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MOCCA

D3.2.1 Deployment Plan for 2016-2017

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Authors:	Romain Cancouët, Grigor Obolensky
Quality Controllers:	Sylvie Pouliquen
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Euro-Argo ERIC	N/A	Coordinator	N/A
The French Republic	Ifremer	Member	SHOM, INSU/CNRS, Meteo-France, IRD, IPEV
The Federal Republic of Germany	BSH	Member	GEOMAR, University of Hamburg, Alfred-Wegener-Institute for Polar and Marine Research (AWI)
The Hellenic Republic	HCMR	Member	N/A
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¹ As indicated in the "Technical and Scientific description of the Euro-Argo ERIC" July 2013 attached to the Euro-Argo Statutes.

² Integers correspond to submitted versions.

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1. INTRODUCTION

This document details the deployment plans as of October 2016 for Argo floats bought through the MOCCA (Monitoring Climate Change with Argo) project.

As a remind, MOCCA fleet consists of 150 Argo profiling floats, divided into:

- **30** Temperature and Salinity (T/S) floats, Iridium transmission, **co-financed by ERIC partners**:
 - 10 by BSH, Germany;
 - 4 by OGS, Italy;
 - 2 by IOPAN, Poland;
 - 14 by KNMI, Netherlands.
- **20** Temperature and Salinity (T/S) floats, **Argos** transmission;
- **100** Temperature and Salinity (T/S) floats, **iridium** transmission.

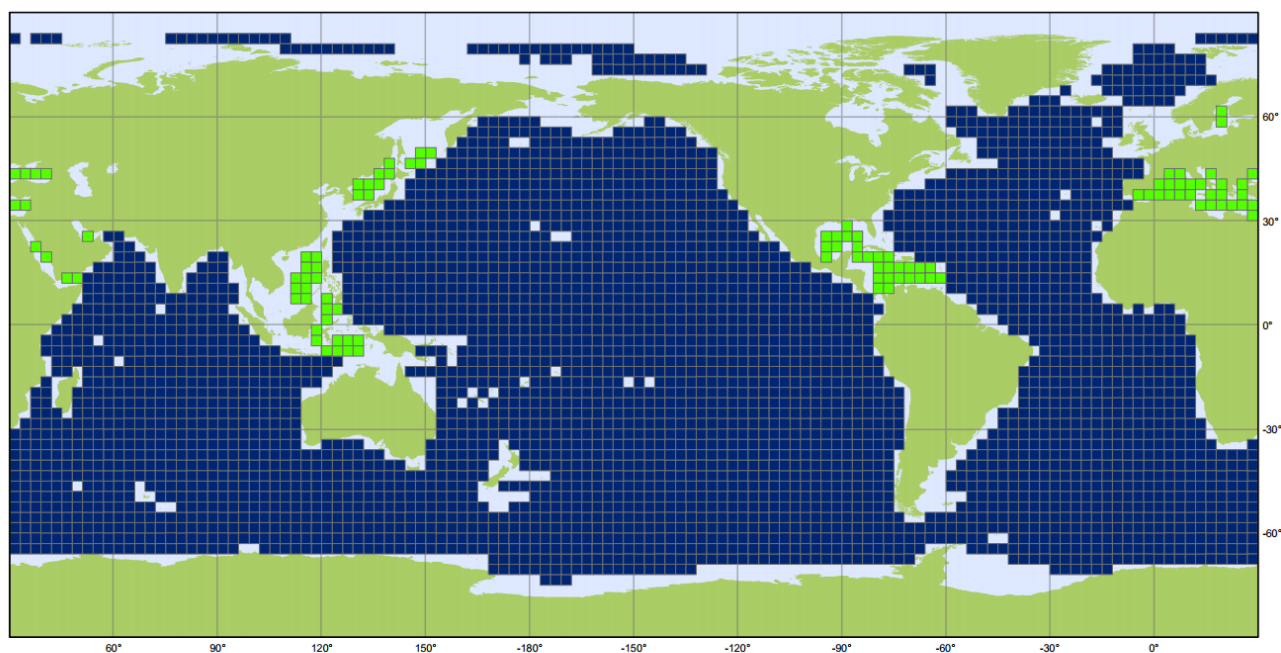


Figure 1: Euro-Argo ERIC warehouse with MOCCA floats ready for shipment.

Floats are considered ready for deployment once they have passed the acceptance tests, as defined in the procedure and tests reports³. Shipment of floats is organized according to float reception dates, acceptance tests dates and cruise planning.

³ See MOCCA deliverables “D3.1.1 Acceptance test description” and “D3.1.2 Set1 Acceptance Test Report”.

As part of the international Argo program, MOCCA floats should contribute as much as possible to the global array design:



Argo

Global Design - 3753 Floats
Target density values 3° x 3°, as confirmed at AST#17

April 2016

1 (3543) 2 (105)



Generated by www.jcommops.org, 19/05/2016

Figure 2: ARGO Global Ocean design array, © jcommops, July 2016.

More in detail, elaboration of the deployment plan for the MOCCA floats is based on the following elements:

- Recommendations from the “Strategy for the evolution of European contribution to Argo for the next decade” document;
- National plans;
- Argo density/age maps (from JCOMMOPS and Argo Information Centre);
- Cruises opportunities from partners and others;
- Recommendations from STAG (Euro-Argo Scientific and Technical Advisory Group).

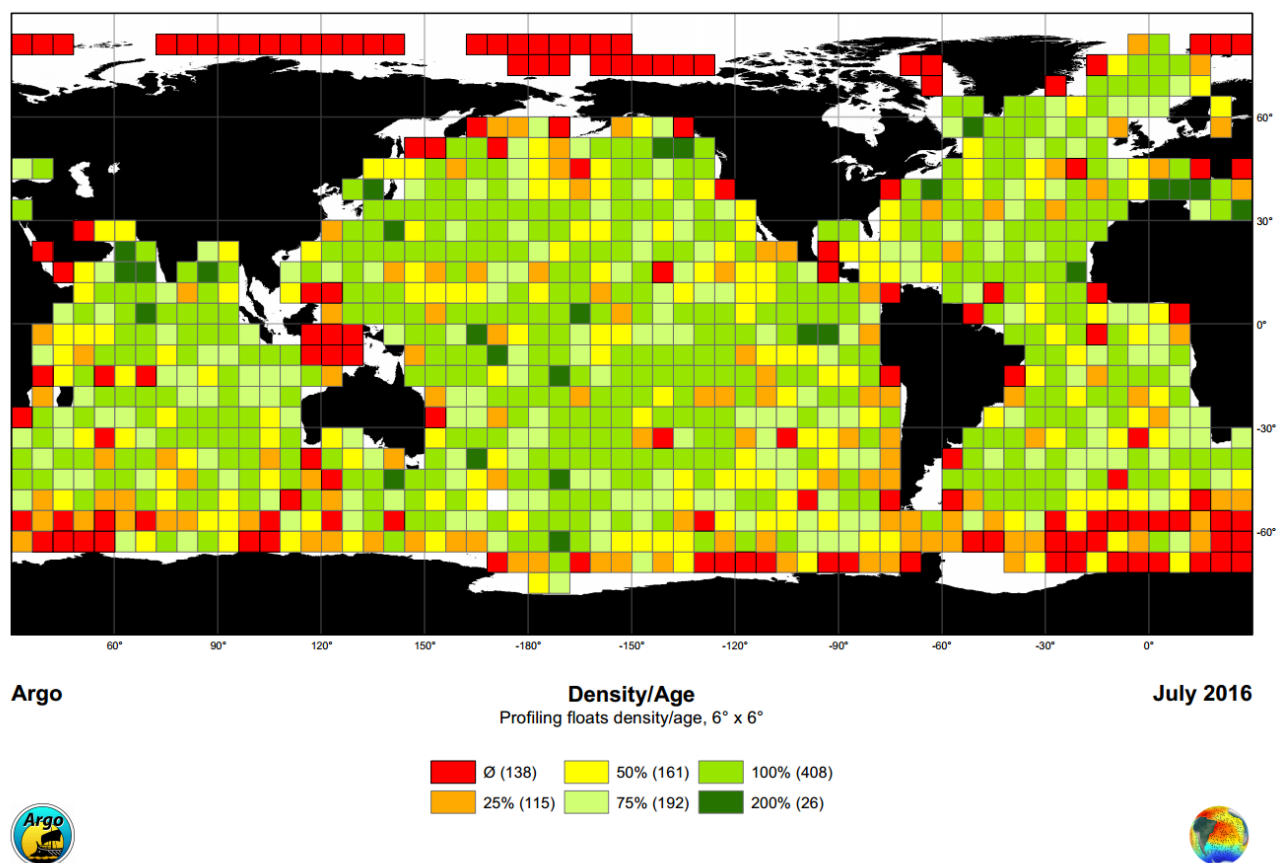


Figure 3: Density map of Argo floats compared to initial design, © jcommops, July 2016.

