

## Report on the Italian Argo Program for 2015

### 1. The status of implementation (major achievements and problems in 2015).

- floats deployed and their performance:

In total, **26 Italian floats** were deployed in 2015 (see Tables 1 and 2 for details). These floats were Arvor and Provor designs manufactured by NKE (France), Apex floats produced by Teledyne Webb Research (USA) and NOVA/DOVA profilers manufactured by METOCEAN (Canada). The majority of the floats transmit data via Iridium telemetry (Arvor-I, Provor Bio, Provor Nut, NOVA, DOVA) and some have Argos telemetry (Apex).

Two floats were deployed in the Black Sea and 14 units were released in the Mediterranean (Table 1). Except for float WMO 6901844, all these instruments were still operating in early January 2016. In the Mediterranean, most floats have a parking depth at 350 dbar and maximal profiling depths alternating at 700 and 2000 dbar. In the Black Sea, the parking depth was set to 200 dbar. They all have cycles of 5 days, except float WMO 6903174 deployed in the Malta Channel which has a diurnal cycle.

<u>Model</u>	<u>WMO</u>	<u>Deploy date</u>	<u>Lat</u>	<u>Lon</u>	<u>Cycles</u>	<u>Last TX date</u>	<u>Lat</u>	<u>Lon</u>	<u>Status*</u>	<u>Cycle</u>
Provor Bio	<a href="#">6901862</a>	<a href="#">26-Mar-2015 18:26</a>	41.53	18.06	115	07-Jan-2016 10:35	39.58	17.96	A	5
Arvor I	<a href="#">6901869</a>	<a href="#">22-May-2015 18:26</a>	34.21	24.85	46	09-Jan-2016 00:20	34.64	25.55	A	5
Apex	<a href="#">6901867</a>	<a href="#">26-May-2015 11:54</a>	32.95	34.82	45	12-Jan-2016 09:05	35.54	35.80	A	5
Provor Bio	<a href="#">6901863</a>	<a href="#">26-May-2015 16:18</a>	36.69	20.10	54	07-Jan-2016 10:35	36.71	19.25	A	5
Provor Nut	<a href="#">6901866</a>	<a href="#">27-May-2015 15:12</a>	43.16	29.00	46	07-Jan-2016 09:44	43.45	30.92	A	5
Provor Bio	<a href="#">6901864</a>	<a href="#">30-May-2015 14:59</a>	39.21	10.87	50	07-Jan-2016 11:54	38.49	8.41	A	5
Arvor I	<a href="#">6901870</a>	<a href="#">06-Aug-2015 14:53</a>	37.28	11.50	158	12-Jan-2016 00:41	0.00	0.00	ANP	5
Apex	<a href="#">6903172</a>	<a href="#">29-Aug-2015 06:22</a>	42.00	10.03	27	12-Jan-2016 08:14	41.00	12.80	A	5
Apex	<a href="#">6903173</a>	<a href="#">29-Aug-2015 23:15</a>	39.78	11.88	27	08-Jan-2016 09:36	39.54	12.18	A	5
Nova	<a href="#">6903177</a>	<a href="#">02-Oct-2015 23:15</a>	40.82	1.99	20	10-Jan-2016 02:10	38.87	2.09	A	5
Dova	<a href="#">6903178</a>	<a href="#">30-Oct-2015 14:08</a>	41.74	17.69	21	10-Jan-2016 02:41	42.28	17.94	A	5
Apex	<a href="#">6903175</a>	<a href="#">15-Nov-2015 15:28</a>	33.01	30.69	12	11-Jan-2016 04:10	33.21	30.37	A	5
Apex	<a href="#">6903176</a>	<a href="#">15-Nov-2015 20:55</a>	32.34	31.56	12	11-Jan-2016 08:37	32.32	32.02	A	5
Arvor I	<a href="#">6901844</a>	<a href="#">24-Nov-2015 00:19</a>	33.61	34.02	0	24-Nov-2015 00:19	33.62	34.02	D	-
Arvor I	<a href="#">6901834</a>	<a href="#">25-Nov-2015 06:55</a>	43.16	28.99	9	11-Jan-2016 00:09	41.65	30.12	A	5
Nova	<a href="#">6903174</a>	<a href="#">14-Dec-2015 10:35</a>	36.23	14.58	29	12-Jan-2016 04:12	36.25	14.63	A	1

\*Status in early January 2016: A = active, D = dead; ANP = active without positions.

