

# ARGO-ITALY: ANNUAL REPORT 2015



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## 1. Introduction

ARGO-ITALY is the Italian component of a worldwide in situ global observing system, based on autonomous profiling floats, surface drifters, gliders and ship-of-opportunity measurements. It is primarily focused on the Italian seas, the Mediterranean and Black seas and the Southern Ocean, and includes observations of temperature, salinity, currents and biogeochemical/optical properties of seawater. The ARGO-ITALY objective is to provide a significant and sustained Italian contribution to the global ocean monitoring.

ARGO-ITALY contributes to international programs such as Argo and Euro-Argo (global monitoring of water properties with profiling floats), GDP (Global Drifter Program to measure near-surface temperature and currents), EGO (gliding vehicles to measure water properties) and SOOP (Ship-Of-Opportunity Program to temperature profiles) which have been developed to monitor the entire World Ocean on a long term basis.

ARGO-ITALY is a cost-effective long-term monitoring system that is a unique source of information to study the role of the oceans, and the Mediterranean Sea in particular, on the climate system. It also provides the data required by operational ocean monitoring systems in order to improve significantly extended forecasts of the atmosphere and oceans. ARGO-ITALY contributes to programs of operational oceanography, such as MONGOOS (Mediterranean Oceanography Network for the Global Ocean Observing System) and is essential for the production of marine core and downstream services products of Copernicus/GMES (Global Monitoring for Environment and Security). It is also an important component of GEOSS (Global Earth Observation System of Systems).

ARGO-ITALY is funded by the Italian Ministry of Instruction, University and Research (MIUR) since 2011. The operation of instruments at sea and the collection of data began in February 2012. A dedicated web site was developed to help with the internal organization of the project, to publish graphical and tabulated summaries and photographs on the operation of instruments in near-real time, and to post news, related links, small project calls, etc. related to ARGO-ITALY. The web address is: [www.argoitaly.ogs.trieste.it](http://www.argoitaly.ogs.trieste.it)

This report summarizes the activities of ARGO-ITALY in 2015 in terms of procurements of the instruments, their preparation and their deployments. Information about data processing and archiving is also given. Plans for 2016 and beyond are included in the last section.

## 2. Argo float activities in 2015

### 2.1 Float procurement

The following Argo floats were purchased in 2015-2016 with funds of ARGO-ITALY:

1. **Two (2) Deep Arvor floats from NKE - Instrumentation, Hennebont, France.** The Deep Arvor uses the Iridium global telephone network (SBD) for data telemetry and has a GPS receiver for position. It is equipped with a Sea-Bird CTD and an Aanderaa Optode to measure pressure, temperature, conductivity (salinity) and dissolved oxygen as deep as 4000 dbar (Fig. 1). Delivery is expected in March 2016.



*Figure 1. Photograph of a Deep Arvor, with the CTD and optode sensors, and Iridium antenna at the top and bladder (to change buoyancy) at the bottom.*

### 2.2 Float deployments

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 and Fig. 2). 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.

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. Another float was deployed in the Malta Channel with the assistance of Maltese collaborators. Three floats were deployed from boats of opportunity (M/Y Alegria and S/Y Morning Glory) with the help of the International Seakeeper Society.

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.

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).

<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 Sea (grey rows) during 2015.*

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, see Fig. 2). 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.



*Figure 2. Provor Nut float (6901866) being deployed from R/V Akademik in the western Black Sea on 27 May 2015.*

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 (see photograph in Fig. 3). 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 Pacific Ocean 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. Float WMO 6901871 failed right after deployment for reasons still to be investigated. Out of the ten floats deployed in the Southern Ocean, seven units were still operational in January 2016.

A first look at the profile data for these floats reveal some problems (bad or missing profiles, offset in salinity, etc.) for some of these floats. The discussion of the quality of the profile data is beyond the scope of this report.



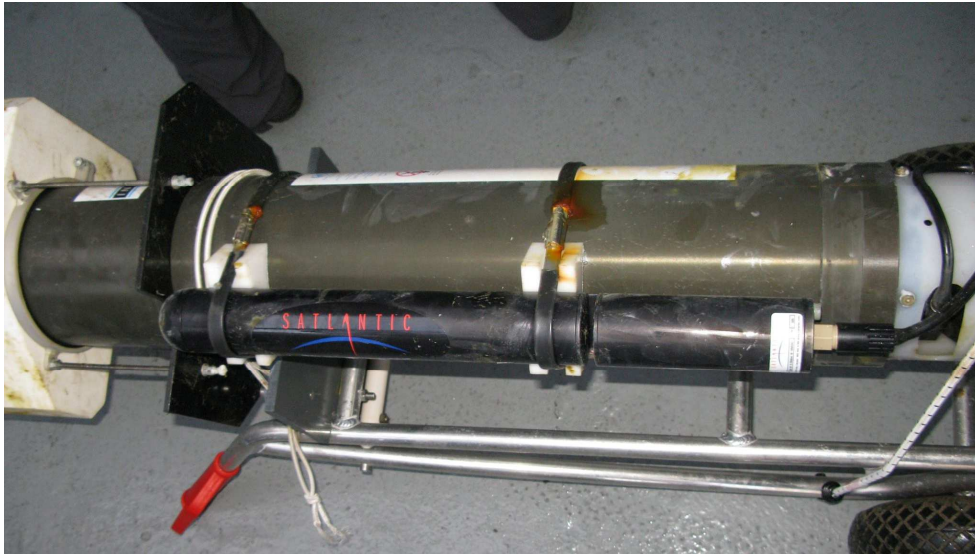


Figure 3. Provor Nut float (WMO 6901865) on the deck of R/V Tethys II after its recovery in the northern Ionian on 15 May 2015.

