Argo-Spain Annual Report 2017

Present status and future plans

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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, 67 floats have been deployed, of which 7 are active at the end of 2017.

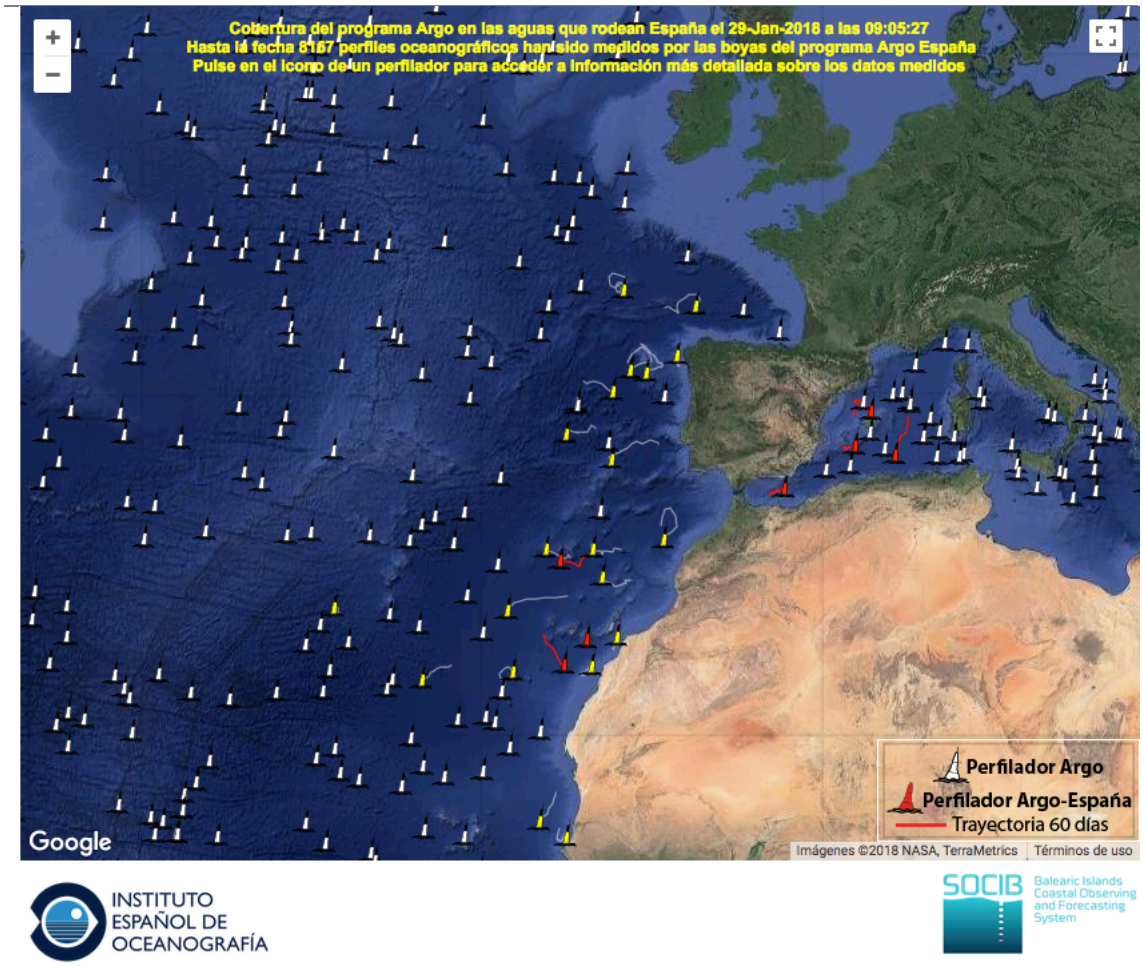

Figure 1. Status of the Argo Spain program on February 5th 2018. Altogether, 68 floats have been deployed.

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

Floats deployed and their performance

During 2017, a total of 3 Argo floats were deployed by Argo-Spain:

- 3 ARVOR - I floats (Argo SPAIN) in the Mediterranean Sea.

