# Argo-Spain Annual Report 2016

**Present status and future plans**

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## 1. Introduction.

In 2002, Argo Spain began its contribution to the Argo program through a European project where a total of 80 Argo profilers were deployed in the North Atlantic. Since then, Argo Spain gives support to all the operators in Spain that use Argo floats as part of their observational strategy.

Two institutions are mainly involved in Argo Spain, the Spanish Institute of Oceanography (IEO, *Instituto Español de Oceanografía*) and the Coastal Ocean Observing and Forecasting System of the he Balearic Islands (SOCIB; *Sistema de Observación Costero y de Predicción de las Islas Baleares*)

## 2. The status of implementation

Since 2003, 63 floats have been deployed by Argo Spain. At the end of 2016, 7 Argo floats were active.



Figure 1. Status of the Argo Spain program on November 24th 2016. Altogether, 63 floats have been deployed.

The following table shows information of each Argo SPAIN profiler deployed:

| 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 | **TBD** | Argo SPAIN | SOCIB ICTS | ARVOR | 70-10-596 | |
| 6901250 | **TBD** | Argo SPAIN | SOCIB ICTS | ARVOR | 70-10-596 | |
| 6901251 | **TBD** | Argo SPAIN | SOCIB ICTS | ARVOR | 70-10-596 | |

Floats deployed and their performance

During 2016, 1 Argo float was deployed by Spain:

1 Deep Arvor float (WMO 6901248) in the Eastern Atlantic (Canary Islands) by the R/V Angeles Alvariño. The float was deployed on November 1st 2016 at 29, 10.00 LAT and -18,29.78 LON by the *Instituto Español de Oceanografía* researchers from Ángeles Alvariño vessel during the RAPROCAN 2016 survey.

This float was deployed as part of the Argo Spain contribution to the pilot program to extended the Argo program deeper than 2000 m.

After 70 days at sea, the Deep – Arvor continues drifting towards to open sea. The float was initially programmed to dive every 5 days measuring temperature and salinity during the ascending phase. After that, the float was reconfigured to dive every 10 days reaching also 4000 meters of depth.

As can be observed in Figure 3, after 2 months and 18 profiles there is not bias or drift in the salinity sensor so far. However, the accuracy in salinity (0.02) of the SBE41CP sensor installed it is not enough to detect long term trends (>5 years) in the area.
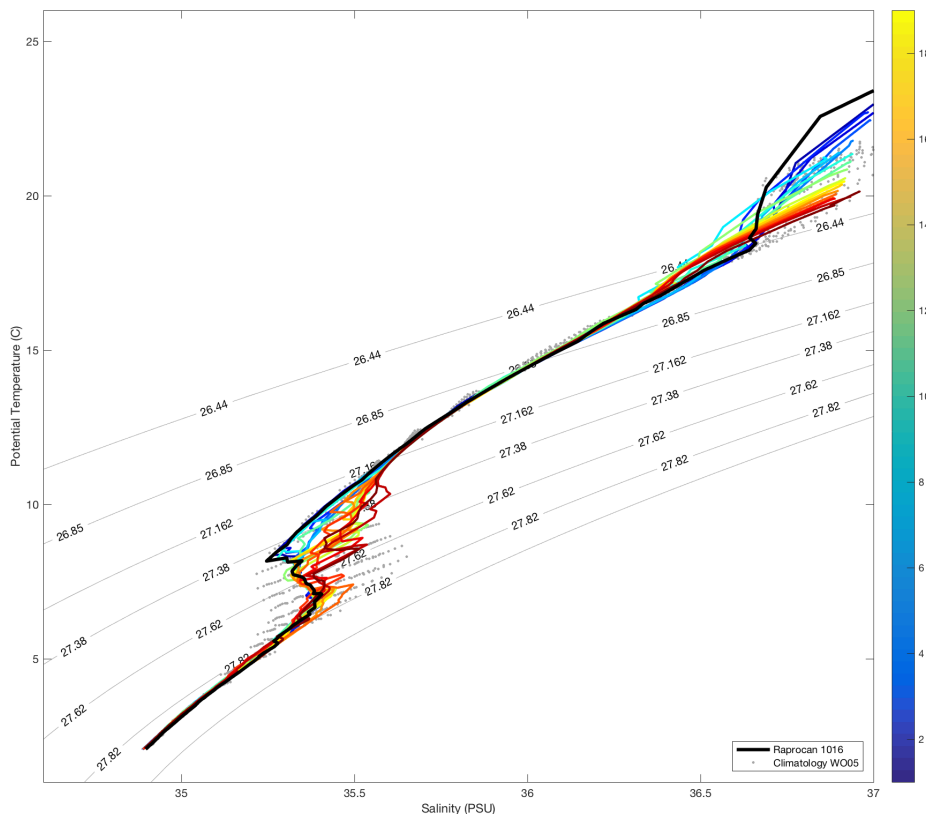


Figure 2. T-S diagram of the Deep Arvor float WMO 6901248

Technical problems encountered and solved

No major technical problems were encountered in 2016.

<u>Status of contributions to Argo data management (including status of pressure corrections, technical files, etc.)</u>

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. A metadata updating for the Argo Spain floats, including the mandatory information in format version 3.1 was sent to Coriolis DAC at the end of 2016.

