



Argo-Spain National Report 2024

Alberto González (IEO-CSIC), Lara Díaz-Barroso (SOCIB), Irene Lizarán (SOCIB), Pedro Vélez-Belchí (IEO-CSIC), Joaquín Tintoré (SOCIB)

1. The status of implementation of the new global, full-depth, multidisciplinary Argo array (major achievements and problems in 2024)

a. floats deployed and their performance

Argo Spain contributed to extending the international Argo network during 2024 deploying floats in the Atlantic Ocean and Mediterranean Sea. These deployment missions were coordinated by the Spanish Institute of Oceanography (IEO-CSIC) and the Balearic Islands Coastal Observing and Forecasting System (SOCIB). The specifications of the deployments by area are shown below.

Atlantic Ocean

Within the framework of the biannual oceanographic cruises RAPROCAN, STOCA and RADCAN, together with the collaboration of other IEO-CSIC research groups, a total of 6 floats were launched in the Atlantic Ocean by IEO-CSIC (Table 1). All of them were deployed into three areas mainly: The Canary Basin, the Cantabrian Sea and the Gulf of Cadiz. All the deployed floats corresponded to Core Argo floats.

Western Mediterranean Sea

During the SOCIB Canales Spring 2024 and SOCIB Canales Autumn 2024 oceanographic cruises, Spain deployed one core Argo float in each campaign. Additionally, in November 2024, during the SOCIB-IMEDEA EBAMAR cruise, another core Argo float was deployed, using the R/V SOCIB as a ship of opportunity in all cases (Table 1).

In total, 3 core Argo floats were deployed across these missions. Two of these cruises are part of the SOCIB 'CANALES' endurance line, which aims to deepen the understanding of the state and variability of the Balearic Sea, further consolidating and advancing scientific research in the region.

WMO	Deployment date	Deployment location	Cruise
7901142	21/01/2024	36°03'15.5"N, 7°20'10.3"W	STOCA2401
7901143	21/01/2024	36°20'10.0"N, 7°13'08.0"W	STOCA2401
3902505	13/05/2024	39°16'39.0"N 1°58'33.6"E	SOCIB Canales Spring 2023
1902720	25/08/2024	36°03'09.4"N, 7°20'03.5"W	STOCA2408
6990667	26/08/2024	36°21'47.5"N, 7°14'57.5"W	STOCA2408
1902721	29/08/2024	40°41'26.9"N, 9°36'37.8"W	RCAN2408
7902224	30/08/2024	42°40'26.0"N, 9°20'25.8"W	RCAN2408
3902614	06/11/2024	38°59'58.9"N 0°44'13.2"E	SOCIB Canales Autumn 2023
4903829	13/11/2024	39°10'12.0"N 3°11'34.8"E	SOCIB-IMEDEA EBAMAR Nov 2024

Table 1. Deployment information related to Spanish deployed floats during 2024.

Different preset configurations were used before each mission. On the one hand, all Core Argo floats were configured to dive up to 2000 dbar and 1000 dbar of parking depth. All floats worked in cycles of 10 days in the Atlantic Ocean and 5 days in the Mediterranean Sea.

Active Spanish floats in 2024

In summary, 19 Spanish floats have been active during 2024 in the Atlantic Ocean and the Western Mediterranean Sea.

b. technical problems encountered and solved

During 2024, IEO-CSIC received feedback from the manufacturer (NKE Instrumentations) about the two floats sent for inspection in 2023. One of the floats was quickly returned to the IEO-CSIC as no problems were detected and the other one is still in repair. On the other hand, IEO-CSIC detected a bug in the configuration process of the float prior deployment. It was reported to the customer service and satisfactorily solved by the manufacturer. This bug apparently came from a firmware

issue in this batch of floats, a topic that was mentioned by the manufacturer during the Argo Tech Meeting celebrated in Seattle.

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

After each deployment, detailed technical information is provided to the DAC in charge of the floats (Coriolis) and the AIC. The Argo-Spain program is aware of the changes in the technical and metadata data formats and is providing the necessary information.

d. status of delayed mode quality control (DMQC) process

Argo-Spain mainly deploys floats in the Atlantic Ocean and the Mediterranean Sea. In terms of DMQC, Argo-Spain, through IEO-CSIC, manages its floats that operate in the Atlantic Ocean, and the *Istituto Nazionale di Oceanografia e di Geofisica Sperimentale* (OGS) manages all the floats that operate in the Mediterranean Sea, including floats of Argo-Spain.

In terms of the floats for which Spain is responsible for the DMQC process, 53 out of the 76 Atlantic floats have been processed, including 1 (WMO 6901273) in the year 2024. IEO-CSIC is in conversations with IFREMER to improve its own DMQC routine based on [Euroargodev](#)'s repository.

