

Argo-España

Parte de la estrategia global de observación del océano



Argo – Spain Annual Report 2018

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Argo – Spain Annual Report

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A. González-Santana – P. Vélez-Belchí
Instituto Español de Oceanografía

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Present status and future plans

Alberto González Santana, Pedro Vélez Belchí

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INSTITUTO
 ESPAÑOL DE
 OCEANOGRAFÍA



Balearic Islands
 Coastal Observing
 and Forecasting
 System

1. Introduction

In 2002, Argo-Spain started the Argo program through a European project where a total of 80 Argo profilers were deployed in the North Atlantic. Since then, data have been collected in order to reach the scientific objectives scheduled:

- Oceanographic data is assimilated into operational models.
- Results of the models are used to redesign observation and measurement strategies.
- Information of subsurface water is used in ocean - atmosphere models, essential for medium and long-term predictions.
- Getting information of salinity and temperature fields at different depths, mixing layer, thermocline depth and its seasonal and spatial variability.
- Data will make strong the Argo ocean observing system, allowing optimal and accurate estimations of the fields and flows into the ocean in climate modeling and statistical analysis of variability.

Data from Argo floats is transmitted from the float and passed through processing and automatic quality control procedures. The target is to issue the data to the GTS and Global Data servers as quickly thereafter as possible. These are called real - time data (RT). The data are also issued to the Principle Investigators. These scientists apply other procedures to check data quality. The main target is to return the processed data to the global data centers within 6 to 12 months. These procedures are called the delayed mode (DM). The adjustments applied to delayed-data may also be applied to real - time data, to correct sensor drifts for real - time users. However, these real - time adjustments will be recalculated by the delayed mode quality control (DMQC).

The main working area covers the North Atlantic Ocean, Canary Islands region and Mediterranean Sea. This allows us to get a general perspective of completely different ocean dynamics.

In this document we briefly describe all the stages of the data management (data processing, data correction and generation of data products and figures) of the DMQC for Argo-Spain floats. It is designed to process data of the most widely used and commercially exploited Argo platforms (APEX, ARVOR and NAVIS).

2. The status of implementation

The Argo-Spain program started in 2002 and is currently coordinated by the IEO. Since then, 82 floats have been deployed, of which 25 were active at the end of 2018.