<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>
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.

At the end of 2015, the ARGO-ITALY program had a total of 51 active floats, including 34 instruments in the Mediterranean Sea, 4 in the Black Sea (Fig. 4) and 13 in the South Pacific and Southern Oceans (Fig. 5).

ARGO-ITALY FLOAT TOT MISSION DAYS ON 31-Dec-2015 -- TOTAL FLOATS: 38

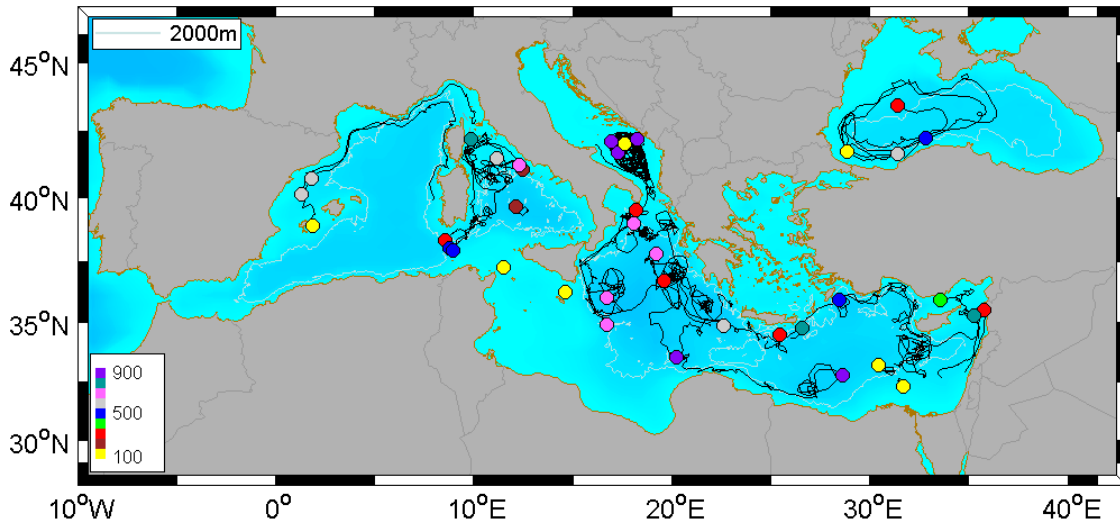


Figure 4. Trajectories and positions (circle symbols) on 31 December 2015 of the 38 ARGO-ITALY floats active in the Mediterranean and Black Sea at the end of 2015. The circle symbols are color-coded as a function of float age in days.

ARGO-ITALY FLOAT TOT MISSION DAYS ON 31-Dec-2015 -- TOTAL FLOATS: 13

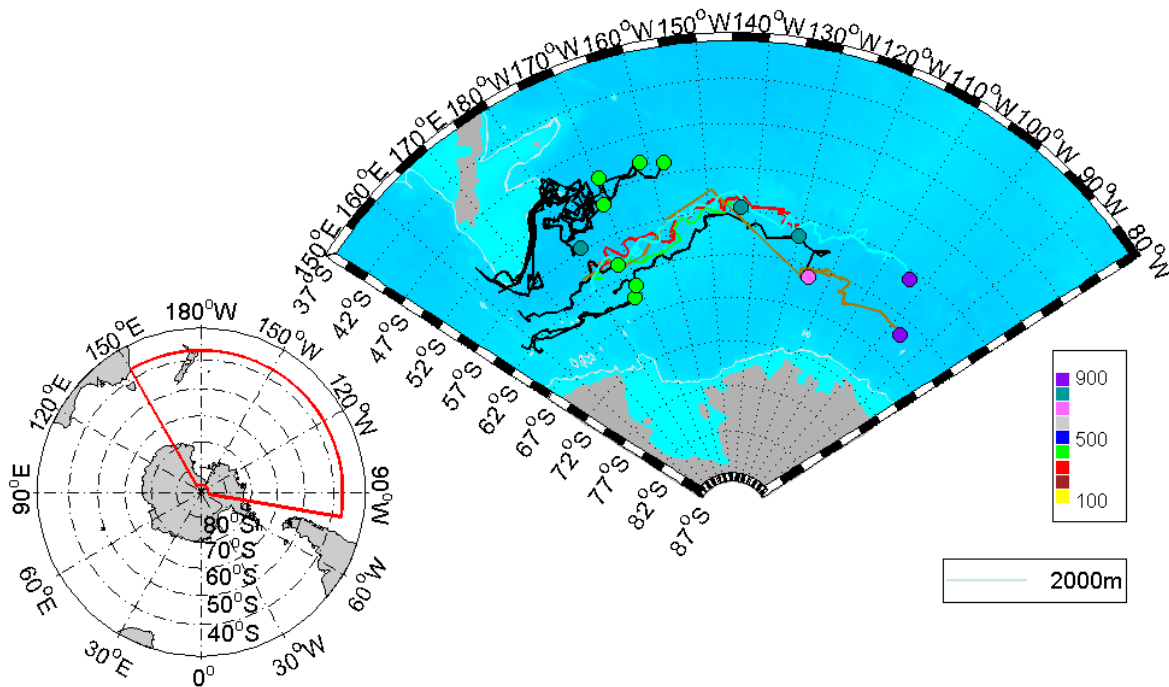


Figure 5. Trajectories and positions (circle symbols) on 31 December 2015 of the 13 ARGO-ITALY floats in the Pacific Sector of the Southern Ocean (Southeast of New Zealand). The circle symbols are color-coded as a function of float age in days.



