: Number of publications using Argo from EU users, and percentage versus Argo publications, per year since 1998.

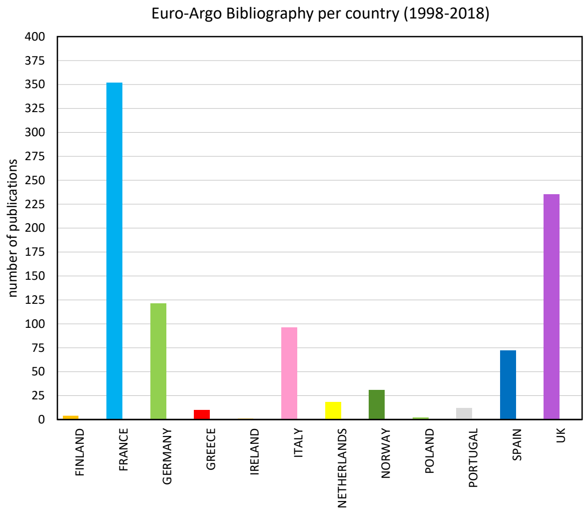


Figure 41: Number of publications by Euro-Argo participating countries since 1998.

4.2.2 Access to Data

Over the 12-month period from November 2017 to October 2018, 30 434 profiles from 794 active floats were collected, controlled and distributed by Coriolis DAC. Compared to 2017, the number of profiles is stable (+0.2 %), the number of floats increased by 1%. The 794 floats managed during that period had 57 versions of data formats from 4 families.

BODC DAC managed 260 active floats (233 being fully processed), from 14 different version of data format, from 3 families.

Coriolis DAC provides data for 409 BGC-Argo floats from 5 families and 57 instrument versions. They performed 53 509 cycles.

Coriolis hosts one of the two global data assembly centres (GDAC) for Argo that contains the whole official Argo dataset. The number of users that access, visualise and download Argo data sets is monitored each year from the Coriolis Argo GDAC portal. The Argo GDAC ftp server is actively monitored by a Nagios agent (see *http://en.wikipedia.org/wiki/Nagios*). Every 5 minutes, a download test is performed. The success/failure of the test and the response time are recorded. There is a monthly average of 561 unique visitors, performing 4302 sessions and downloading 5.9 To of data files (Figure 42).

In November 2018, 165 639 BGC Argo profiles from 1073 floats were available on Argo GDAC. This is a strong increase compared to 2017: +26% more profiles and +24% more floats.

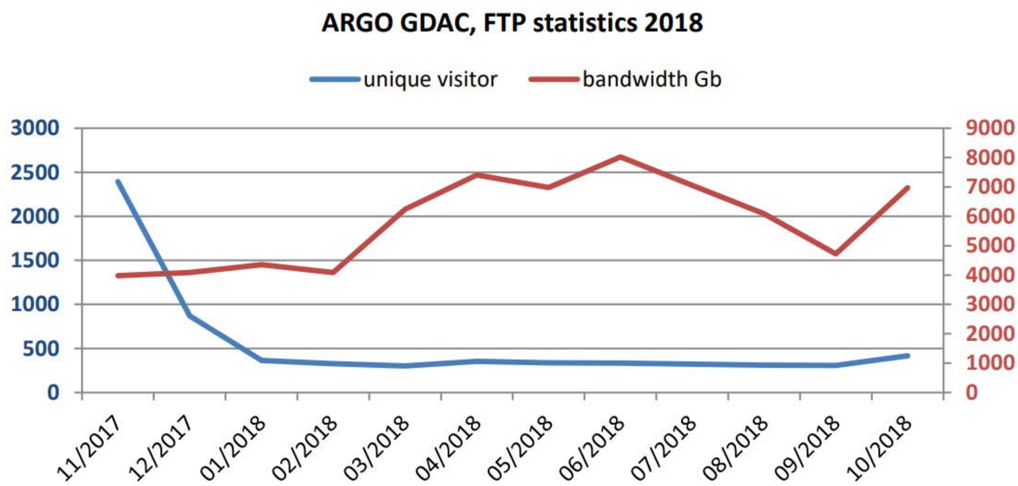


Figure 42: Statistics on the Argo GDAC server between Nov. 2017 to Oct. 2018.