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

Spain has participated in the international Argo program since its inception and is currently a member of the European Research Infrastructure Consortium Euro-Argo (ERIC). Spanish participation in Argo began in 2002 through a first European project, and since then, a total of 115 Argo floats have been deployed. Among these, 76 floats have been deployed in the Atlantic Ocean, and 34 floats have been deployed in the Mediterranean Sea (one of them never communicated, [WMO 4903635](#)). Additionally, 4 floats have been donated to other countries: 2 floats to Costa Rica, 1 float to Morocco, and 1 float to Mexico.

In 2022, the agreement was renovated between the Ministry of Science and Innovation, IEO-CSIC and SOCIB ([Disposición 14622 del BOE núm. 214 de 2022](#)), assuming the financial commitment that Spain participates as a full member of the ERIC Euro-Argo. The interest in such participation was demonstrated in the process of prioritizing Spain's participation in European research infrastructures, as detailed in the document on the Spanish Strategy for participation in scientific infrastructures and international organizations. At the end of 2024, the first monitoring meeting between the three

member institutions was held. Additionally, it was agreed that an annual monitoring meeting would take place.

However, the Argo-Spain program currently lacks proper long-term funding for the deployment of Argo floats. The contribution to the Euro-Argo ERIC is secured and sustained through membership payments from the Spanish Ministry of Science, Innovation, and Universities, as well as SOCIB. Additionally, the availability of extra funding relies on access to infrastructure calls. Both IEO-CSIC and SOCIB are committed to ensuring deployments of at least 3 floats per year, and its transmission costs. Also, IEO-CSIC funds the scientific coordination (1.5 person/month per year).

At the end of 2021, SOCIB received funding from NextGenerationEU/PRTR to ensure the purchase and deployment of floats in the Mediterranean Sea during the next few years.

The personnel of Argo-Spain during 2024 consisted of the following individuals from IEO-CSIC and SOCIB:

IEO-CSIC:

- 1 technician working 75% of their time.
- 1 Principal Investigator (PI) working 30% of their time.

SOCIB:

- 1 student working 50% of their time.
- 1 technician working 50% of their time.
- 1 technician working 10% of their time.
- 1 researcher working 15% of their time.
- 1 PI working 5% of their time

- 3. Summary of deployment plans: please see the [separate documents](#) explaining the longer term outlook this year as a response to G7 requests. This spreadsheet is to be returned separately ASAP to help prepare for the meeting. It can be sent to Megan or dropped in the folder link containing the instructions.**

This information is included in the European deployment planning statistics for subsequent years, which is located in the "national_deployment_information" folder of the AST65. However, we attach below individually the theoretical contribution of Argo-Spain for the coming years (Table 2).

SPA	2024						
	Total	Core	Core + O	Core + 2-3 BGC	Core + 4-6 BGC	Deep	Deep + O
Nordic Seas	0						
Mediterranean Sea	3	3					
Black Sea	0						
Baltic Sea	0						
Southern Ocean	0						
Arctic Ocean	0						
Global Ocean	6	6					
Total	9	9	0	0	0	0	0
SPA	2025						
	Total	Core	Core + O	Core + 2-3 BGC	Core + 4-6 BGC	Deep	Deep + O
Nordic Seas	0						
Mediterranean Sea	3	3*					
Black Sea	0						
Baltic Sea	0						
Southern Ocean	2	1	1				
Arctic Ocean	0						
Global Ocean	13	8	2			3	
Total	18	12	3	0	0	3	0
SPA	2026						
	Total	Core	Core + O	Core + 2-3 BGC	Core + 4-6 BGC	Deep	Deep + O
Nordic Seas	0						
Mediterranean Sea	3	3					
Black Sea	0						
Baltic Sea	0						
Southern Ocean	0						
Arctic Ocean	0						
Global Ocean	10	8	2				
Total	13	11	2	0	0	0	0

Table 2, Potential deployments of Spanish floats (float types and corresponding quantities) projected for the coming years as part of Euro-Argo ERIC

*One of these floats will be a coastal model.

4. Summary of any research and development efforts over the past year to try new sensors or improve float technology. This could include new collaborations with vendors or other partners.

IEO-CSIC is part of the team that developed the experiment based on sensor intercomparison mounted in deep argo floats. A scientific communication titled "*Intercomparison of extended-depth SBE41CP, SBE61 and RBRargo|deep6k CTDs for Deep-Argo application using three and two-headed Deep-Arvor floats*" led by Virginie Thierry was accepted by the end of 2024.

On the other hand, Euro-Argo secured funding from the European Commission during 2024 to launch the [Euro-Argo ONE \[2025-2027\]](#) project. Both IEO-CSIC and SOCIB will lead a task dedicated to develop a global strategy to achieve a more efficient and sustainable Argo network through the recovery of Argo floats. The manufacturer NKE Instrumentations appears as a partner among all participants and is planned to work side by side to improve float technology.