Since 18 February 2012, a total of 81 ARGO-ITALY floats have been deployed. In less than 4 years, they have provided about 7000 CTD profiles. The histograms of number of CTD profiles per float is shown in Fig. 6. Fifteen floats have done more than 180 profiles. In total, 7 floats (9 %) have failed just after deployment.

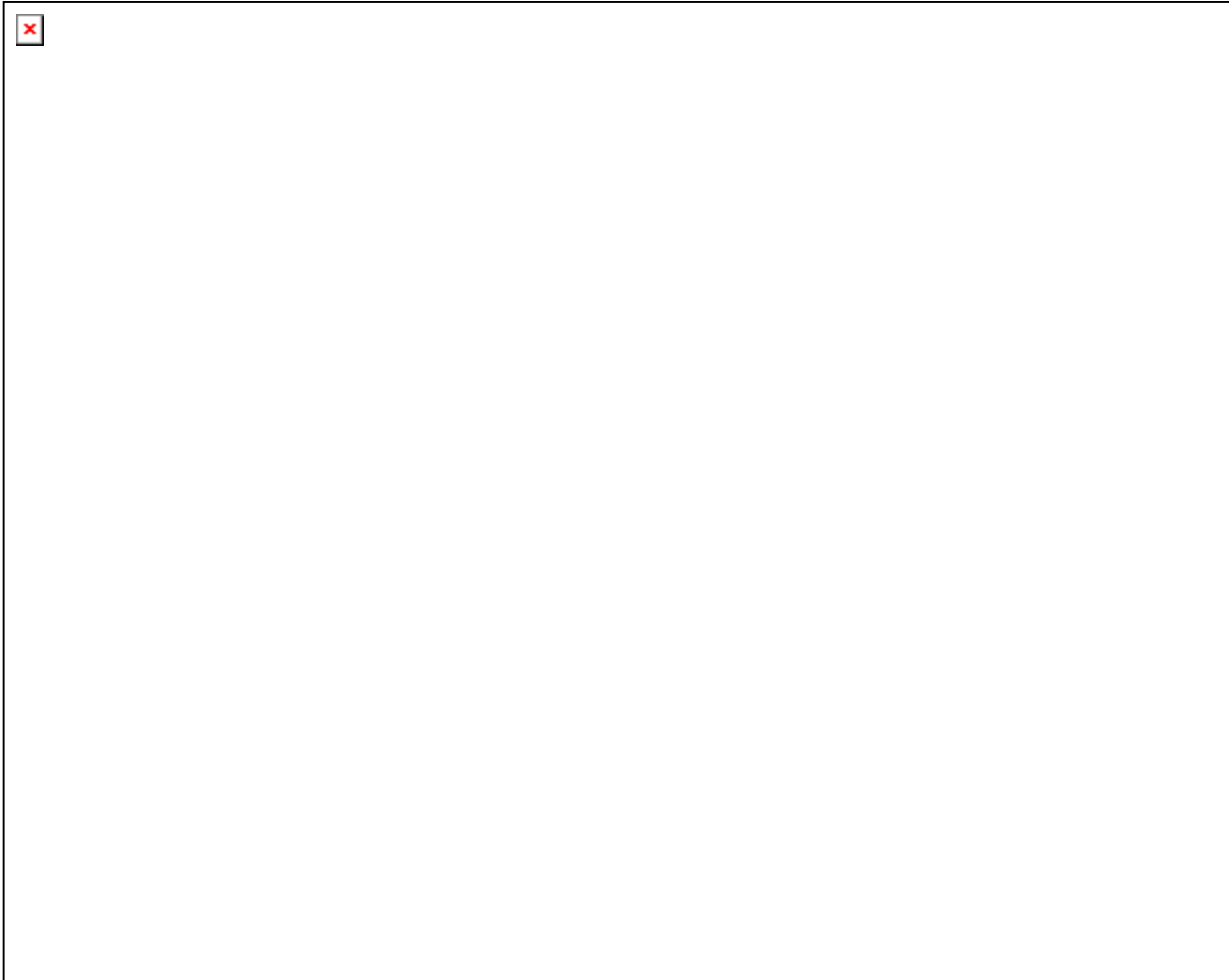


Figure 6. Histogram of the number of CTD profiles per float (red: dead float, blue: alive at the end of 2015).

The temporal evolution of the number of active floats is shown in Fig. 7 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. In 2014 and 2015 the annual numbers of deployments (25 and 26, respectively) were related to annual losses of 10 in 2014 and 13 in 2015.

After less than 4 years of activities, the maximum operating life of the ARGO-ITALY floats is a bit more than 3 years (~1140 days, see Fig. 8). The mean half life is about 500 days for all floats in the Mediterranean and Black seas. Floats with Argos positioning and telemetry appear to have a shorter mean half life (near 400 days), compared to near 600 days for the floats with Iridium. Arvor floats show the longest performances with a mean half life of more than 600 days. These statistics have to be interpreted with caution since most of the floats are still alive (51 floats out of 81 units).