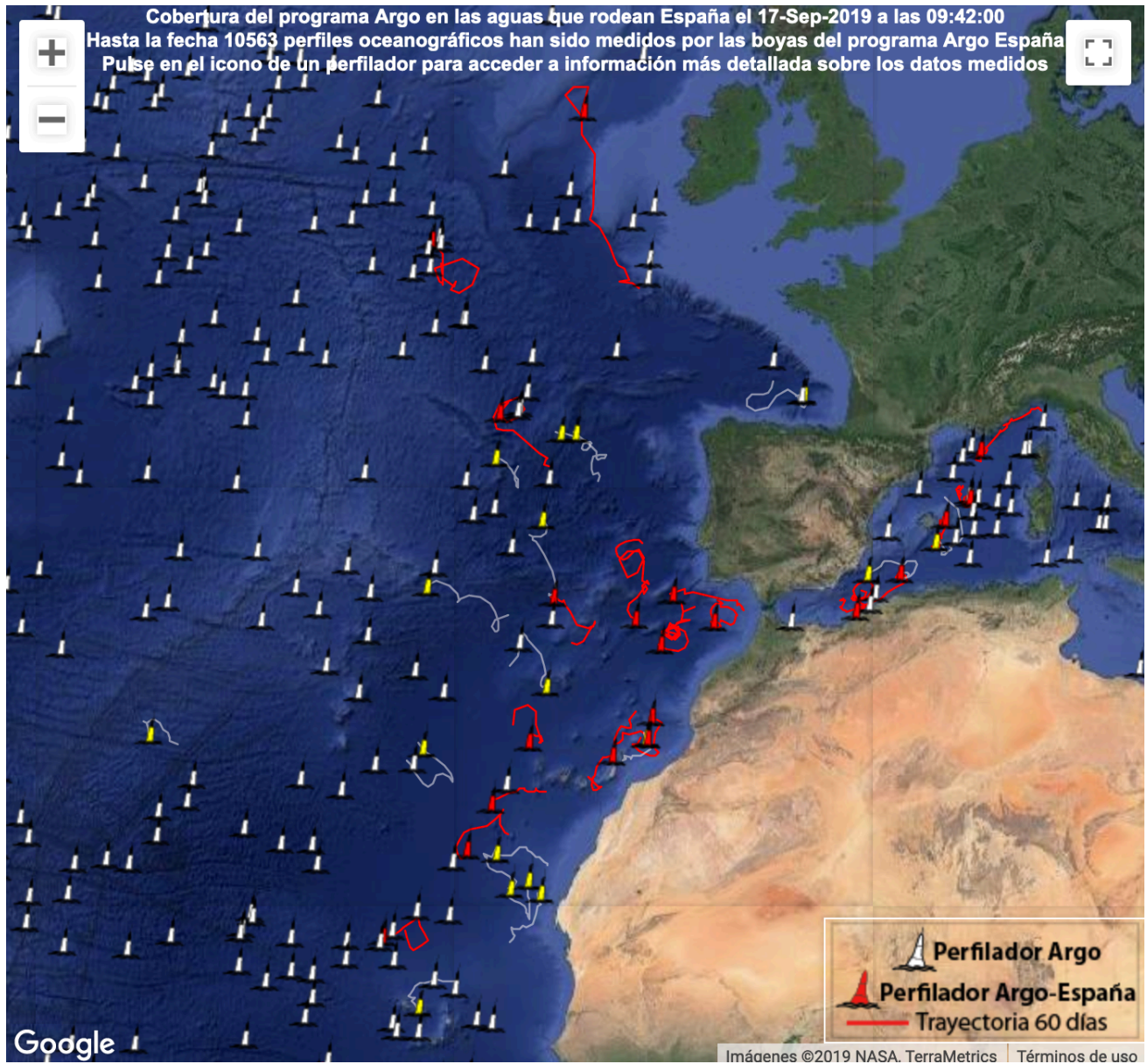


Figure 1. Status of the Argo Spain program on September 18th 2019. Altogether, 90 floats have been deployed.

The following table shows relevant information of each Argo-Spain float. It is a database that records information of some features from the deployment until the floats stop completely.