*Table 1. Status information for the 16 Italian floats deployed in the Mediterranean and Black Seas (grey rows) during 2015.*

Most floats were deployed from research vessels of opportunity (i.e., R/V Minerva, R/V Tethys II and R/V OGS Explora for the Mediterranean and R/V Akademik for the Black Sea) with the help of colleagues from Italy, France and Bulgaria. One float was deployed from a commercial ship of

opportunity in the Levantine basin with the help of a Cypriot colleague. Three floats were deployed from boats of opportunity (M/Y Alegria and M/Y Morning Glory) with the help of the International Seakeeper Society.

Three floats equipped with biogeochemical and optical sensors (Provor Bio) were deployed in the southern Adriatic, northern Ionian and southern Tyrrhenian Sea. The Provor Bio is a Provor CTS 4 with Iridium global telephone network (RUDICS) for data telemetry and a GPS receiver for position. It measures at 1 dbar vertical resolution not only temperature and salinity (Sea-Bird CTD) but also irradiance at three wavelengths (412 nm, 490 nm, 555 nm), fluorescence of colored dissolved organic matter, fluorescence of chlorophyll-a, backscattering coefficient (530nm) and attenuation coefficient (660 nm).

One NOVA float equipped with SBE 63 optical dissolved oxygen sensor (also called DOVA) was deployed in the southern Adriatic in late October 2015.

One Provor Nut float was deployed in the western Black Sea (WMO 6901866). The Provor Nut float is a Provor Bio float with additional sensors: an Aanderaa optode oxygen sensor and a SUNA nitrate sensor. The firmware of this float was modified to be able to measure (and also transmit to the satellite) simultaneously nitrate and hydrogen sulphide concentrations.

One Provor Nut WMO 6901865 deployed in the southern Adriatic on 18 February 2014 was recovered at sea by French collaborators during a cruise on the R/V Tethys II. The float appeared in excellent condition after 15 months at sea. This float was sent back to the manufacturer (NKE) for refurbishing and it will be re-deployed in 2016.

Ten Italian floats were deployed in the South Pacific and the Pacific sector of the Southern Ocean (Table 2) with the help of Italian colleagues onboard the South Korean R/V Araon. These floats included 5 Arvor floats from NKE and 5 Apex floats from Teledyne Webb Research. All the floats were programmed to cycle between the surface and 2000 dbar every 10 days and to drift at the parking depth of 1000 dbar. Out of the ten floats deployed in the Southern Ocean, seven units were still operational in January 2016.

<b>Model</b>	<b>WMO</b>	<b>Deploy date</b>	<b>Lat</b>	<b>Lon</b>	<b>Cycles</b>	<b>Last TX date</b>	<b>Lat</b>	<b>Lon</b>	<b>Status*</b>	<b>Cycle</b>
Apex	<a href="#">6901875</a>	<a href="#">03-Jan-2015 02:27</a>	-51.01	163.01	38	09-Jan-2016 02:01	-50.81	190.29	A	10
Arvor I	<a href="#">6901843</a>	<a href="#">03-Jan-2015 06:50</a>	-52.01	163.18	37	09-Jan-2016 23:59	-50.27	-162.46	A	10
Arvor I	<a href="#">6901841</a>	<a href="#">03-Jan-2015 11:05</a>	-53.01	163.05	37	10-Jan-2016 00:05	-52.98	-171.05	A	10
Arvor I	<a href="#">6901840</a>	<a href="#">03-Jan-2015 20:50</a>	-55.00	162.85	37	09-Jan-2016 23:57	-51.06	-158.03	A	10
Apex	<a href="#">6901871</a>	<a href="#">04-Jan-2015 00:00</a>	-56.00	162.79	0	04-Jan-2015 00:00	0.00	0.00	D	-
Apex	<a href="#">6901872</a>	<a href="#">04-Jan-2015 09:29</a>	-58.01	162.69	38	10-Jan-2016 12:37	-60.29	185.54	A	10
Apex	<a href="#">6901873</a>	<a href="#">04-Jan-2015 19:47</a>	-60.01	162.59	15	26-May-2015 05:22	-64.59	182.36	D	10
Apex	<a href="#">6901874</a>	<a href="#">06-Jan-2015 01:14</a>	-61.01	157.31	36	12-Jan-2016 07:58	-63.35	189.37	A	10
Arvor I	<a href="#">6901842</a>	<a href="#">06-Jan-2015 09:42</a>	-62.00	158.48	16	17-Jun-2015 09:36	-64.27	173.38	D	10
Arvor I	<a href="#">6901838</a>	<a href="#">06-Jan-2015 18:16</a>	-63.00	159.69	36	03-Jan-2016 00:09	-64.81	-173.25	A	10

\*Status in early January 2016: A = active, D = dead; ANP = active without positions.