This leads to the following current target deployment areas for the MOCCA floats:

- **Southern Ocean** (ice-free): poor density in Argo network + recommendation from STAG;
- Deployment of Iridium floats in **equatorial regions** was also deemed important (in terms of extreme events);
- **Nordic Seas** (ice free): based on actual national plans, gap in the area from target identified in Strategy Document;
- **Marginal Seas** enhancement: Black Sea, Mediterranean Sea (Aegean, Levantine), Baltic Sea;
- **Global Ocean**;

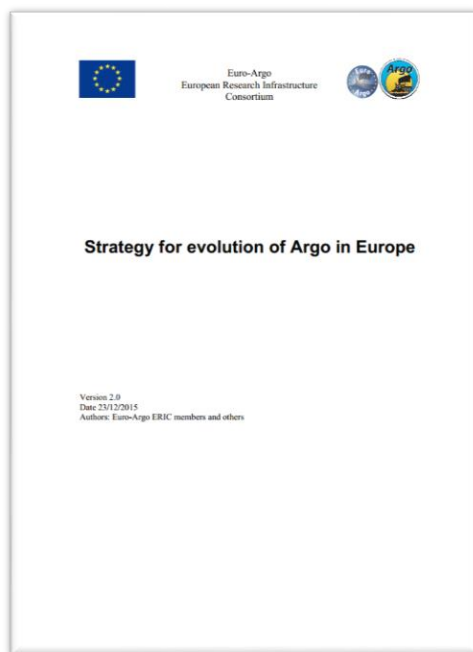
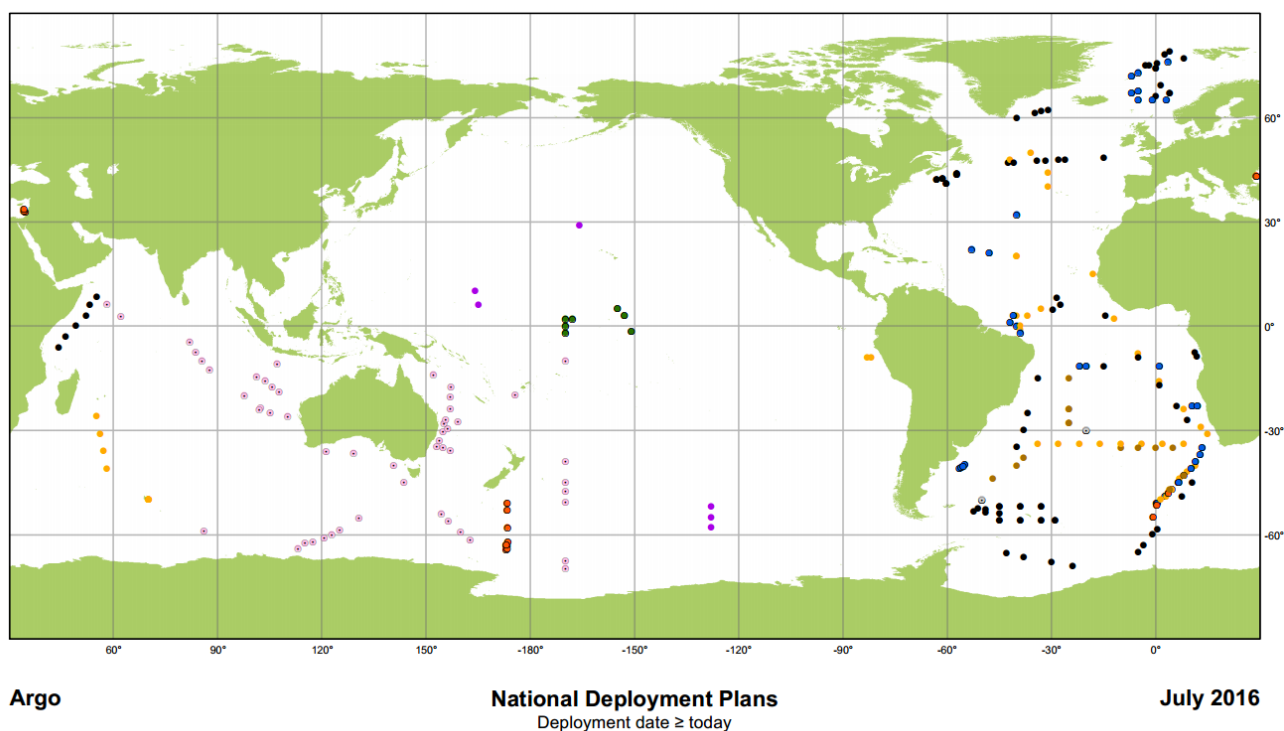


Figure 4: Strategy document of Euro-Argo.



AUSTRALIA (53) FRANCE (44) ITALY (20) NETHERLANDS (14) USA (7)
 EUROPE (33) GERMANY (88) JAPAN (6) UK (14)



Generated by www.jcommops.org, 05/08/2016

Figure 5: National deployment plans for Argo floats, © jcommops, July 2016.

Maps of current plans and planned deployments will be enlightened in the next chapters, as well as additional information on cruise details and focuses on Europeans seas.

2. CO-FINANCED FLOATS

Shipment of co-financed floats to partners has been prioritized in order to fulfil partner's needs and existing national deployment plans.

Thus:

- **10 floats** from BSH were sent in April 2016 to Barbados, to be deployed in the **subtropical Atlantic Ocean** from RV METEOR. On 22 September 2016, 5 floats had been launched and are operational.
- **2 floats** from OGS were sent in May 2016 to Toulon, to be deployed on French naval schooner "La Belle Poule" in **Mediterranean Sea**. They were deployed in June 2016. The 2 remaining floats from OGS will be shipped end of 2016 according to their requirements.
- **2 floats** from IOPAN were sent in May 2016 to Sopot and have been successfully deployed in June 2016 in the **Nordic Seas**.
- **14 floats** from KNMI have been shipped to the Netherlands in early September, to be deployed in the **Southern Ocean** from commercial ship Plancius, at the end of 2016 and beginning of 2017.

To distinguish between co-financed floats and truly MOCCA floats in the Argo Identification Center (AIC) of jcommops (WMO-IOC Joint Technical Commission for Oceanography and Marine Meteorology in-situ Observing Programmes Support Centre), specific programs have been defined in the database:

- MOCCA-GER for German floats,
- MOCCA-IT for Italian floats,
- MOCCA-POL for Polish floats,
- MOCCA-NETH for Dutch floats,
- And **MOCCA-EU** for the 120 DG-MARE EASME financed floats.

3. PLANS FOR 2016

3.1. Nordic Seas

Given the higher vulnerability of high latitudes to global warming and the potential impacts of global warming and an enhanced hydrological cycle on the water mass transformation in these regions, Nordic Seas have been identified by Euro-Argo as important deployment areas for the coming years.

Based on national plans for 2016, there are gaps in the area from target identified in the Euro-Argo Strategy document.

As of 1st June 2016, 35 floats were active, 2 were deployed by Norway in 2016 and 9 were planned for the year (6 Germany, 1 Norway, 2 Poland).

It was decided at the 7th Euro-Argo Management Board meeting in Helsinki, Finland (June 2016) to deploy additional MOCCA floats in the Nordic Seas.

Hence, the following deployment plans arise:

- **4 Iridium floats** have been deployed in the **Norwegian Basin** in August 2016 from French Navy vessel Beautemps-Beaupré;
- **4 Iridium floats** have been deployed in the **Greenland Sea** (3) and **Norwegian Basin** (1) in August 2016 from Norwegian vessel R/V Håkon Mosby.