WMO ID	STATUS	PROJECT NAME	FLOAT OWNER	PLATFORM TYPE	CONTROLLER BOARD TYPE PRIMARY	Depl. Date (DD/MM/YYYY)
1900275	EOWL	Argo SPAIN	IEO	APEX	APF8C	21/09/2003
1900276	EOWL	Argo SPAIN	IEO	APEX	APF8C	22/09/2003
1900277	EOWL	Argo SPAIN	IEO	APEX	APF8C	24/09/2003
1900278	EOWL	Argo SPAIN	IEO	APEX	APF8C	19/09/2003
1900279	EOWL	Argo SPAIN	IEO	APEX	APF8C	27/09/2003
1900377	EOWL	Argo México	IEO	PROVOR		04/05/2005
1900378	EOWL	Argo Costa Rica	IEO	PROVOR		07/12/2005
1900379	EOWL	Argo Costa Rica	IEO	PROVOR		07/12/2005
4900556	EOWL	Argo SPAIN	IEO	PROVOR		05/03/2005
4900557	EOWL	Argo SPAIN	IEO	PROVOR		10/09/2004
4900558	EOWL	Argo SPAIN	IEO	PROVOR		10/09/2004
6900230	EOWL	Argo SPAIN	IEO	APEX	APF8C	13/09/2003
6900231	EOWL	Argo SPAIN	IEO	APEX	APF8C	18/12/2003
6900506	EOWL	Argo SPAIN	IEO	APEX		13/09/2006
6900633	NW	Argo SPAIN	ICM	APEX	APF8C	14/02/2012
6900634	NW	Argo SPAIN	ICM	APEX	APF8C	14/02/2012
6900635	EOWL	Argo SPAIN	ICM	APEX	APF8C	09/11/2011
6900636	Active	Argo SPAIN	ICM	APEX	APF8C	28/07/2012
6900659	EOWL	Argo SPAIN	SOCIB ICTS	APEX		12/01/2011
6900660	EOWL	Argo SPAIN	SOCIB ICTS	APEX	APF8C	08/09/2011
6900661	EOWL	Argo SPAIN	SOCIB ICTS	APEX	APF8C	22/06/2011
6900662	EOWL	Argo SPAIN	SOCIB ICTS	APEX	APF8C	10/06/2012
6900760	EOWL	Argo SPAIN	IEO	APEX	APF9A	05/09/2010
6900761	EOWL	Argo SPAIN	IEO	APEX	APF9A	06/09/2010
6900762	EOWL	Argo SPAIN	IEO	APEX	APF9A	11/09/2010
6900763	EOWL	Argo SPAIN	IEO	APEX	APF9A	10/09/2010
6900764	EOWL	Argo SPAIN	IEO	APEX	APF9A	01/02/2011
6900765	EOWL	Argo SPAIN	IEO	APEX	APF9A	03/02/2011
6900766	EOWL	Argo SPAIN	IEO	APEX	APF9A	16/12/2010
6900767	EOWL	Argo SPAIN	IEO	APEX	APF9A	24/12/2010
6900768	EOWL	Argo SPAIN	IEO	APEX	APF9A	27/12/2010
6900769	EOWL	Argo SPAIN	IEO	APEX	APF9A	04/02/2011
6900770	EOWL	Argo SPAIN	IEO	APEX	APF9A	07/02/2011
6900771	EOWL	Argo SPAIN	IEO	APEX	APF9A	07/02/2011

6900772	EOWL	Argo SPAIN	IEO	APEX	APF9A	27/10/2010
6900773	EOWL	Argo SPAIN	IEO	APEX	APF9A	15/02/2011
6900774	EOWL	Argo SPAIN	IEO	APEX	APF9A	20/02/2011
6900775	EOWL	Argo SPAIN	IEO	APEX	APF9A	23/02/2011
6900776	EOWL	Argo SPAIN	IEO	APEX	APF9A	25/02/2011
6900777	EOWL	Argo SPAIN	IEO	APEX	APF9A	26/02/2011
6900778	EOWL	Argo SPAIN	IEO	APEX	APF9A	01/12/2010
6900779	EOWL	Argo SPAIN	IEO	APEX	APF9A	01/12/2010
6900780	EOWL	Argo SPAIN	IEO	APEX	APF9A	25/01/2011
6900781	EOWL	Argo SPAIN	IEO	APEX	APF9A	26/01/2011
6900782	EOWL	Argo SPAIN	IEO	APEX	APF9A	27/01/2011
6900783	EOWL	Argo SPAIN	IEO	APEX	APF9A	01/12/2010
6900784	EOWL	Argo SPAIN	IEO	APEX	APF9A	05/09/2010
6900785	EOWL	Argo SPAIN	IEO	APEX	APF9A	06/09/2010
6900786	EOWL	Argo SPAIN	SOCIB ICTS	APEX	9I-8373	01/05/2012
6900787	EOWL	Argo SPAIN	SOCIB ICTS	APEX	9I-8500	15/07/2013
6900788	EOWL	Argo SPAIN	SOCIB ICTS	APEX	9I-8496	15/04/2013
6900789	EOWL	Argo SPAIN	IEO	APEX	APF9A	13/12/2012
6901237	EOWL	Argo SPAIN	IEO	APEX	APF9A	21/12/2012
6901238	EOWL	Argo SPAIN	IEO	APEX	APF9A	17/09/2013
6901239	EOWL	Argo SPAIN	IEO	APEX	APF9A	27/07/2015
6901240	Active	Argo SPAIN	IEO	APEX	APF9A	20/04/2014
6901241	EOWL	Argo SPAIN	IEO	APEX	APF9A	10/12/2012
6901242	EOWL	Argo SPAIN	SOCIB ICTS	APEX	APF 9i-9253	01/10/2014
6901243	Active	Argo SPAIN	SOCIB ICTS	APEX	9i-9271	22/11/2014
6901244	EOWL	Argo SPAIN	SOCIB ICTS	APEX	9i-9283	11/27/2015
6901245	Active	Argo SPAIN	SOCIB ICTS	ARVOR		21/11/2014
6901246	Active	Argo SPAIN	Euro Argo	ARVOR_D	70-10-444-000	03/02/2015
6901247	Active	Argo SPAIN	SOCIB ICTS	APEX	APF 9i-9253	01/10/2014
6901248	Active	Argo SPAIN	IEO	ARVOR_D	70-10-444-000	01/11/2016
6901249	Active	Argo SPAIN	SOCIB ICTS	ARVOR	70-10-596	19/02/2017
6901250	Active	Argo SPAIN	SOCIB ICTS	ARVOR	70-10-596	10/07/2017
6901251	Active	Argo SPAIN	SOCIB ICTS	ARVOR	70-10-596	19/12/2017
6901252	Active	Argo SPAIN	IEO	ARVOR_L	70-10-444	11/08/2018
6901253	Active	Argo SPAIN	IEO	ARVOR_L	70-10-444	29/05/2018
6901254	Active	Argo SPAIN	IEO	ARVOR_L	70-10-444	15/10/2018