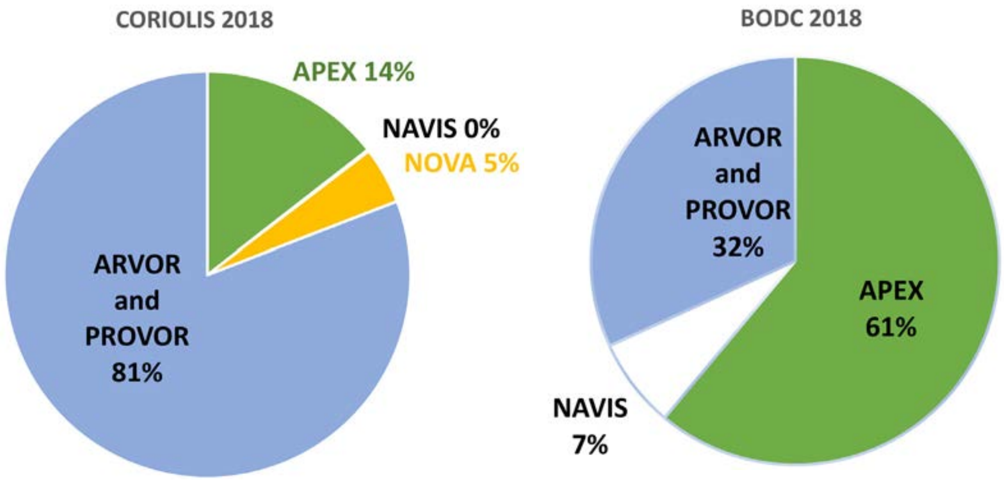


Figure 43: Repartition of active float types managed by the 2 European DACs in 2018.

4.2.3 Twitter followers

The Euro-Argo twitter account gained 232 new followers between January and December 2018.

@EuroArgoERIC

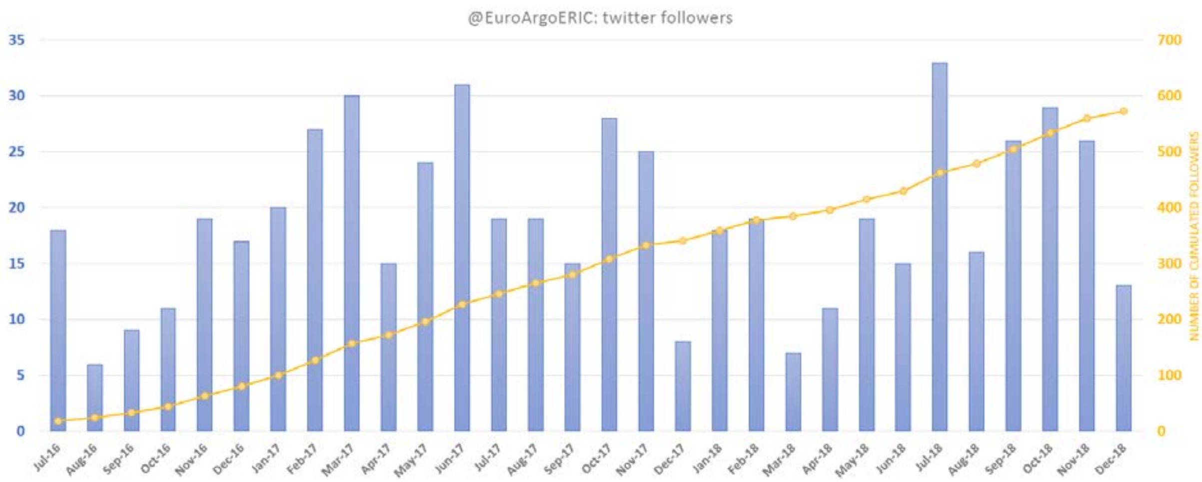


Figure 44: Evolution of the number of new (left axis, in blue) and cumulated (right axis, yellow) followers on the Euro-Argo ERIC twitter account.

5. FINANCIAL STATUS

There is a positive balance of about 227K€ in Euro-Argo ERIC 2018 budget execution. This is due, in part, to the contribution of about 250K€ that the ERIC received in 2018 for staff funding from the EU projects. The central ERIC income in 2018 reached 340K€ (+50K€ compared to 290K€ planned) as Bulgaria became a full member and Norway moved from Observer to full member.