Table 2. Status information for the 10 Italian floats deployed in the Southern Ocean during 2015.

Since 18 February 2012, a total of 81 Italian floats have been deployed. In less than 4 years, they have provided about 7000 CTD profiles. The temporal evolution of the number of active floats is shown in Fig. 1 with weekly resolution, along with the annual numbers of float deployments and float deaths for the period 2012-2015. It is seen that after the significant increase in float population in 2012-2014, the network tends to stabilize around 50 active instruments.

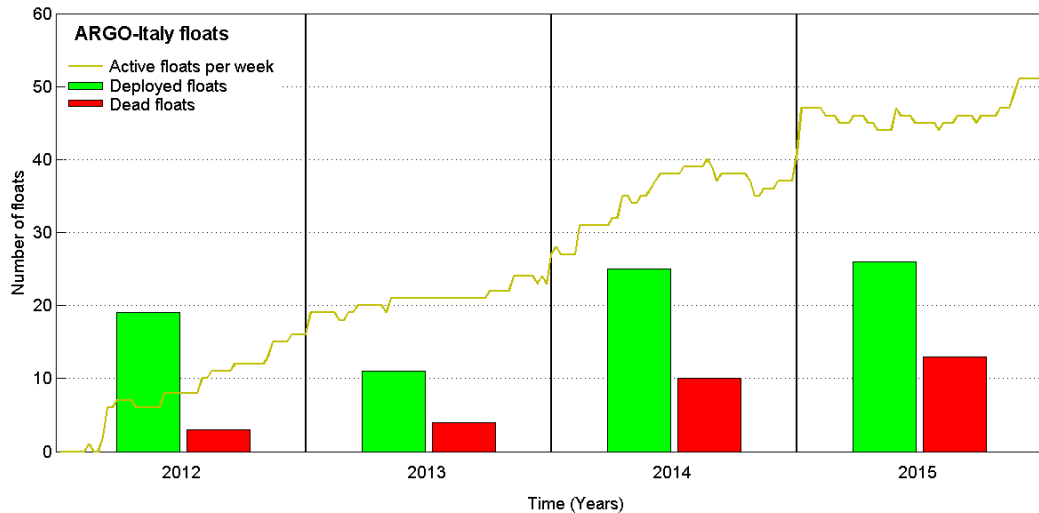


Figure 1. Temporal evolution of the number of active floats with weekly resolution and histogram of the annual float deployments and losses.

- technical problems encountered and solved

Float WMO 6901870 deployed in the Tyrrhenian Sea on 6 August 2015 suffered a malfunction from the beginning. It cycled, collected profile data and transmitted the data correctly but unfortunately there was a problem with the GPS and no positions for the profiles are available.

Float WMO 6901834 was deployed on 24 November 2015 from a commercial container ship transiting between Limassol in Cyprus and Haifa in Israel. Unfortunately the float stopped functioning right after deployment and no data are available from it. The cause of this failure has still to be investigated.

Float WMO 6901871 failed right after deployment for reasons still to be investigated.

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

The data management for the Italian float was done by the Coriolis GDAC. Metadata and data are available through the Coriolis web site in near real-time.

- status of delayed mode quality control process

The delayed mode quality control (DMQC) of the Mediterranean physical data provided by the Italian floats was done for 27 floats (16 D-files sent to Coriolis, 11 D-files not yet sent). OGS will continue this activity in 2016 and beyond as part of the Copernicus CMEMS and MOCCA projects. Note that OGS is responsible for the DMQC of all the floats operated in the Mediterranean Sea. The temperature and salinity data of 178 Mediterranean floats (over a total of 282 floats; 210 dead and 72 alive floats) have been quality controlled following the standard Argo procedure, covering the period 2000-2015.