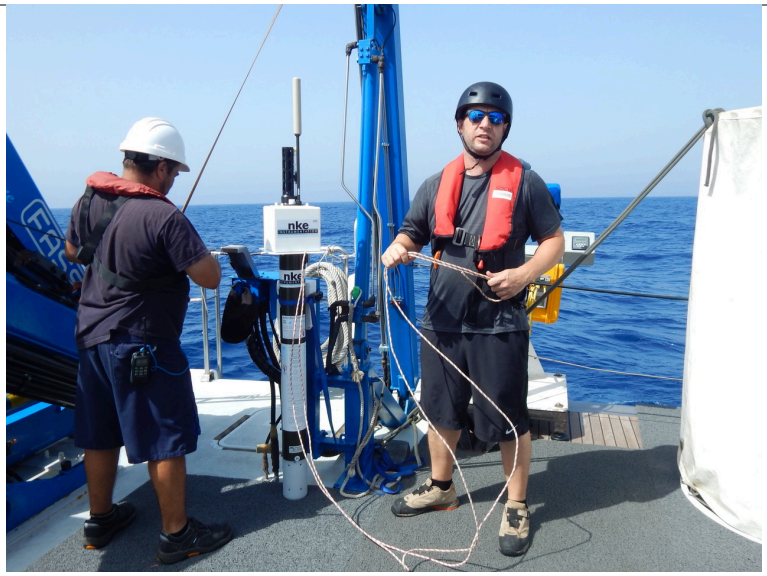

Figure 2. SOCIB staff moments before the deployment of WMO 6901251 under safety measures at *IRENE* survey.

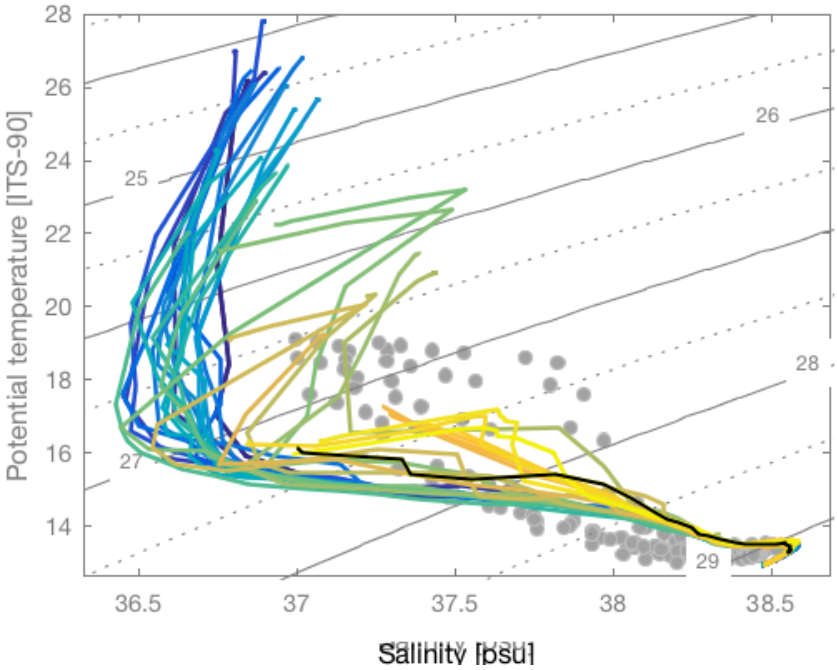

Figure 3. T-S diagram of WMO 6901251.

For instance, the ARVOR – I 6901251 is currently diving south of the Balearic Islands archipelago after 35 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 700m within a parking depth of 350m.

Technical problems encountered and solved

Float WMO 6901250 was deployed on July 10th, 2017 in the Mediterranean Sea. The float didn't dive up properly and drifted on surface under dangerous conditions (possible cruise crash and extra bio deposition) for almost a month. Location position was reported every hour but any profiles carried out since the deployment. After some checks, the trouble was identified: Float failed during autotest, because of internal vacuum issues that mostly happens when the float was tested after been exposed in high sunny conditions (boxes on the deck). Parameters were corrected and WMO 6901250 carried out its first profile on August 6th, so far, the float is in good conditions.

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, but the total corrected files will be submitted during 2018.

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 67 floats deployed so far. A total of 47 floats have been deployed in the Atlantic Ocean and 20 floats deployed in the Mediterranean Sea (fig. 4).

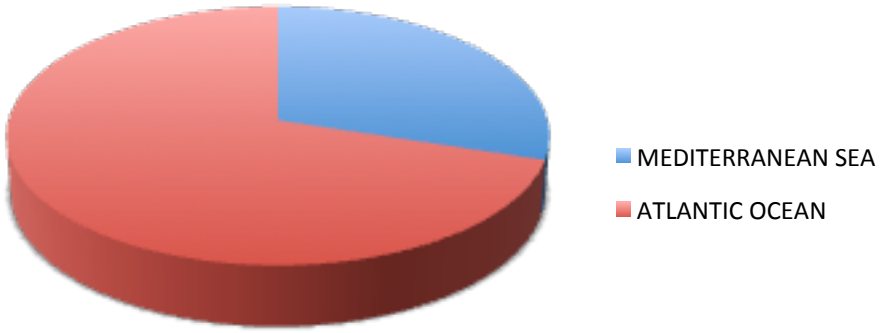

Figure 4. Argo-Spain floats fleet

DMQC have been carried out for 16 floats in 2016 (34%), for 19 floats (40,5%) in 2017. It is planned to carry DMQC for the remaining 9 floats (19%) during 2018 (fig. 5). All the Argo-Spain should have gone through the first round of DMQC during the first semester of 2018. Significant improvements have been made in the processing of the data in Argo-Spain.