Salary expenses is around 270K€ (25K€ on ERIC and about 250K€ on projects) and other expenditures of 170K€. A positive balance of 227K€ (240K€ on the ERIC, deficit of 13K€ on projects) is reached at the end of the year 2018.

As far as projects are concerned, the budget execution is as planned for MOCCA, AtlantOS and ENVRIplus, and incomes following the project reporting period justification are expected second half of 2019 and early 2020 (AtlantOS and ENVRI+ have been extended until respectively September 2019 and June 2019).

Type	Code	Debit	Credit	Total
Initial Balance				484 629
SG: Sales of goods	SG		710 151	710 151
GC: Grants & Contracts	GC		909 096	909 096
MF: Memberschip fees	MF		340 000	340 000
II: Interest income	II		0	0
VA: VAT reimbursement	VA		1 148	1 148
PG: Purchases of Goods	PG	707 139		-707 139
PE: Personnel costs	PE	270 277		-270 277
TV: Travel costs	TV	34 788		-34 788
MA: Material costs	MA	2 354		-2 354
AC: Accounting fees	AC	4 934		-4 934
BS: Bank services	BS	223		-223
SC: Other subconstracts	SC	126 193		-126 193
DP: Depreciation	DP			
Total flows		**1 734 996**	**1 960 395**	
END BALANCE				**710 028**

Table 7: Financial status - Summary 2018 - Grand Total

	ERIC	ATLANTOS	MOCCA	ENVRI	JERICO	TOTAL
Purchases of goods for resale	695 422					695 422
Other purchases of goods for resale	11 717					11 717
Insurance premiums			6 060			6 060
Personal	25 152	40 987	132 058	66 397	5 684	270 277
Studies	30 000					30 000
Business travel	18 126	1 638	7 438	7 586		34 788
Telecommunication costs	5 000	10 435	55 031			70 466
Others costs	25 091	427	668	992		27 179
Depreciation	3 334	175 964	409 787			589 086
Sales of goods for resale	710 151					710 151
Operating Grants		284 205	523 046	93 718	8 127	909 097
Subscription members and observers	340 000					340 000
Other incomes	3 436					3 436
Accounting result	**239 745**	**54 754**	**-87 997**	**18 743**	**2 444**	**227 689**

Table 8: Financial status - Analysis per project.

Country	Floats purchased	Floats deployed	Full Time Employee
Bulgaria	0	0	0.15
Finland	5	4	0.21
France	75	85	10.20
Germany	32	51	2.50
Greece	0	4	0.30
Ireland	6	4	0.38
Italy	24	29	1
Netherlands	0	3	0.08
Norway	20	6	0.40
Poland	3	6	0.75
Spain	0	14	0.35
U.K.	24	33	4.40
Total	**189**	**239**	**20,72**

Table 9: Euro-Argo members and observers 2018 budget

ANNEX 1: GLOSSARY

AOML: Atlantic Oceanographic and Meteorological Laboratory
ARC: Argo Regional Centre
BEERI: Board of European Environmental Research Infrastructure
BGC: Biogeochemical
BODC: British Oceanographic Data Centre
BSH: Bundesamt für Seeschifffahrt und Hydrographie
CMEMS: Copernicus Marine Environment Monitoring System
CORIOLIS: French infrastructure for *in situ* coordination
CPER: Contrat de Plan Etat-Région
CSIO: China Second Institute of Oceanography
CSIRO: Commonwealth Scientific and Industrial Research Organisation
DAC / GDAC: Data Assembly Centre / Global Data Assembly Centre
DFO: Department of Fisheries and Oceans
DO: Dissolved Oxygen
DMQC: Delayed Mode Quality Control
EASME / EMFF: Executive Agency for SMEs / European Maritime and Fisheries Fund
EGU: European Geophysical Union
EMSO: European Multidisciplinary Seafloor and water column Observatory
EOOS: European Ocean Observing System
ERIC: European Research Infrastructure Consortium
ESFRI: European Strategy Forum on Research Infrastructures
EU: European Union
EuroGOOS: European Global Ocean Observing System
GEOMAR: Helmholtz-Zentrum für Ozeanforschung Kiel
HCMR: Hellenic Centre for Marine Research
IEO: Instituto Español de Oceanografía
IFM-HH: Institut für Meereskunde Hamburg, Universität Hamburg
IMR: Institute of Marine Research
INCOIS: Indian National Centre for Ocean Information Services
INTAROS: Integrated Arctic Observing System
ISA: Ice Sensing Algorithm
IO-BAS: Institute of Oceanology - Bulgarian Academy of Sciences
JCOMMOPS: Joint technical Commission for Oceanography and Marine Meteorology in situ Observations Programme Support Centre
JMA: Japan Meteorological Administration