6901255	Active	Argo SPAIN	IEO	ARVOR_L	70-10-444	16/6/2019
6901256	Active	Argo SPAIN	IEO	ARVOR_L	70-10-444	01/06/2018
6901257	Active	Argo SPAIN	IEO	ARVOR_L	70-10-444	06/02/2019
6901258	Active	Argo SPAIN	IEO	ARVOR_L	70-10-444	04/06/2018
6901259	Active	Argo SPAIN	IEO	ARVOR_L	70-10-444	11/03/2019
6901260	Active	Argo SPAIN	IEO	ARVOR_L	70-10-444	18/06/2018
6901262	Active	Argo SPAIN	IEO	ARVOR_L	70-10-444	08/06/2018
6901263	Active	Argo SPAIN	IEO	ARVOR_L	70-10-444	06/02/2019
6901264	Active	Argo SPAIN	IEO	ARVOR_L	70-10-444	17/06/2018
6901265	Active	Argo SPAIN	IEO	ARVOR_L	70-10-444	10/06/2018
6901266	Active	Argo SPAIN	IEO	ARVOR_L	70-10-444	13/06/2018
6901267	EOWL	Argo SPAIN	IEO	ARVOR_L	70-10-444	18/07/2018
6901268	Active	Argo SPAIN	IEO	ARVOR_L	70-10-444	18/03/2019
6901269	Active	Argo SPAIN	IEO	ARVOR_L	70-10-444	16/06/2018
6901270	Active	Argo SPAIN	IEO	ARVOR_L	70-10-444	18/08/2018
6901271	Active	Argo SPAIN	IEO	ARVOR_L	70-10-444	30/10/2018
6901272	Active	Argo SPAIN	IEO	ARVOR_L	70-10-444	26/03/2019
6901273	Active	Argo SPAIN	IEO	ARVOR_L	70-10-444	11/12/2018
6901274	Active	Argo SPAIN	IEO	ARVOR_L	70-10-444	04/03/2019
6901275	EOWL	Argo SPAIN	IEO	ARVOR_L	70-10-444	05/03/2019
6901277	Active	Argo SPAIN	IEO	ARVOR_L	70-10-444	31/07/2019

Table 1. Argo Spain floats database.

Floats deployed and their performance

During 2018, a total of 15 Argo floats were deployed by Argo-Spain:

- 3 ARVOR - L floats (Argo Spain) in the Mediterranean Sea.
- 12 ARVOR – L floats (Argo Spain in the North Atlantic).