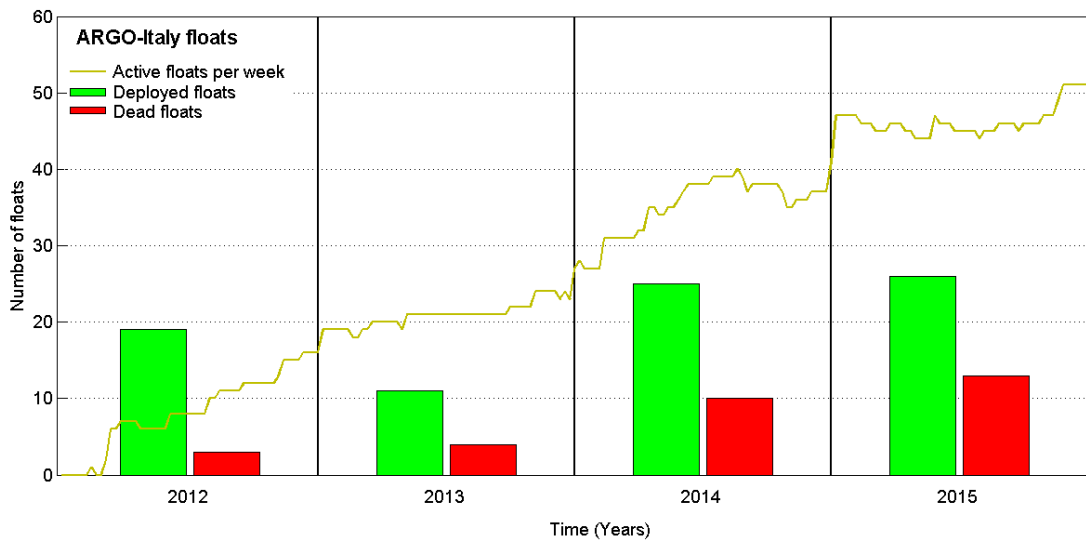


Figure 7. Temporal evolution of the number of active floats with weekly resolution and histogram of the annual float deployments and losses.

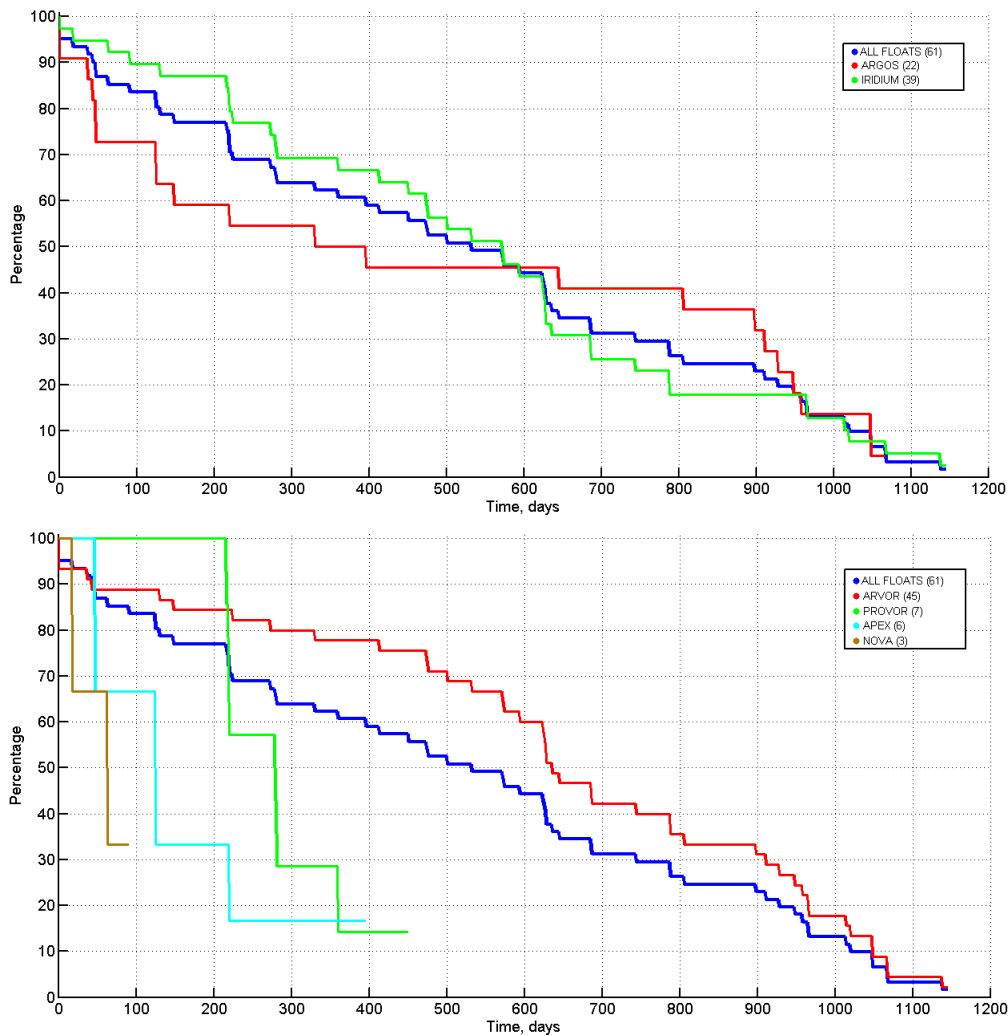


Figure 8. Survival rate diagrams for all the ARGO-ITALY floats in the Mediterranean and Black seas, separated by transmission mode (top) and float type (bottom).

Table 3 summarizes the main statistics of the ARGO-ITALY floats for the period 2012-2015. In 2015, more than 2700 CTD profiles were obtained with Italian Argo floats. These profiles provided data on total vertical distance of more than 3100 km in 2015. For the period 2013-2015 the 81 floats of ARGO-ITALY provided data on a total vertical distance of more than 7000 km in about 7000 profiles.