Thus, in September 2016 the number of Argo floats in the Nordics Seas is satisfying and is represented on the following map:

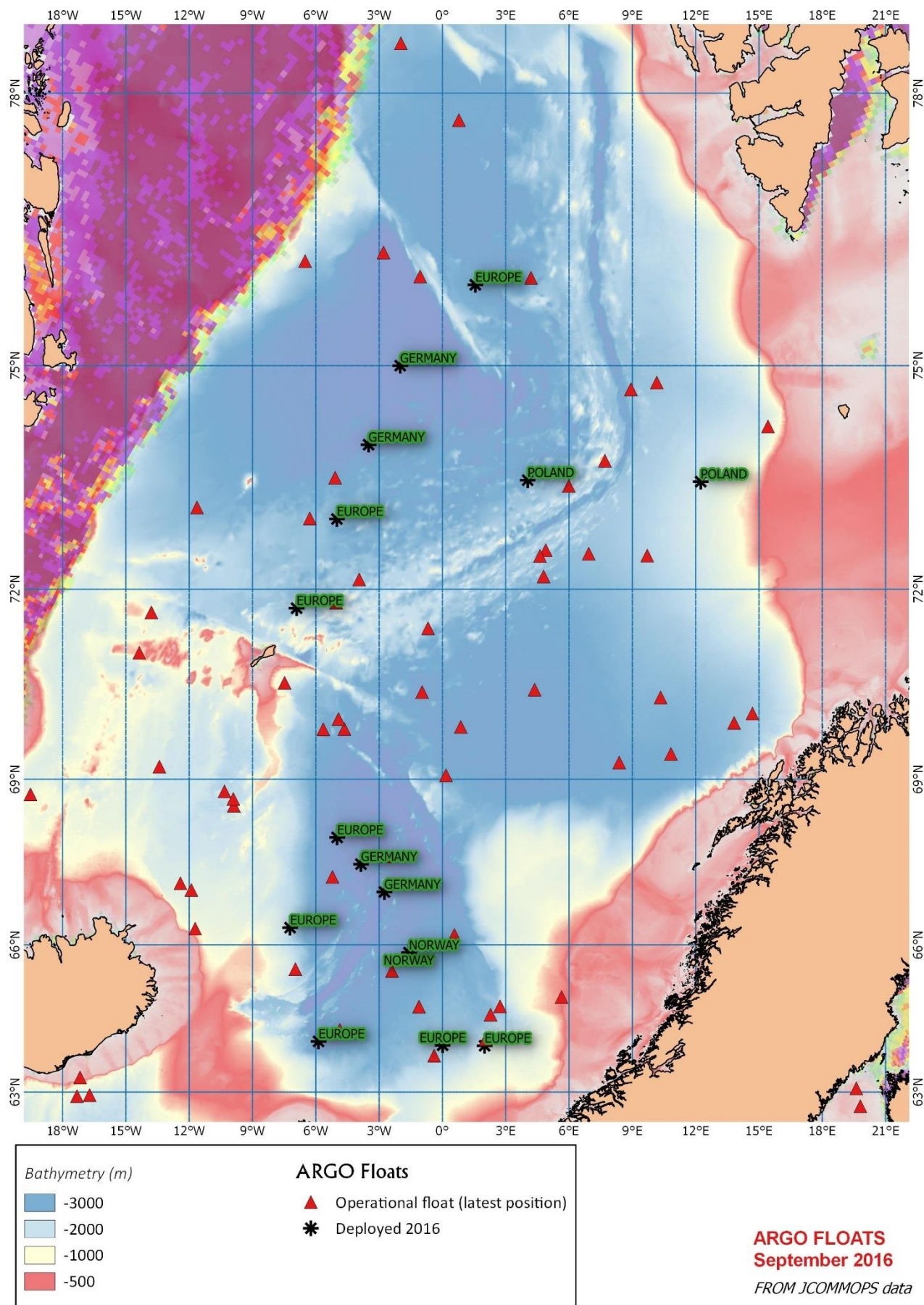


Figure 6: Deployment map for 2016 in Nordic Seas

3.2. Rockall Trough (NW Ireland)

An interesting opportunity to deploy a float on the northwest of Ireland coast was brought up by the Marine Institute, so **1 Iridium float** has been deployed close to the **Rockall Trough** area in August 2016, from RV Celtic Explorer.

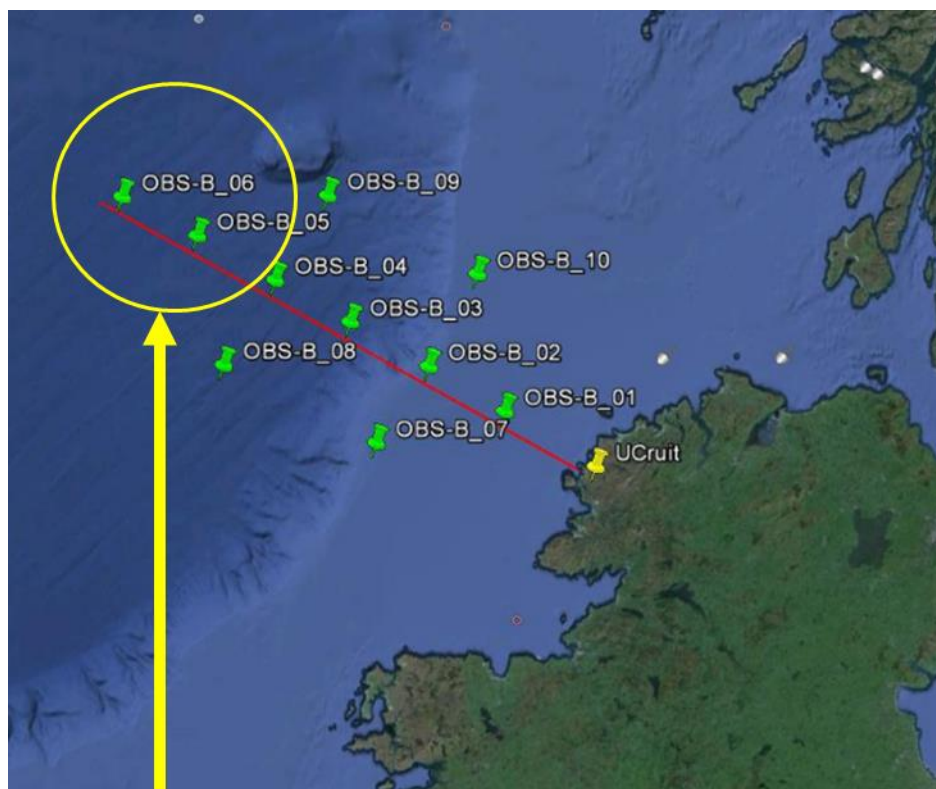


Figure 7: Ship track of cruise CV16030

3.3. Transit Azores-Guadeloupe + Caribbean area

Thanks to Andreas Sterl (KNMI), an opportunity of deployment in collaboration with the NIOZ (Royal Netherlands Institute for Sea Research) was found to deploy:

- **3 Iridium floats** during the **transit** of vessel R/V PELAGIA between **Azores and Guadeloupe**, with the objective of filling existing **gaps in the Argo array network in the Atlantic**;
- **3 Iridium floats** to be deployed in the **Caribbean area** during a research cruise of the NIOZ. This corresponds to a region considered important by the Argo Steering Team (AST) due to the presence of extreme events, and the new design of the Argo global array (see Figure 2) is now doubled in the Caribbean.