The major contribution of Argo Spain to extend the international Argo network during 2018 was focused in the central and north Atlantic areas, deploying a total of 7 ARVOR – L floats. This deployment mission was coordinated by IEO in collaboration with partners who cooperated for the success of the mission. For further and detailed information, please see the attached link:

<http://www.oceanografia.es/argo/Informes/6901253InformeLanzamiento.pdf>

As another example, the ARVOR – L float with WMO 6901260 is currently diving southwest of Portugal after 100 profiles developed (Fig. 3). The float was programmed to dive up to 2000m every 5 days measuring temperature and salinity during the ascending phase, developing a profile depth of 2000m within a parking depth of 1000m.



Figure 2. R/V Ángeles Alvariño crew moments before the deployment of WMO 6901260 under safety measures at *STOCA1806* survey.

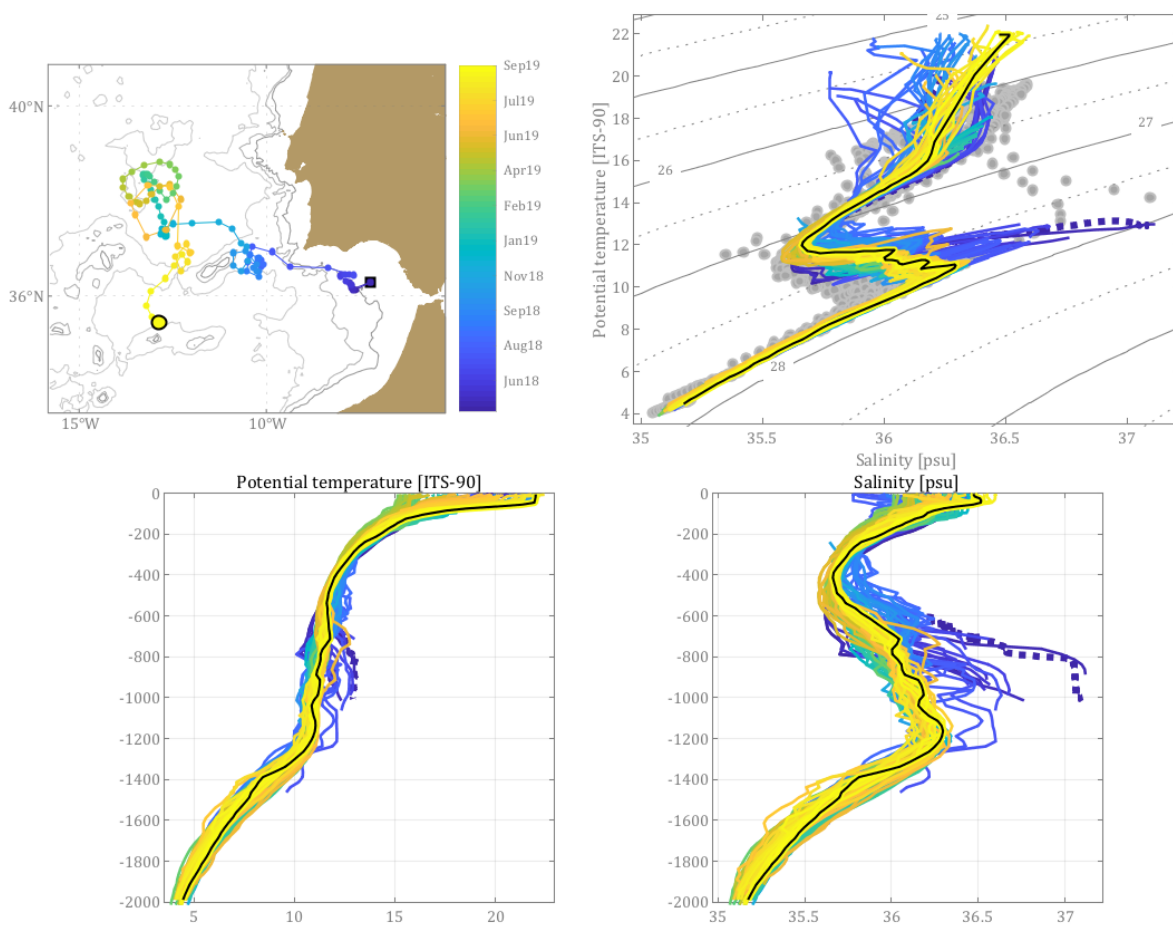


Figure 3. The trajectory of the float since the deployment is showed in the upper left side of the picture. T-S diagram of the data collected by WMO 6901260 is showed in the upper right side of the picture. The grey points are the climatology of the area. The black line is the first profile carried out by the float. The dark blue dashed line describes the CTD cast carried out from the R/V Ángeles Alvariño. Potential Temperature and Salinity profiles are also shown in the lower side on the picture.

Technical problems encountered and solved