Year	2012	2013	2014	2015	2012-2015
<b>Deployments</b>					
CTD floats deployed in Med	13	7	13	11	44
CTD floats deployed in BS	4	1	2	1	8
CTD floats deployed in SO and Atlantic	2	3	7	10	22
Bio floats deployed	0	0	3	4	7
<b>Total floats deployed</b>	<b>19</b>	<b>11</b>	<b>25</b>	<b>26</b>	<b>81</b>
<b>CTD profiles</b>					
CTD profiles in Med	400	1099	1560	1743	4802
CTD profiles in BS	105	236	323	268	932
CTD profiles in SO and Atlantic	6	90	205	475	776
Bio profiles	0	0	244	266	510
<b>Total profiles</b>	<b>511</b>	<b>1425</b>	<b>2332</b>	<b>2752</b>	<b>7020</b>
<b>Vertical distances (km)</b>					
Distance in Med	440	902	1485	1813	4640
Distance in BS	71	210	283	257	821
Distance in SO and Atlantic	2	125	380	875	1382
Distance of bio floats	0	0	199	245	444
<b>Total distance (km)</b>	<b>513</b>	<b>1237</b>	<b>2347</b>	<b>3190</b>	<b>7287</b>

Table 3. Statistical information on the performance of the ARGO-ITALY floats in 2012-2015.

### 3. SVP drifter activities in 2015

#### 3.1 Drifter procurement

No drifter was purchased in 2015.

#### 3.2 Drifter deployments

In total, **36 drifters** were deployed in 2015. Ten SVP drifters were deployed in the South Pacific or in the Southern Ocean (Pacific Sector) whereas 26 were released in the Mediterranean Sea. Since some drifters were recovered and deployed several times, there were 39 deployments in total.

Table 4 shows the status information of drifters initially deployed in 2014 and subsequently redeployed in 2015. One drifter (Argos ID 116395) originally deployed in June 2014 as part of the REP14 experiment west of Sardinia was redeployed twice, the first time off Sardinia on 19 March 2015 with the help of local colleagues. It stranded on Ustica Island in May and was redeployed off the island on 13 May 2015. It finally stranded on the northern coast of Sicily where it is still transmitting. Its trajectories are shown in Fig. 9. One drifter (Argos ID 136010) deployed in the Alboran Sea in April 2014 during the Alborex Experiment stranded on the Favignana Island (off western Sicily) and was recovered and re-deployed between Maretimo and Favignana Islands on 2 July 2015 (Fig. 10). Its trajectory is depicted in Fig. 11. This drifter meandered to south in the Sicily Channel and eastern Ionian before stranding on the Libyan coast in late August 2015.

Argos/IMEI	Deploy Date	Lat	Lon	Last Date	Lat	Lon	Status*
<a href="#">b116395</a>	19-Mar-2015 07:50	39.91	8.26	01-May-2015 15:09	38.68	13.16	D
<a href="#">c116395</a>	13-May-2015 10:03	38.74	13.21	12-Feb-2016 01:28	38.25	15.44	A
<a href="#">b136010</a>	02-Jul-2015 12:48	37.9	12.25	02-Dec-2015 05:00	32.4	14.99	D

\*Status in early February 2016: A = active, D = dead.

Table 4. Status information for the Italian drifters re-deployed in the Western Mediterranean in 2015.

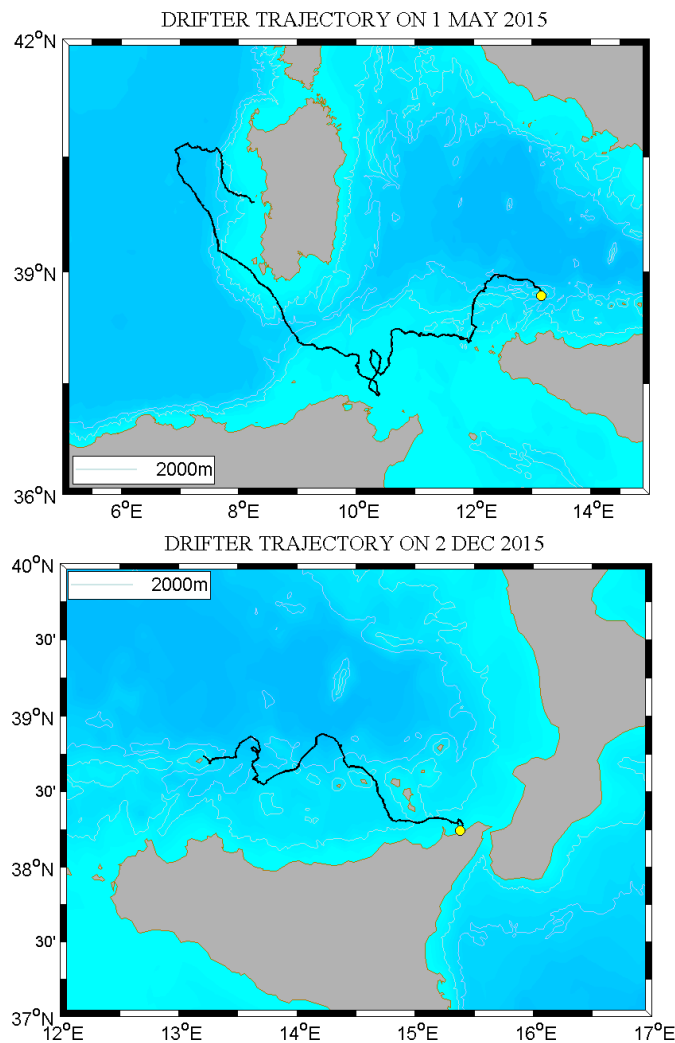


Figure 9. Trajectories and last positions (yellow dots) of drifter with Argos ID 116395 after re-deployments west of Sardinia (top – b116395) and near Ustica Island (bottom – c116395) in the western Mediterranean in 2015.