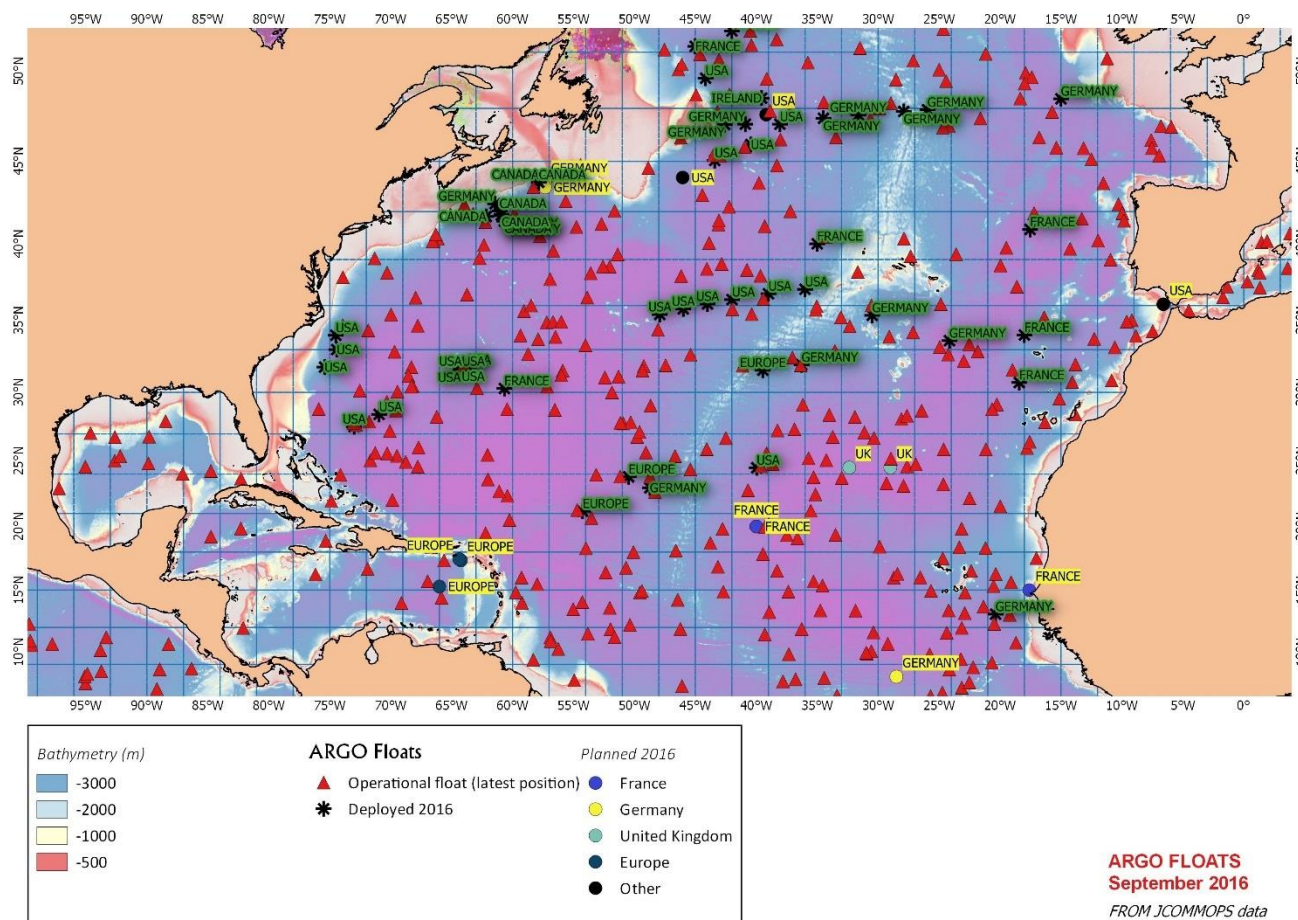


Figure 8: Deployment map for 2016 in the North Atlantic

3.4. Tropical South-Atlantic and Benguela current

An opportunity of deployment came from GEOMAR and was relayed thanks to Birgit Klein (BSH), to launch floats from R/V Meteor on M131 cruise which cross the Atlantic along the 12°S parallel.

Additionally, permissions were asked to Angola and Namibia to deploy floats along their coast in the EEZ.

These are really valuable areas in term scientific interests and under-sampling of the Argo array so we made plans to deploy:

- **3 Iridium floats** during the line transect between Recife and Luanda, with the objective of **filling existing gaps in the Argo array network in Tropical South-Atlantic**;
- **2 Iridium floats** to be deployed in the **Namibian EEZ**, with major focus in studying ocean currents and **upwelling systems** of the African coast.

Additionally, 1 float will be deployed by Germany on the 12°S transect and 2 floats in the Angolan EEZ.

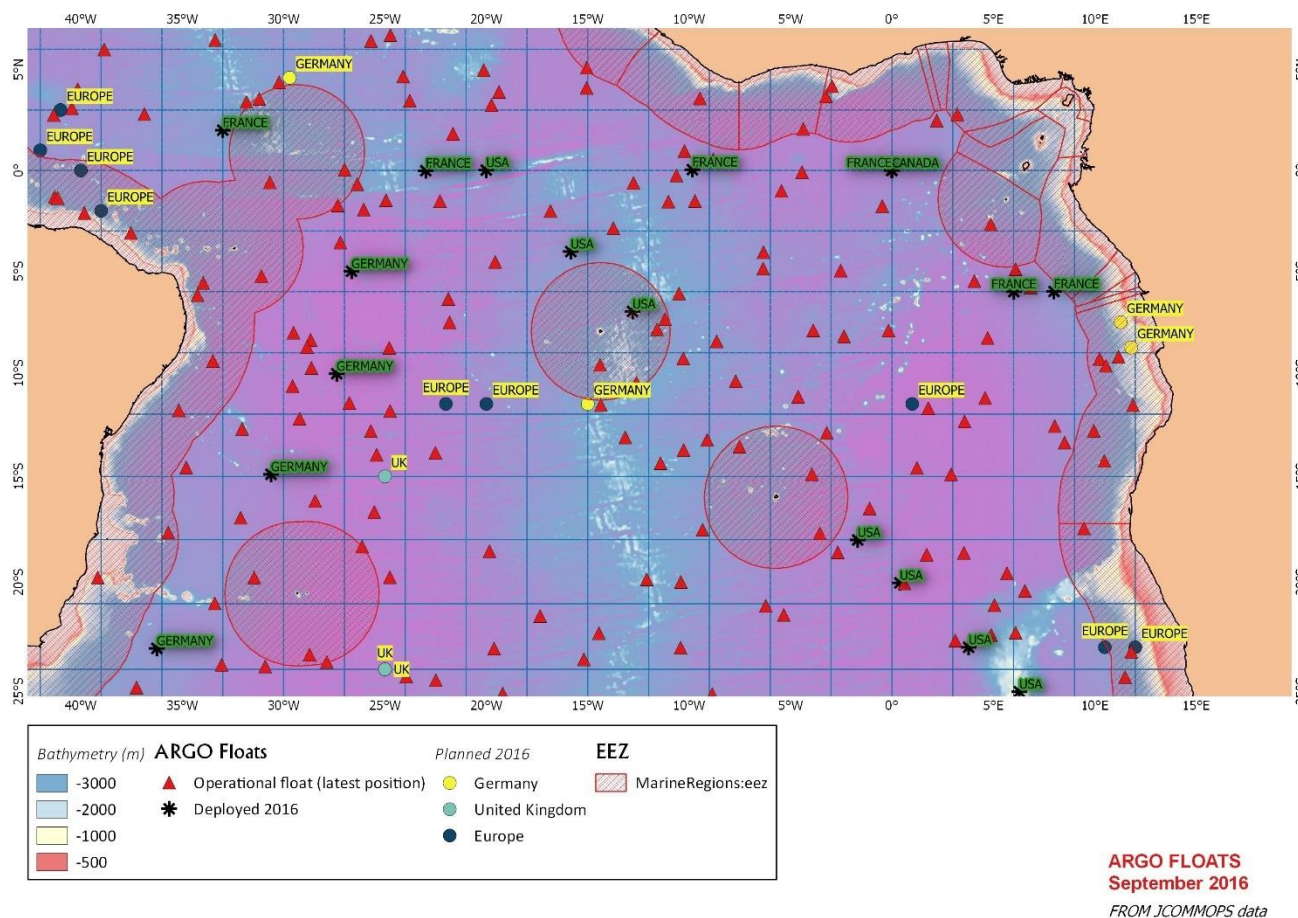


Figure 9: Deployment map for 2016 in the South Atlantic

3.5. Good Hope

Southern Ocean is tagged as a priority in Euro-Argo strategy. Since 2003 a lot of Argo float deployments have been done during the GOODHOPE⁴ cruises, as part of an international co-operative project which objectives are to study and monitor the Indo-Atlantic connections through the Southern Ocean.