The ARVOR - L float WMO 6901267 was deployed on July 18th, 2018 at the Mediterranean Sea. The float worked as expected, developing a number of 32 profiles in total, until it grounded at Formentera island. It was recovered for thorough inspection before a next re - deployment (on hold).

Status of contributions to Argo data management (including status of pressure corrections, technical files, etc)

After each deployment, the detailed technical information is provided to the DAC in charge of the floats (Coriolis) and to the AIC. The Argo-Spain program is aware of the changes in the technical and metadata data formats and is providing the necessary information. Some of the earlier floats deployed by Spain were affected by TNPD. Most of these floats were already corrected during 2017 and 2018, remaining only but the total corrected files will be submitted during 2019.

Status of delayed mode quality control process

Argo-Spain mainly deploys floats in the Atlantic Ocean and Mediterranean Sea. In terms of DMQC, Argo-Spain manages its floats that operate in the Atlantic Ocean and the Instituto Nazionale di Oceanografia e di Geofisica Sperimentale (OGS) manages all the floats that operate in the Mediterranean Sea, including floats of Argo-Spain. The DMQC of the Argo Spain floats that operate in the Mediterranean Sea will be assumed by Argo Spain itself at some point, always subject to personnel availability.

Argo-Spain float fleet is comprised of 82 floats deployed so far. A total of 59 floats have been deployed in the Atlantic Ocean and 23 floats deployed in the Mediterranean Sea (fig. 4).

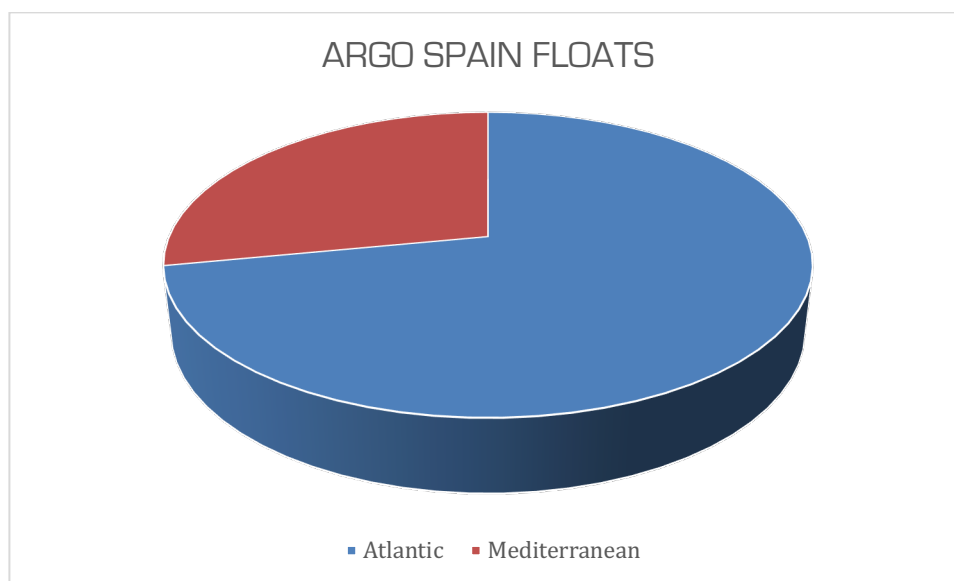


Figure 4. Argo-Spain floats fleet.