Figure 10. Redeploying drifter with Argos ID 136010 west of Sicily in July 2015.

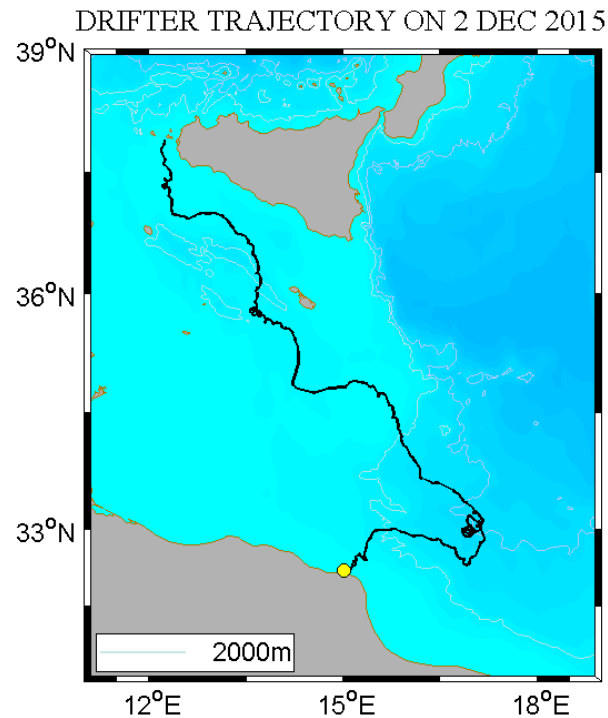


Figure 11. Trajectories and last position (yellow dots) of drifter with Argos ID 136010 after re-deployment west of Sicily in July 2015.

SVP drifters were deployed from R/V Araon by Italian colleagues on a transect between New Zealand and Ross Sea in January 2015. Status information about these drifters are listed in Table 5. They have Iridium telemetry. As of 9 February 2016, 9 of these drifters were still operating. Their trajectories are displayed in Fig. 12. A few drifters moved to the northeast off New Zealand, whereas the others were caught by the Circumpolar Circulation and moved swiftly eastward, some of them approaching longitude 100°W after about one year of drift.

Drifters were deployed in the northeastern Adriatic Sea in February 2015 as part of the North Adriatic Experiment (more specifically in the Kvarner Bay), an Italy-Croatia bilateral project involving drifter, float, glider and ADCP measurements. Some drifters were CODE designs manufactured by DBI in Cape Coral, Florida, and others were SVP drifters (drogued at 15 m depth) produced by Pacific Gyre, Oceanside, California. They all transmit GPS locations and sea surface temperature at hourly intervals. Their status information is provided in Table 6.

All the drifters deployed in Kvarner Bay entered the open Adriatic and moved westward toward the Italian coast (Fig. 13). Some of them meandered in the North Adriatic and other went south in the coastal current along the Italian Peninsula. Two drifters reached the South Adriatic and one of them (a300234062746280) exited via the Otranto Strait into the Ionian. It eventually stranded on the Greek Peloponese coast, where it was still transmitting in February 2015.



Argos/IMEI	Deploy Date	Lat	Lon	Last Date	Lat	Lon	Status*
<a href="#">a300234061363990</a>	03-Jan-2015 02:27	-51.01	163.01	05-Feb-2016 22:00	-42.63	-177.67	D
<a href="#">a300234062818740</a>	03-Jan-2015 06:50	-52.01	163.18	09-Feb-2016 06:00	-44.21	-175.71	A
<a href="#">a300234062831810</a>	03-Jan-2015 11:05	-53.01	163.05	09-Feb-2016 06:00	-47.11	-178.64	A
<a href="#">a300234061396460</a>	03-Jan-2015 20:50	-55	162.85	09-Feb-2016 06:00	-60.47	-101.27	A
<a href="#">a300234062831750</a>	04-Jan-2015 00:00	-56	162.79	09-Feb-2016 06:00	-53.97	-104	A
<a href="#">a300234062830780</a>	04-Jan-2015 09:29	-58.01	162.69	09-Feb-2016 06:00	-50.35	-150.98	A
<a href="#">a300234061399590</a>	04-Jan-2015 19:47	-60.01	162.59	09-Feb-2016 06:00	-62.6	-121.13	A
<a href="#">a300234062832730</a>	06-Jan-2015 01:14	-61.01	157.31	09-Feb-2016 06:00	-59.27	-81.76	A
<a href="#">a300234062832740</a>	06-Jan-2015 09:42	-62	158.48	09-Feb-2016 06:00	-52.74	-98.79	A
<a href="#">a300234062832780</a>	06-Jan-2015 18:16	-63	159.69	09-Feb-2016 06:00	-65.86	-104.45	A

\*Status in early February 2016: A = active, D = dead.

Table 5. Status information for the 10 Italian drifters deployed South Pacific / Southern Ocean in winter 2015.