KMA: Korea Meteorological Administration

KORDI: Korea Ocean Research and Development Institute

LOV: Laboratoire d'Océanographie de Villefranche

MB: Management Board

MEDS: Marine Environmental Data Service

MI: Marine Institute

MOCCA: Monitoring the Oceans and Climate Change with Argo

NMDIS: National Marine Data and Information Service

NOC: National Oceanography Centre

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

OW: Owens and Wong

ROOS: Regional Ocean Observing System

SOARC: Southern Ocean Argo Regional Centre

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

TWR: Teledyne Webb Research

ANNEX 2: 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 3: EURO-ARGO ERIC GOVERNANCE BODIES

Euro-Argo ERIC Members	
Council Members	**Position**
Jean-Marie FLAUD	*Chair* - MESR France
Alessandro CRISE	*Vice-Chair* - OGS Italy
Atanas PALAZOV	IOB-BAS Bulgaria
Mikko STRAHLENDORFF	FMI Finland
Bernd BRÜGGE	BSH Germany
Vasilios LYKOUSIS	HCMR Greece
Mick GILLOOLY	MI Ireland
Sybren DRIJFHOUT	KNMI Netherlands
Odd Ivar ERIKSEN	Research Council of Norway
Jon TURTON	Met Office United Kingdom
Dariusz DREWNIAK	Ministry of Science and Higher Education Poland
Joaquin TINTORÉ	SOCIB Spain
Jon TURTON	Met Office United Kingdom
Pierre-Yves LE TRAON	Special Advisor to the French representative
Management Board Members	
Birgit KLEIN	*Chair* - BSH Germany
Diarmuid O' CONCHUBHAIR	*Vice-Chair* - MI Ireland
Violeta SLABAKOVA	IO-BAS Bulgaria
Jari HAAPALA	FMI Finland
Guillaume MAZE	Ifremer France
Gerasimos KORRES	HCMR Greece
Pierre-Marie POULAIN	OGS Italy
Andreas STERL	KNMI Netherlands
Kjell Arne MORK	IMR Norway
Waldemar WALCZOWSKI	IOPAN Poland
Pedro VÉLEZ-BELCHI	IEO Spain
Matt DONNELLY	NERC-BODC United Kingdom
Euro-Argo ERIC Central Research Infrastructure	
Sylvie POULIQUEN	*Programme Manager* - Ifremer France
Francine LOUBRIEU	*Administrative Assistant* - Ifremer France
Grigor OBOLENSKY	*Programme Engineer* - CNRS France
Romain CANCOUËT	*Operational Engineer* - Euro-Argo ERIC
Claire GOURCUFF	*Science Officer* - Euro-Argo ERIC
Andrea GARCIA-JUAN	*Operational Engineer* - Euro-Argo ERIC
Scientific & Technological Advisory Group (STAG)	
Glenn NOLAN	EuroGOOS - EOOS
Susan WIJFFELS	CSIRO Australia - Argo International
Johnny JOHANNESSEN	NERSC Norway - Copernicus Marine Service
Arne KÖRTZINGER	GEOMAR Germany - Research
Magdalena BALMASEDA	ECMWF UK - Seasonal Prediction
Euro-Argo ERIC expert assisting the STAG	
Hervé CLAUSTRE	LOV France - Bio-Argo

ERIC EURO-ARGO
Technopôle Brest Iroise
1625, route de Ste-Anne
29280 PLOUZANÉ - FRANCE
Tél. + 33 (0)2 98 22 44 83

EURO-ARGO.EU
euroargo@ifremer.fr
@EuroArgoERIC