DMQC have been carried out for 16 floats in 2016 [35,5%], for 19 floats [42,2%] in 2017 and for 4 floats in 2018 [8,8%]. It is planned to carry DMQC for the remaining 6 floats [13,3%] during 2019 (fig. 5). After this task, active current floats older than 1 year will be include in the Argo Spain DMQC and processed.

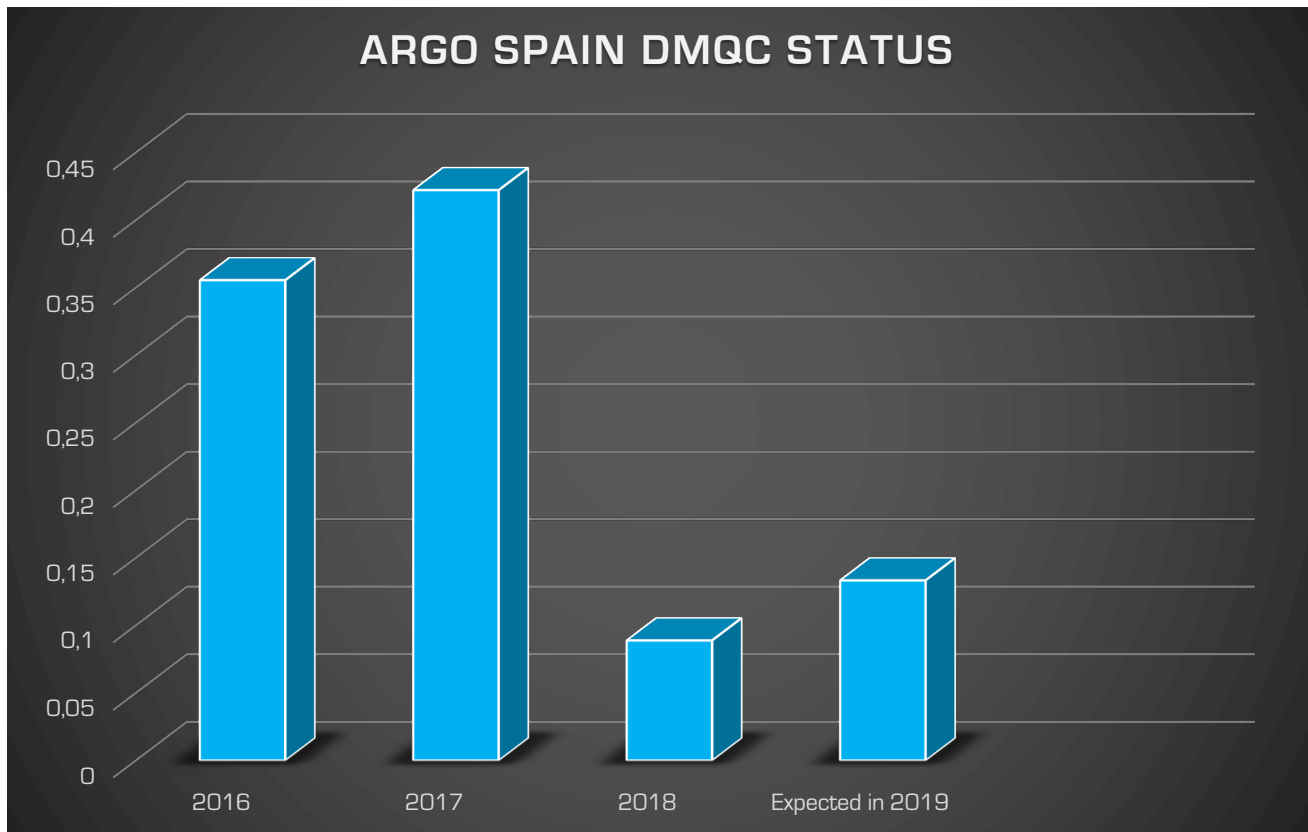


Figure 5. Argo-Spain floats fleet.