Euro-Argo would like to contribute to gather better observations of Southern Ocean and thus it was decided to deploy:

- **9 Argos floats** during the SANAE (**South African National Antarctic Expedition**) cruise of S/A AGULHAS II which will leave Cape Town for Antarctica in early December 2016, following the GOODHOPE track;
- **3 Iridium floats** during the M133 cruise of F/S METEOR which will leave Cape Town for South America in mid-December 2016. A specific cycling scheme at the beginning of floats' life will allow for a study of anticyclonic eddies in the Cape Basin;
- **6 Argos floats** during the MSM60 cruise of vessel F/S MARIA S. MERIAN, that will follow a transect along the **35°S parallel across the South-Atlantic**.

⁴ <http://www.ifremer.fr/lpo/La-recherche/Equipe-MAAIA/Projets-en-cours/GoodHope>

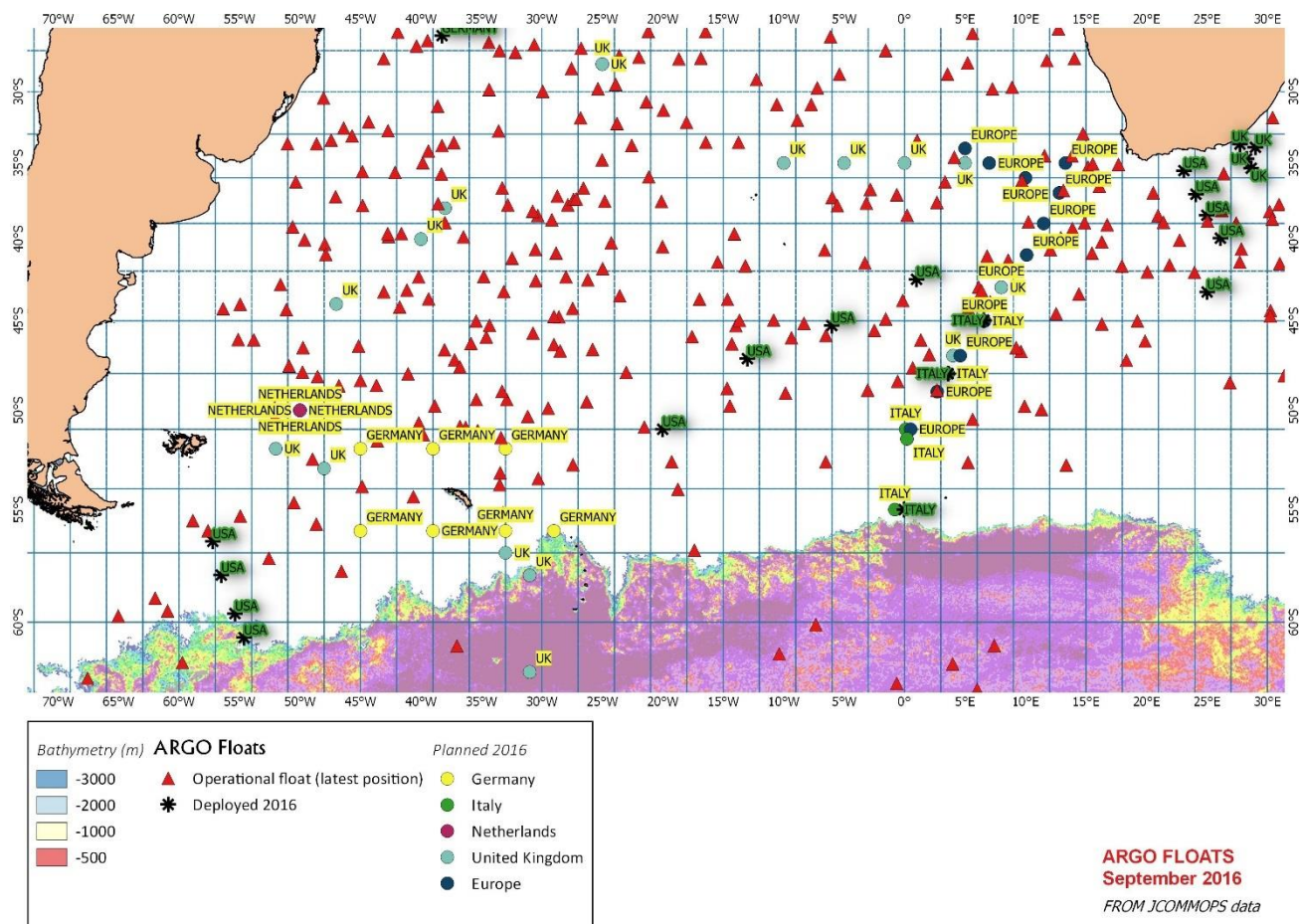


Figure 10: Deployment map for 2016 in the Southern Ocean

3.6. Equatorial Atlantic Retroflexion and Brazil-Malvinas Confluence region

Contact has been made through the French Argo deployment team with Josep Lluís Pelegri from “Institut de Ciències del Mar, CSIC” in Spain.

He has 2 scientific campaigns in late 2016 and spring 2017 where a lot of CTD stations will be carried out, which is a great asset for **calibration and validation of Argo data** when floats are deployed.

Then the plan is to send:

- **4 Iridium floats** during the RETRO-EZR cruise in **Equatorial Atlantic Retroflexion** area, in the western Atlantic between 1.5°S and 3°N;

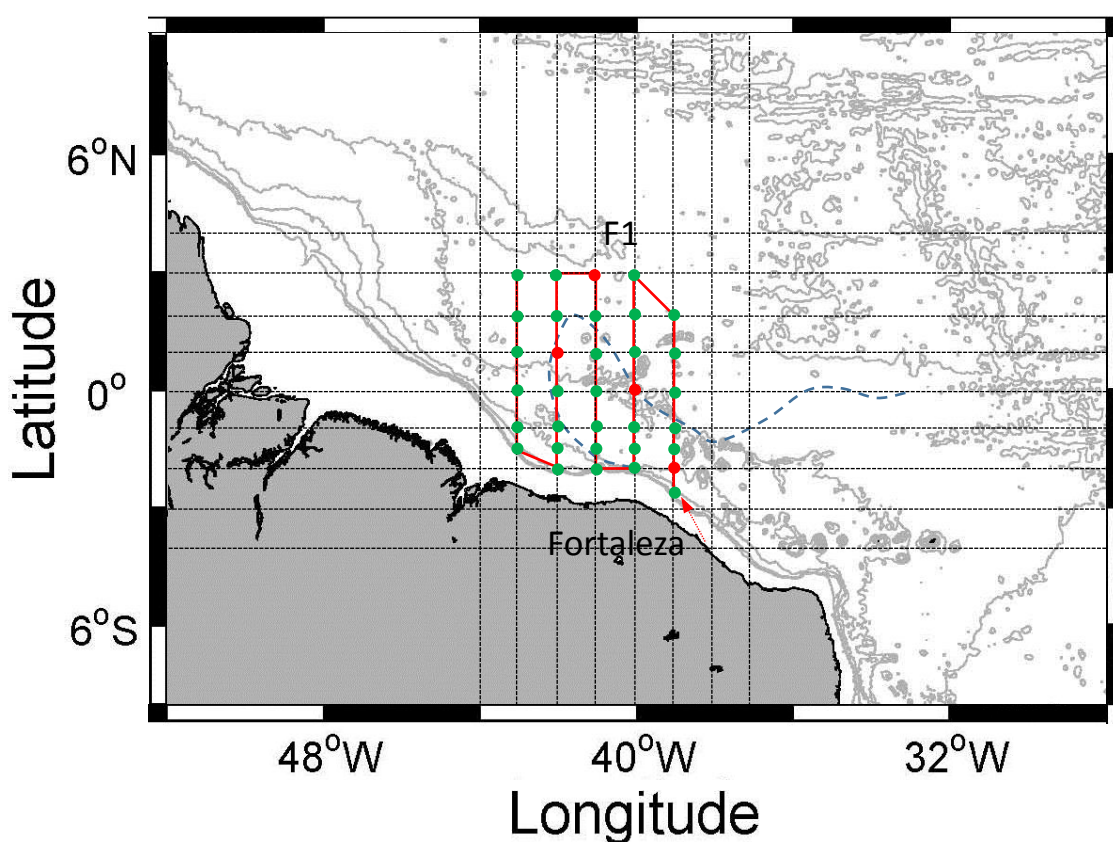


Figure 11: Map with tentative CTD stations (green dots); the red dots indicate those locations where the CTD will be accompanied by an Argo float launching.