Some of the earlier floats deployed by Spain were affected by TNPD. Not all of these floats have been corrected, but the remainder corrected files will be submitted during 2017.

<u>Status of delayed mode quality control process</u>

Argo Spain began the DMQC during 2016. So far, the DMQC for floats 6900506, 6900765, 6900767, 6900768, 6900769, 6900778, 6900779, 6900780, 6900781 6900782, 6900783 has been carried out and the netcdf files sent to the Coriolis DAC.

During 2017 we plan to carry out DMQC to all the Argo Spain float that stopped transmitting before July 1, 2016.

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

The Argo Spain program does not have a long tem funding for deployments of Argo floats. However, the contribution to the Euro-Argo fee for the next 4 years is secured, since Spain has joined the Euro-Argo Infrastructure. This contribution is funded by the IEO and SOCIB.

The IEO funds the scientific coordination (1.5 man x month per year) and the transmission costs. In addition, a specific budget from Ministry of Economy has been assigned to incorporate one full – time research technician for the next three years to the Argo Spain program from 2017. There are also plans to purchase a total of 25 floats for the period 2017-2019. SOCIB funds the purchase and deployment of 3 Argo floats per year in the Western Mediterranean until 2020.

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

The deployment of Argo floats in Argo Spain are designed to support ongoing research programs of the Spanish marine sciences community but taking into account the overall needs of Argo. Based on that, the current plans for 2017/2018 are:

- Deployment of 3 floats in the Western Mediterranean Sea in 2017 and 2018
- Deployment of 2 floats in the subtropical North/ South Atlantic in 2017 and 5 in 2018

## 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 number of CTD cruise data being added to the reference database by Argo PIs, it is requested that you include the number and location of CTD cruise data uploaded by PIs within your country to the CCHDO website in the past year. These cruises could be used for Argo calibration purposes only or could be cruises that are open to the public as well.

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 2016. A new member of the Argo Spain was hired during 2016 and will provide the CCHDO with the CTD cast. However, the DMQC is currently carried out using also the CTD cast performed after most of the Argo-Spain deployments.

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

Aguiar-González, B., L. Ponsoni, H. Ridderinkhof, H. M. van Aken, W. P. M. de Ruijter, and L. R. M. Maas, 2016: Seasonal variation of the South Indian tropical gyre. Deep Sea Research Part I: Oceanographic Research Papers, 110, 123-140

Alvera-Azcárate, A., A. Barth, G. Parard, and J.-M. Beckers, 2016: Analysis of SMOS sea surface salinity data using DINEOF. Remote Sensing of Environment, 180, 137-145

Aznar, R., M. G. Sotillo, S. Cailleau, P. Lorente, B. Levier, A. Amo-Baladrón, G. Reffray, and E. Álvarez-Fanjul, 2016: Strengths and weaknesses of the CMEMS forecasted and reanalyzed solutions for the Iberia–Biscay–Ireland (IBI) waters. Journal of Marine Systems, 159, 1-14

Capó, E., A. Orfila, J. M. Sayol, M. Juza, M. G. Sotillo, D. Conti, G. Simarro, B. Mourre, L. Gómez-Pujol, and J. Tintoré, 2016: Assessment of operational models in the Balearic Sea during a MEDESS-4MS experiment. Deep Sea Research Part II: Topical Studies in Oceanography, 133, 118-131

Castellanos, P., E. J. D. Campos, I. Giddy, and W. Santis, 2016: Inter-comparison studies between high-resolution HYCOM simulation and observational data: The South Atlantic and the Agulhas leakage system. Journal of Marine Systems, 159, 76-88

González-Gambau, V., E. Olmedo, A. Turiel, J. Martínez, J. Ballabrera-Poy, M. Portabella, and M. Piles, 2016: Enhancing SMOS brightness temperatures over the ocean using the

nodal sampling image reconstruction technique. Remote Sensing of Environment, 180, 205-220

Hernández-Guerra, A. and L. D. Talley, 2016: Meridional overturning transports at 30°S in the Indian and Pacific Oceans in 2002–2003 and 2009. Progress in Oceanography, 146, 89-120

Hernández-Molina, F. J., A. Wåhlin, M. Bruno, G. Ercilla, E. Llave, N. Serra, G. Rosón, P. Puig, M. Rebesco, D. Van Rooij, D. Roque, C. González-Pola, F. Sánchez, M. Gómez, B. Preu, T. Schwenk, T. J. J. Hanebuth, R. F. Sánchez Leal, J. García-Lafuente, R. E. Brackenridge, C. Juan, D. A. V. Stow, and J. M. Sánchez-González, 2016: Oceanographic processes and morphosedimentary products along the Iberian margins: A new multidisciplinary approach. Marine Geology, 378, 127-156

Rodríguez-Cabello, C., C. González-Pola, and F. Sánchez, 2016: Migration and diving behavior of Centrophorus squamosus in the NE Atlantic. Combining electronic tagging and Argo hydrography to infer deep ocean trajectories. Deep Sea Research Part I: Oceanographic Research Papers, 115, 48-62