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

The Italian Ministry of Research has provided funding to buy 22 floats in 2015, including 5 instruments with dissolved oxygen sensors and 2 deep floats (4000 dbar). In addition, the Italian human resources per year devoted to Argo-Italy amounts to about 50 man-months for technical, administrative and scientific personnel involved in the project in 2015. It is expected that the same level will be maintained in 2016, including the procurement of 12 additional standard floats and 3 floats with biogeochemical/optical sensors. The Italian Ministry of Research is committed to provide funding in order to sustain the Italian contribution to Argo beyond 2016 as founding member of the Euro-Argo Research Infrastructure Consortium. In addition to the Italian national funding, OGS has funding from EC (CMEMS, MOCCA) and ONR (CINEL) projects for several activities related to Argo.

**3. Summary of deployment plans (level of commitment, areas of float Deployment, low or high resolution profiles) and other commitments to Argo (data management) for the upcoming year and beyond where possible.**

The Italian deployment plans are detailed in Table 3. The main areas of interest are the Mediterranean and Black seas and the Southern Ocean.

Year	Floats with T/S		Floats with biogeochemical sensors		Total
	Quantity	Area	Quantity	Area	
2016	15	Mediterranean	2	Mediterranean	<b>35</b>
	2	Black Sea	1	Black Sea	
	15	Southern Ocean			
2017	15	Mediterranean	2	Mediterranean	<b>35</b>
	2	Black Sea	1	Black Sea	
	15	Southern Ocean			

*Table 3. Italian float deployment plans for 2016-2017.*

OGS is committed to carry out the DMQC on all the Argo floats of the Mediterranean Sea as part of the Copernicus CMEMS and MOCCA projects over the next years.

The website for the Italian contribution to Argo (Argo-Italy) was improved and upgraded (<http://argoitaly.ogs.trieste.it/>). The link to the Mediterranean & Black Sea Argo Centre (MedArgo) is <http://nettuno.ogs.trieste.it/sire/medargo/>

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

##### Operational ocean forecasting.

All Argo temperature and salinity data in the Mediterranean (alongside with other in-situ and remotely sensed data) are routinely assimilated into the Mediterranean Forecasting System (MFS) operational forecasting system run by the Italian Istituto Nazionale di Geofisica e Vulcanologia (INGV). Assessments have clearly demonstrated the positive impact of Argo data on ocean analyses and predictions. In particular, studies on the optimization of float sampling and cycling characteristics for the Mediterranean have been performed, as well as the development of methodology for the assimilation of Argo float sub-surface velocities into numerical models.

##### Ocean science.

Argo data are being used by several researchers in Italy to improve the understanding of marine properties (e.g. circulation, heat storage and budget, and mixing), climate monitoring and on how they are applied in ocean models, with particular focus to the Mediterranean Sea.

#### **5. Issues that your country wishes to be considered and resolved by the AST.**

N/A

#### **6. Number of CTD cruise data added to the Argo reference database by Italian PIs in 2014.**

N/A

#### **7. Italian contribution to Argo bibliography in 2015.**

Kovacevic V., Ursella L., Gacic M., Notarstefano G., Menna M., Bensi M. and P.-M. Poulain (2015). On the Ionian thermohaline properties and circulation in 2010-2013 as measured by Argo floats, *Acta Adriat.*, 56(1): 97 - 114, 2015.

Dobricic, S., C. K. Wikle, R. F. Milliff, N. Pinardi, and L. M. Berliner (2015) Assimilation of oceanographic observations with estimates of vertical background-error covariances by a Bayesian hierarchical model, *Q. J. R. Meteorol. Soc.*, 141(686), 182-194, <http://dx.doi.org/10.1002/qj.2348>

Lavigne, H., D'Ortenzio, F., Ribera D'Alcalà, M., Claustre, H., Sauzède, R., and Gacic, M. (2015) On the vertical distribution of the chlorophyll a concentration in the Mediterranean Sea: a basin-scale and seasonal approach, *Biogeosciences*, 12, 5021-5039, doi:10.5194/bg-12-5021-2015.

Pinardi, N., et al. (2015) Mediterranean Sea large-scale low-frequency ocean variability and water mass formation rates from 1987 to 2007: A retrospective analysis, *Prog. Oceanogr.*, 132, 318-332, <http://dx.doi.org/10.1016/j.pocean.2013.11.003>

Tonani, M., et al. (2015) Status and future of global and regional ocean prediction systems, *J. Oper. Oceanogr.*, 8(sup2), s201-s220, <http://dx.doi.org/10.1080/1755876X.2015.1049892>