- **4 Iridium floats** during the RETRO-BMC cruise in the **Brazil-Malvinas Confluence** region, in the western Atlantic between 36°S and 42°S.

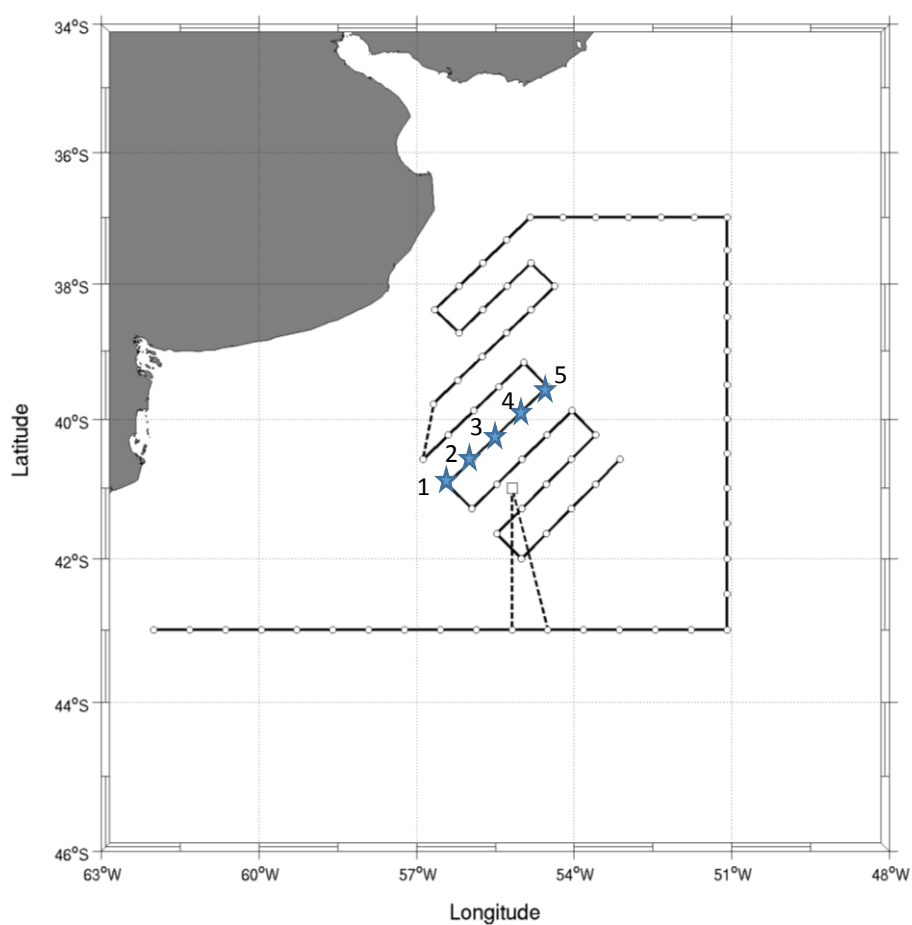


Figure 12: Map with tentative CTD stations (circles); the stars indicate those locations where the CTD will be accompanied by an Argo float launching.

All the floats will be deployed from R/V HESPERIDES and will have **high-frequency cycling periods for the 1st 20 days** (date of scientific campaigns). Then they will **switch to the standard core Argo mission, contributing to the global network.**

3.7. Marginal Seas

European and marginal seas are targets for MOCCA deployments as identified in the Strategy Document of Euro-Argo.

Hence a part of the MOCCA fleet will be dedicated to enhance the Argo array in these areas.

3.7.1. *Baltic Sea*

During the 7th Management Board of Euro-Argo it was considered that one float could be deployed in the Baltic Sea, with the assistance of Sweden.

Discussions between FMI, SMHI, Euro-Argo and NKE started in the summer to check if the technology of NKE Arvor floats is adapted to the Baltic Sea, and what would the best configuration of the float for this specific area.

A 2-way communication system is absolutely required in case one need to change float mission parameters and to reduce surfacing time, so iridium will be preferred.

As of October 2016, discussions are still ongoing, and the following items need to be sorted out:

- Check ARVOR software is adapted to process and transmit low range of salinity data (probably yes);
- Check if ARVOR buoyancy need to be adapted to reach enough surface emergence in low density waters;
- Increase vertical positioning accuracy (to +/- 5 dbar) on ARVOR software and check float behaviour (especially stabilisation phases);
- Allow day-to-day monitoring of the float and adapt parking and profile depths according to bathymetry (= avoid as much as possible grounding in soft sediments).

Status of discussions will be presented at the 8th Management Board in Trieste. Most probably the deployment could be postponed to 2017.

3.7.2. *Mediterranean Sea*

Given national plans in 2016 for the Mediterranean, there is no strong need to deploy additional MOCCA floats, except in the under-samples regions such as the eastern Med (Aegean Sea and Levantine Sea).

Contacts between Euro-Argo and Greece and Turkey were established in order to deploy:

- **1 Iridium float in the Aegean Sea**, with the help of HCMR;
- **1 Iridium float in the Cilician basin and Rhodes Gyre**, with the help of Turkey.

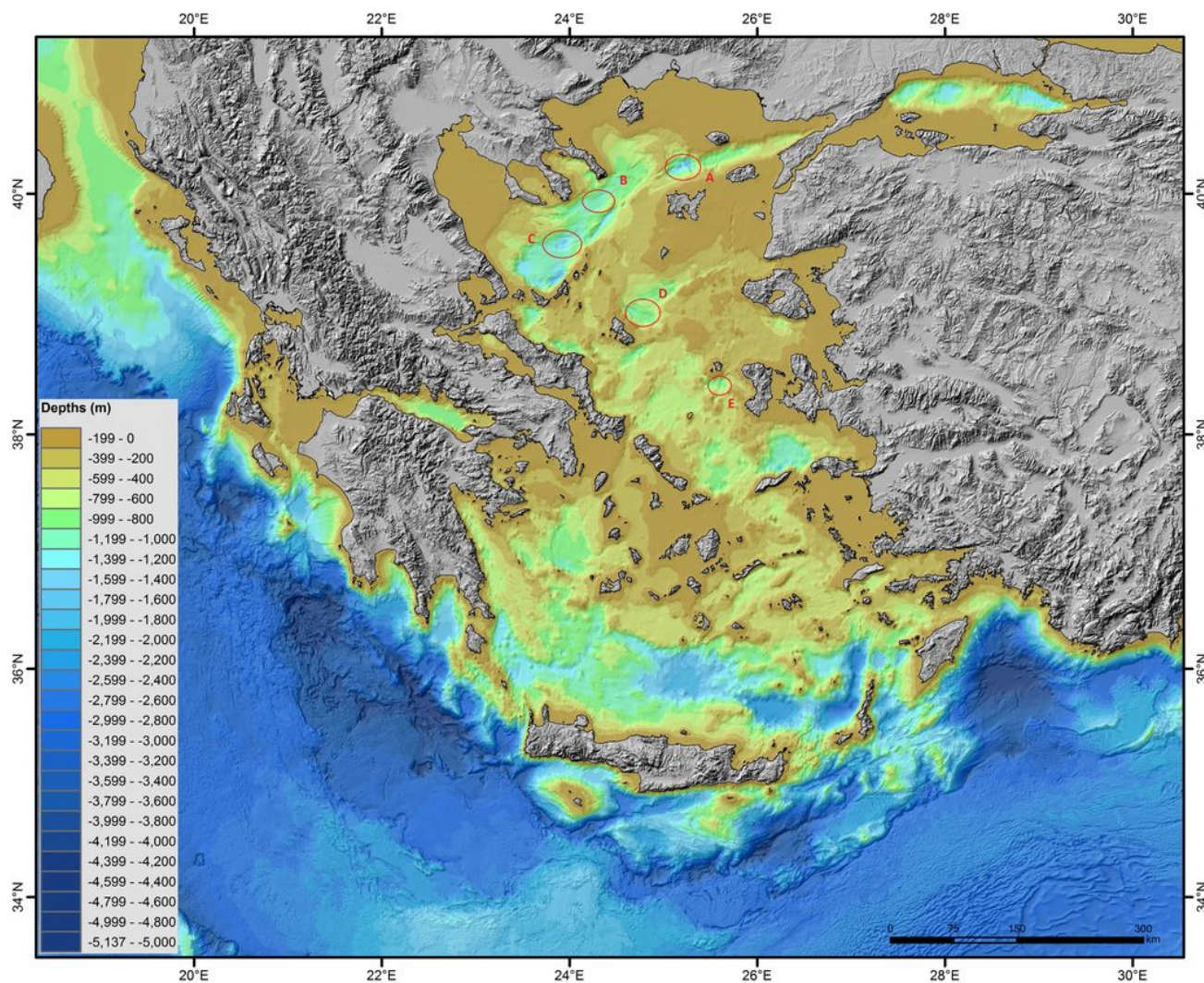


Figure 13: Foreseen deployment locations (A-B-C-D-E) for the Aegean Sea

3.7.3. Black Sea

In order to strengthen links between Euro-Argo and countries on the Black Sea, it was plans to deploy:

- **1 Iridium float in Western Black Sea with the help of Romania;**
- **1 Iridium float in Western Black Sea with the help of Bulgaria;**
- **1 Iridium float in Southern Black Sea with the help of Turkey;**

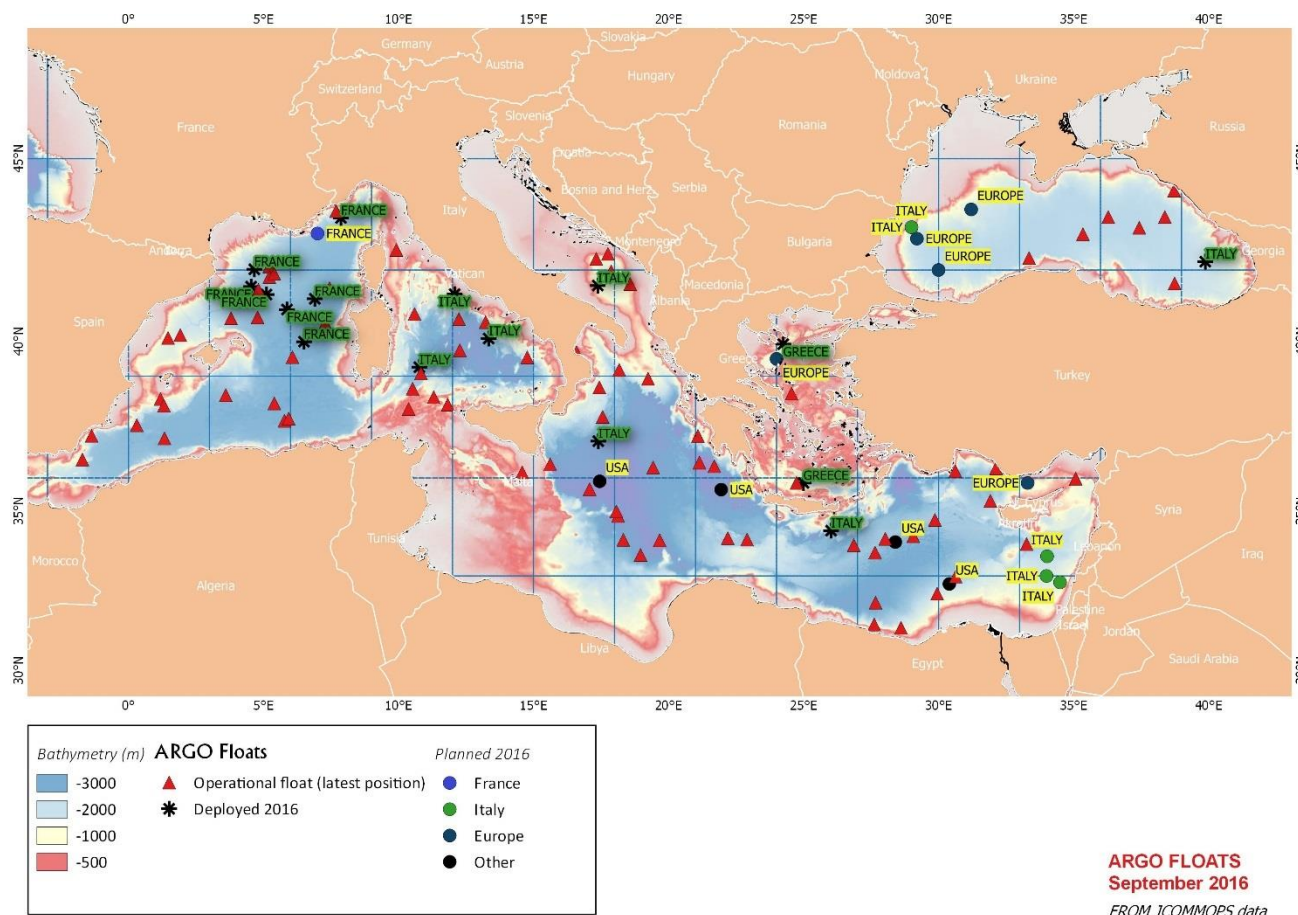


Figure 14: Deployment map for 2016 in the Mediterranean and Black Seas

3.8. Involvement of new countries in Euro-Argo deployments

Following the discussions during the 7th Management Board, it was decided to involve “new” countries for the deployment of the MOCCA floats. This could be seen as a starting process for countries that are not yet part of Euro-Argo to join the Infrastructure as candidate or observer members.

Thus contacts have been made between Euro-Argo and Bulgaria, Romania and Turkey and this led to successful opportunities of deployments.

Other contacts between Euro-Argo and Portugal, Spain and Sweden produced interesting possibilities but came not to final deployments yet.

3.9. Summary tables for MOCCA deployments in 2016

3.9.1. Co-financed floats (30)

CRUISES	COUNTRY	AREA	NB FLOATS	DEADLINE SHIPMENT	HARBOR	REMARKS
FLOATS ALREADY SHIPPED						
M127,M129, M131	GERMANY	Atlantic	10	April 2016	Barbados	BSH
MED	ITALY	Mediterranean	2	May 2016	Toulon	OGS
ARANDA	POLAND	Nordic	2	May 2016	Sopot	IOPAN
PLANCIUS	NETHERLANDS	Southern Ocean (Atlantic)	14	September 2016	Vlissingen	KNMI
Subtotal: 28						
FLOATS TO BE SHIPPED						
MED	ITALY	Mediterranean	2	2017		OGS
Subtotal: 2						
TOTAL 30 MOCCA FLOATS CO-FINANCED						

3.9.1. MOCCA-EU (120)

CRUISES	COUNTRY	AREA	NB FLOATS	DEADLINE SHIPMENT	HARBOR	REMARKS
FLOATS ALREADY SHIPPED						
CV16030	IRELAND	Rockall Trough	1	August 2016	Galway	MI
NARVAL	FRANCE	Nordic	4	June 2016	Brest	Navy
PELAGIA	NETHERLANDS	Atlantic + Caribbean	6	June 2016	Texel	NIOZ
M131	GERMANY	Tropical SA	5	June 2016	Kiel	BSH/GEOMAR
MOSBY	NORWAY	Nordic	4	July 2016	Bergen	IMR
	ROMANIA	Black Sea	1	September 2016	Constanta	GeoEcoMar
	TURKEY	Cilician + BS	2	September 2016	Ankara	METU
	BULGARIA	Black Sea	1	September 2016	Varna	IO-BAS
	GREECE	Aegean Sea	1	September 2016	Anavyssos	HCMR
HESPERIDES	SPAIN	Atlantic	8	October 2016	BARCELONA	CSIC
AGULHAS	FRANCE	Southern Ocean	9	October 2016	Cape Town	Good Hope
M133/MERIAN	GERMANY	Southern Ocean	3+6	October 2016	Cape Town	Good Hope
TOTAL 51 MOCCA FLOATS						

In conclusion, 79 MOCCA floats will be deployed in 2016, including 28 co-financed ones. The remaining 71 MOCCA floats will be deployed in 2017.