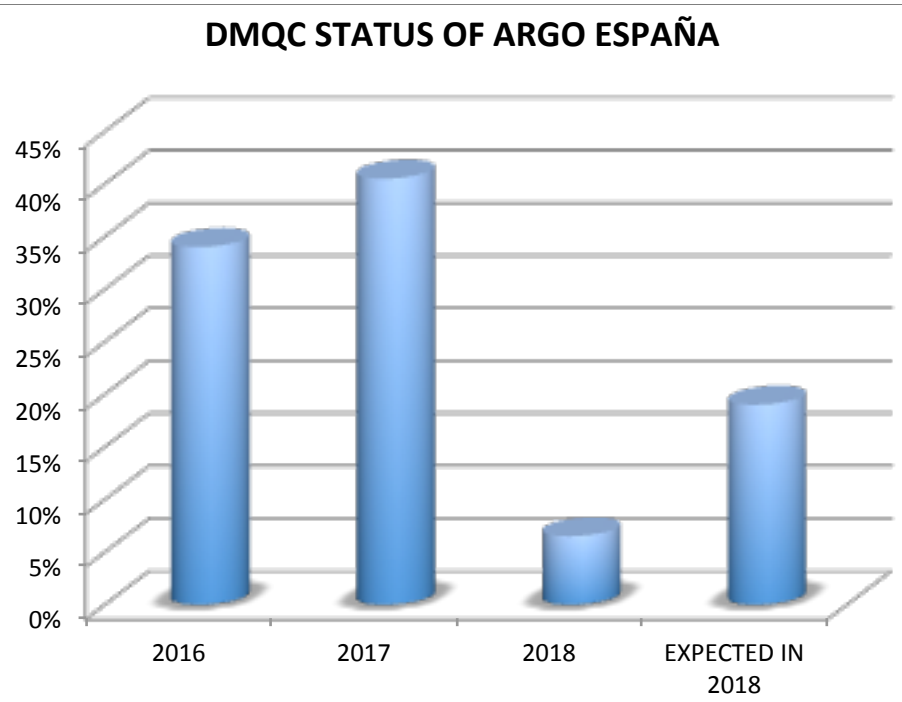

Figure 5. Argo-Spain floats fleet.

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 funding covers for 2018-2020 float procurement in the period 2018-2021 (5 argo floats per year), transmission costs and part-time personnel support. The *IEO* funds the scientific coordination (0.25 FTE). In addition, a specific budget from Ministry of Economy has been assigned to incorporate 1 FTE technician that expires in October, 2018. 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 -I) to be deployed in the Mediterranean Sea in 2018, 2019, 2020 and 2021
- 5 floats (ARVOR -I) to be deployed in the Atlantic Sea in 2018, 2019, 2020, and 2021
- 1 float (DEEP ARVOR) to be deployed in the Eastern Atlantic in 2018

- 1 float (DEEP ARVOR) to be deployed in the Galician Bank in 2018

Point out that both Deep Arvor floats are part of the AtlantOS 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 2017. This task will be undertaken throughout 2018.

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

- Olita, A., Capet, A., Claret, M. et al. Frontal dynamics boost primary production in the summer stratified Mediterranean Sea. Ocean Dynamics (2017) 67: 767. https://doi.org/10.1007/s10236-017-1058-z
- Sánchez-Román, A., Ruiz, S., Pascual, A., Mourre, B., and Guinehut, S. On the mesoscale monitoring capability of Argo floats in the Mediterranean Sea, Ocean Sci., 13, 223-234, https://doi.org/10.5194/os-13-223-2017, 2017.
- Fernandez, D., P. Sutton, and M. Bowen (2017), Variability of the subtropical mode water in the Southwest Pacific, J. Geophys. Res. Oceans, 122, 7163–7180, doi:10.1002/2017JC013011.
- Somavilla, R., C. González-Pola, and J. Fernández-Diaz (2017), The warmer the ocean surface, the shallower the mixed layer. How much of this is true? J. Geophys. Res. Oceans, 122, 7698–7716, doi:10.1002/2017JC013125.