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

Argo data are widely used by Spanish researchers to advance the understanding of climate and ocean variability. Additionally, operational ocean forecasting models rely on Argo data for model assessments and improvements through data assimilation. Key examples include:

- Western Mediterranean Operational Forecasting System ([WMOP](#))
- Atlantic-Iberian Biscay Irish-Ocean Physics Analysis and Forecast ([IBI-MFC](#))
- Mediterranean Sea Physics Reanalysis ([Med MFC](#))

As part of its commitment to the Argo program, SOCIB has generated a data product compiling all historical Argo deployments conducted by SOCIB, ensuring accessibility to the deployment records: [SOCIB Argo Profiling Floats](#), DOI: <https://doi.org/10.25704/yb5v-yx90>

Additionally, SOCIB contributes to the monitoring and visualization of sub-regional ocean indicators through the Sub-regional Mediterranean Sea Indicators tool. This operational product provides continuous and timely information on ocean state and variability at multiple temporal scales (from daily events to interannual/decadal trends). It is designed for use by the scientific community, marine science educators, decision-makers, and environmental agencies, incorporating Argo data as a fundamental source: [Sub-regional Mediterranean Sea Indicators](#)

For more information on the Argo Spain national program, visit: www.argoespana.es

6. **Issues that your country wishes to be considered and resolved by the Argo Steering Team regarding the international operation of Argo. These might include tasks performed by OceanOPS, the coordination of activities at an international level and the performance of the Argo data system. If you have specific comments, please include them in your national report. Also, during the AST-26 plenary, each national program will be asked to mention a single highlight or issue via a very brief oral report.**

No issues.

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

A CTD cast is performed after most of the Argo-Spain deployments.

8. **Keeping the Argo bibliography ([Bibliography | Argo \(ucsd.edu\)](#)) up to date and accurate is an important part of the Argo website. This document helps demonstrate the value of Argo and can possibly help countries when applying for continued Argo funding. To help me with this effort, please include a list of all papers published by scientists within your country in the past year using Argo data, including non-English publications. There is also the thesis citation list ([Thesis Citations | Argo \(ucsd.edu\)](#)). If you know of any doctorate theses published in your country that are missing from the list, please let me know.**

Finally, if you haven't already sent me a list of Argo PIs in your country, please do so to help improve the statistics on how many papers are published including an Argo PI vs no Argo PIs.

- Arumí-Planas, C., Dong, S., Perez, R., Harrison, M. J., Farneti, R., & Hernández-Guerra, A. (2024). *A multi- data set analysis of the freshwater transport by the Atlantic meridional overturning circulation at nominally 34.5°S*. Journal of Geophysical Research: Oceans, 129, e2023JC020558. <https://doi.org/10.1029/2023JC020558>
- Camprubí, L. (2024). *Jason y los argonautas: temporalidad, usabilidad y conocimiento tácito en el monitoreo oceánico de Argo*. Asclepio, 76(2), e25. <https://doi.org/10.3989/asclepio.2024.25>

- Chevillard, C., Juza, M., Díaz-Barroso, L., Reyes, E., Escudier, R., & Tintoré, J. (2024). *Capability of the Mediterranean Argo network to monitor sub-regional climate change indicators*. *Frontiers in Marine Science*, 11(416486). <https://doi.org/10.3389/fmars.2024.1416486>
 - García-Jiménez, J., Ruescas, A. B., Amorós-López, J., & Sauzède, R. (2025). *Combining BGC-Argo floats and satellite observations for water column estimations of particulate backscattering coefficient*. *EGUsphere* [preprint]. <https://doi.org/10.5194/egusphere-2024-3942>
 - González-Santana, D., & Vélez-Belchí, P. (2024). *The Argo Online School: An e-learning tool to get started with Argo*. *Journal of Open Source Education*, 7(80), 193. <https://doi.org/10.21105/jose.00193>
 - Hoerstmann, C., Aguiar-González, B. M., Barrillon, S., Capaneto Bastos, C., Grosso, O., Pérez Hernández, M. D., Doglioli, A. M., Petrenko, A. A., & Benavides, M. (2024). *Nitrogen fixation in the North Atlantic supported by Gulf Stream eddy-borne diazotrophs*. *Nature Geoscience*, 17, 1141–1147. <https://doi.org/10.1038/s41561-024-01567-2>
 - Pirro, A., Martellucci, R., Gallo, A., Kubin, E., Mauri, E., Juza, M., Notarstefano, G., Pacciaroni, M., Bussani, A., & Menna, M. (2024). *Subsurface warming derived from Argo floats during the 2022 Mediterranean marine heat wave*. *State of the Planet*, 4(osr8-18). <https://doi.org/10.5194/sp-4-osr8-18-2024>
- 9. Does your National Program have any deployment plans for RBR floats in the next couple years? If so, please indicate how many floats you will be buying in 2024 and 2025 (if known) and where they might be deployed.**

At the moment, this option is not contemplated in the short term.