3.10. Summary map for 2016

All the deployment plans for the MOCCA fleet in 2016 are summarized on the following map:

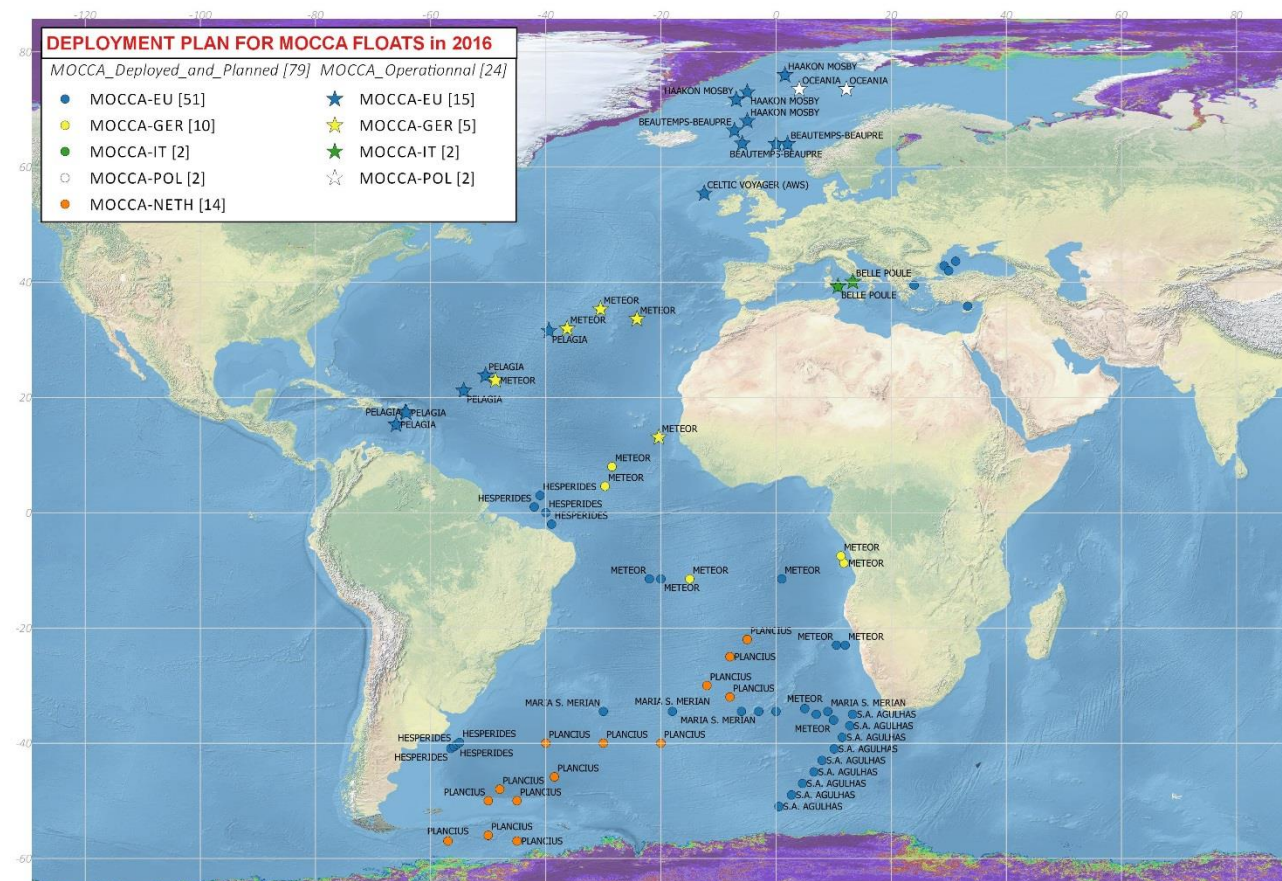


Figure 15: MOCCA deployments in 2016 (world)

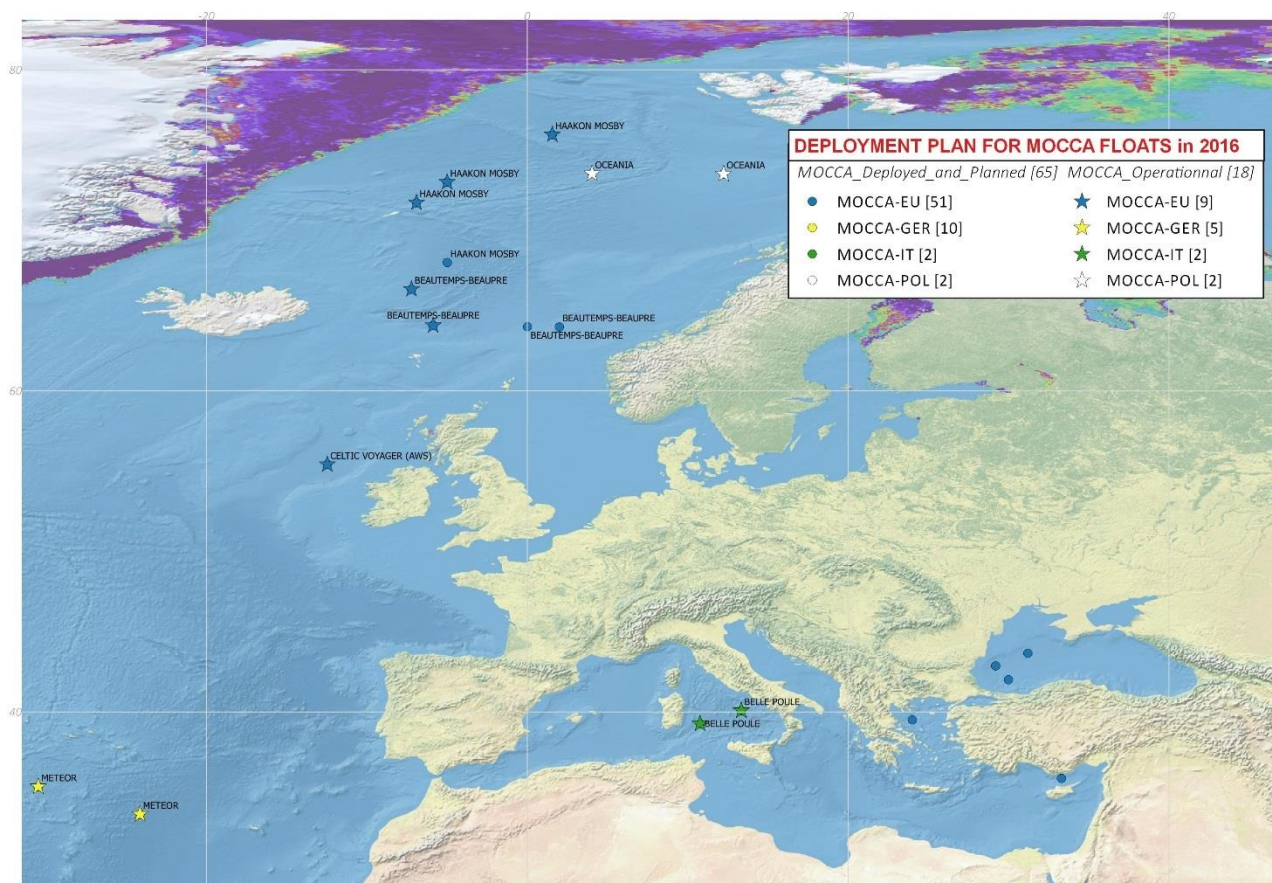


Figure 16: MOCCA deployments in 2016 (zoom on Europe)

4. PLANS FOR 2017

Draft plans for the remaining 71 MOCCA floats to be deployed in 2017 are detailed below:

- Discussions have started with British Antarctic Survey (BAS) to deploy floats from the R/V James Clark Ross during scientific cruise in the Drake passage (SR1b, in September 2017) and in transit between UK and the Southern Ocean;
- MOCCA floats may probably be deployed during the RAPID cruise (transect at 26N) in the Atlantic Ocean in March 2017;
- A huge cruise of R/V OGS Explora between Trieste and Ross Sea could deploy MOCCA floats. Ongoing discussions;
- MOCCA floats could also be deployed on the GO-SHIP line A02 operated by Ireland in June 2017, between Galway and St Johns, Newfoundland and Labrador;
- Discussions have started with the Ship Coordinator of JCOMMOPS, for possible deployments on sailing boats, commercial ships, big sailing races, research vessels (UNOLS, IRSO meeting etc.);
- Further plans will be investigated.