ARGO-ITALY DRIFTER TRAJECTORIES ON 31 DEC 2015

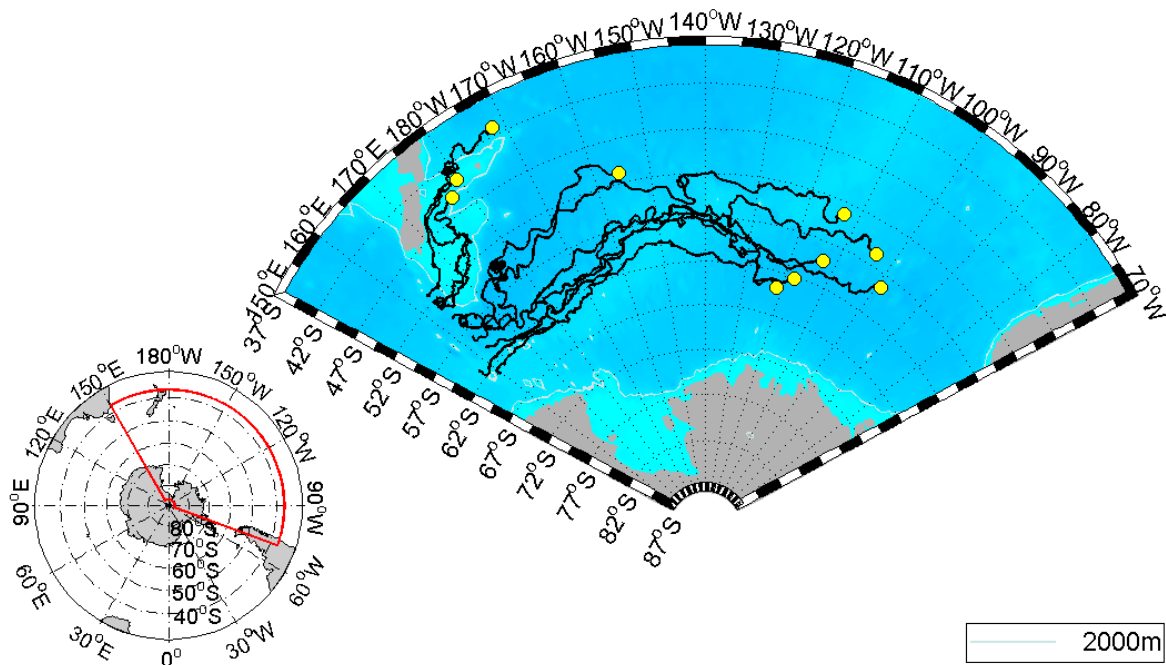


Figure 12. Trajectories and last positions (yellow dots) of the 10 Italian drifters deployed in the Southern Ocean in January 2015.

Argos/IMEI	Type	Deploy Date	Lat	Lon	Last Date	Lat	Lon	Status*
<a href="#">c300234061155700</a>	CODE	19-Feb-2015 11:18	45.02	14.23	24-Feb-2015 18:00	44.83	14	D
<a href="#">c300234061152720</a>	CODE	12-Feb-2015 11:01	45.22	14.36	15-Sep-2015 06:01	43.04	16	D
<a href="#">b300234061156720</a>	CODE	13-Feb-2015 10:29	45.31	14.4	22-Feb-2015 18:00	44.84	13.99	D
<a href="#">c300234061154740</a>	CODE	11-Feb-2015 17:42	44.96	14.2	04-Mar-2015 17:00	44.82	13.2	D
<a href="#">c300234061154690</a>	CODE	11-Feb-2015 18:25	44.94	14.27	09-Jul-2015 01:01	40.98	17.58	D
<a href="#">c300234061151740</a>	CODE	11-Feb-2015 16:58	44.86	14.18	21-Jul-2015 06:01	42.56	14.66	D
<a href="#">d300234061151730</a>	CODE	19-Feb-2015 11:27	45	14.27	15-Mar-2015 15:00	44.59	12.96	D
<a href="#">c300234061151720</a>	CODE	12-Feb-2015 08:34	45.08	14.18	22-Feb-2015 19:00	44.86	14	D
<a href="#">a300234062058460</a>	SVP	19-Feb-2015 10:31	44.88	14.15	04-Nov-2015 13:00	42	15	D
<a href="#">a300234062746280</a>	SVP	19-Feb-2015 10:07	44.79	14.04	08-Feb-2016 21:00	37.66	21.43	A
<a href="#">a300234062837570</a>	SVP	19-Feb-2015 12:13	44.87	14.23	10-Mar-2015 17:00	43.68	13.29	D
<a href="#">a300234062837700</a>	SVP	19-Feb-2015 12:48	44.67	14.22	13-Nov-2015 11:00	44.49	12.28	D
<a href="#">a300234062837720</a>	SVP	19-Feb-2015 13:11	44.73	14.12	20-Feb-2015 08:00	44.72	14.16	D
<a href="#">b300234062837720</a>	SVP	24-Feb-2015 10:41	44.78	13.69	23-Aug-2015 12:00	38.91	16.42	D
<a href="#">b300234062837570</a>	SVP	23-Mar-2015 20:00	44.06	13.55	24-Sep-2015 18:00	43.67	13.32	D

\*Status in early February 2016: A = active, D = dead.

Table 6. Status information for the Italian drifters deployed during the North Adriatic Experiment in February 2015. Re-deployed drifters are highlighted in gray.