3. Present level of and future prospects for national funding for Argo including a summary of the level of human resources devoted to Argo.

Aware of the importance of the role that Spain should play and development opportunities, the *IEO* and the *Coastal and Prediction Observation System of the Balearic Islands (SOCIB)* have assumed the financial commitment that entails that Spain takes part as a full member of the Euro-Argo research infrastructure, thus the deployment of at least 3 Argo floats per year since 2015 has been ensured. On January 1, 2017, Spain joined definitively as a full member of the European infrastructure Euro- Argo.

The IEO's funding covers for float procurement in the period 2018-2020 (5 argo floats per year), transmission costs and part-time personnel support. The IEO funds the scientific coordination (0.25 FTE), and is expected that 1 FTE will be incorporated permanently at the beginning of 2020 to Argo Spain. Besides, the long-term support from the IEO, SOCIB will deploy 3 Argo floats per year in the Western Mediterranean until 2021.

4. Summary of deployment plans and other commitments to Argo for the upcoming year and beyond where possible.

The deployment plan has been submitted to the IAC. Although the ultimate deployments may change following feedback from the Spanish research community, the current plan is:

- 3 floats (ARVOR - L) to be deployed in the Mediterranean Sea in 2020 and 2021.
- 5 floats (ARVOR - L) to be deployed in the Atlantic Ocean in 2019 and 2020.
- 1 deep argo float (3 heads) to be deployed in the Subtropical Eastern North Atlantic in 2019 or 2020.

Point out that the 3 heads Deep Arvor float is part of the EA - RISE European project and are Euro-Argo floats.

5. Summary of national research and operational uses of Argo data as well as contributions to Argo Regional Centers.

Argo is used by many Spanish researches to improve the understanding of the climate and ocean variability. Ocean and weather forecast operational models also use Argo data. The web page of the Argo Spain program is: <http://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.

None.

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. However, the data have not been submitted to the CCHDO website due to lack of personnel during 2018. This task will be undertaken throughout 2019.

8. List of all papers published by scientists within Spain in the past year using Argo data, including non-English publications.

Barceló-Llull, B., Pascual, A., Mason, E., & Mulet, S. (2018). Comparing a multivariate global ocean state estimate with high-resolution in situ data: An anticyclonic intrathermocline eddy near the Canary Islands. *Frontiers in Marine Science*, 5(MAR) doi:10.3389/fmars.2018.00066

Hernandez-Lasheras, J., & Mourre, B. (2018). Dense CTD survey versus glider fleet sampling: Comparing data assimilation performance in a regional ocean model west of sardinia. *Ocean Science*, 14(5), 1069-1084. doi:10.5194/os-14-1069-2018

Llanillo, P. J., Pelegrí, J. L., Talley, L. D., Peña-Izquierdo, J., & Cordero, R. R. (2018). Oxygen pathways and budget for the eastern south pacific oxygen minimum zone. *Journal of Geophysical Research: Oceans*, 123(3), 1722-1744. doi:10.1002/2017JC013509

Olmedo, E., Gabarró, C., González-Gambau, V., Martínez, J., Ballabrera-Poy, J., Turiel, A., . . . Lee, T. (2018). Seven years of SMOS sea surface salinity at high latitudes: Variability in arctic and sub-arctic regions. *Remote Sensing*, 10(11) doi:10.3390/rs10111772

Vigo, M. I., García-García, D., Sempere, M. D., & Chao, B. F. (2018). 3D geostrophy and volume transport in the Southern Ocean. *Remote Sensing*, 10(5) doi:10.3390/rs10050715

Outreach publication in Spanish:

González-Santana, A., P. Vélez Belchí. 2018. Argo: conocer el océano global. *Investigación y ciencia*, ISSN 0210-136X, N° 500, 2018, págs. 40-47