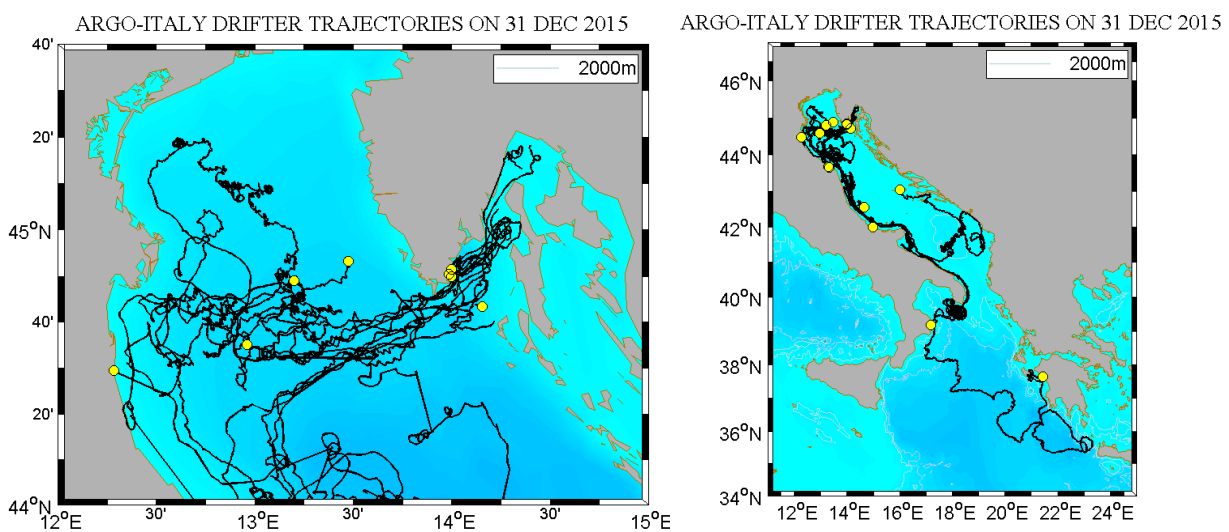


Figure 13. Trajectories and last positions (yellow dots) of the Italian drifters deployed in the northern Adriatic Sea in winter 2015.

In 2015, we have started a collaboration with the International Seakeepers Society to deploy drifters from luxurious boats (sailboats and yachts) in the Mediterranean. As part of this collaboration, 5 SVP drifters were released in the Alboran Sea from M/Y Alegria (see details in Table 7 and Fig. 14) and 5 SVP drifters were deployed in the Levantine Sea from S/Y Morning Glory (Table 8).



Figure 14. Deploying a SVP drifter in the Alboran Sea from M/Y Alegria in October 2015.

Argos/IMEI	Deploy Date	Lat	Lon	Last Date	Lat	Lon	Status*
<a href="#">a300234062832790</a>	04-Oct-2015 06:50	36.27	-3.7	11-Nov-2015 01:00	36.83	-2.47	D
<a href="#">a300234062833830</a>	04-Oct-2015 07:16	36.25	-3.78	23-Oct-2015 15:00	36.13	0.24	D
<a href="#">a300234062833790</a>	04-Oct-2015 07:40	36.24	-3.87	25-Oct-2015 05:00	36.72	2.21	D
<a href="#">a300234062833770</a>	04-Oct-2015 08:09	36.22	-3.98	25-Jan-2016 20:00	37.41	-1.57	D
<a href="#">a300234062834780</a>	04-Oct-2015 08:40	36.21	-4.08	16-Oct-2015 15:00	35.43	-5.05	D

\*Status in early February 2016: A = active, D = dead.

Table 7. Status information for Italian drifters deployed in the Alboran Sea in October 2015.

Argos/IMEI	Deploy Date	Lat	Lon	Last Date	Lat	Lon	Status*
<a href="#">a300234062834800</a>	15-Nov-2015 22:56	32.03	31.86	09-Feb-2016 06:00	31.2	33.85	A
<a href="#">a300234062836780</a>	15-Nov-2015 13:01	33.33	30.29	09-Feb-2016 06:00	34.59	30.16	A
<a href="#">a300234062836570</a>	15-Nov-2015 15:29	33.01	30.69	09-Feb-2016 06:00	35.02	30.26	A
<a href="#">a300234062835700</a>	15-Nov-2015 18:13	32.67	31.12	19-Jan-2016 04:00	33.46	35.29	D
<a href="#">a300234062835790</a>	15-Nov-2015 20:54	32.34	31.55	04-Feb-2016 04:00	31.3	33.28	D

\*Status in early February 2016: A = active, D = dead.

Table 8. Status information for Italian drifters deployed in the Levantine Sea in November 2015.

Drifters in the Alboran Sea were caught by the southward eastern limb of the Western Alboran Gyre (Fig. 15). One of them did a full loop in this gyre before stranding on the Morocco coast. The other drifters moved eastward and split in two groups, one proceeding eastward in the Algerian Current and finally stranding or being picked up off Algeria, and the other group meandering towards Spain and showing interesting coastal re-circulation patterns.

In the Levantine Sea (Fig. 16) the 5 drifters went eastward and northward (directly or after 2 loops in an anticyclonic structure) or southeastward to approach the Egyptian coast east of the Nile Delta where they were trapped in a slow circulation feature.

### 3.3 Other drifter activities

In 2015, OGS began to work on the development of the OGS low-cost drifter (Fig. 17), a design similar to the CODE drifter, but at a substantially reduced cost.

The fundamental component of the drifter is the system that localizes the instrument and then transmits the data on land. Several models are available on the market and they can be GPS/GSM or GPS/Iridium (or similar) modules. The SPOT Gen3 is a low cost GPS/Globalstar location device with Lithium batteries. It was chosen as it appeared ideal to be installed on a drifter. It weighs only 114 g and has a small size (height 8.72 cm, width 6.5 cm and thickness 2.54 cm). It can be used in tracking mode, meaning that it can be switched on and its position can be sent to the satellite at a set period (up to 5 minutes). Furthermore, it is quite cheap (around 179€ plus another 175€ for a year of data transmission).

A few prototypes were tested successfully in the Gulf of Trieste on 28 and 29 September 2015 in moderate sea conditions. No transmission problem occurred and the low-cost CODE drifters followed the water currents as accurately as the original CODE drifter.

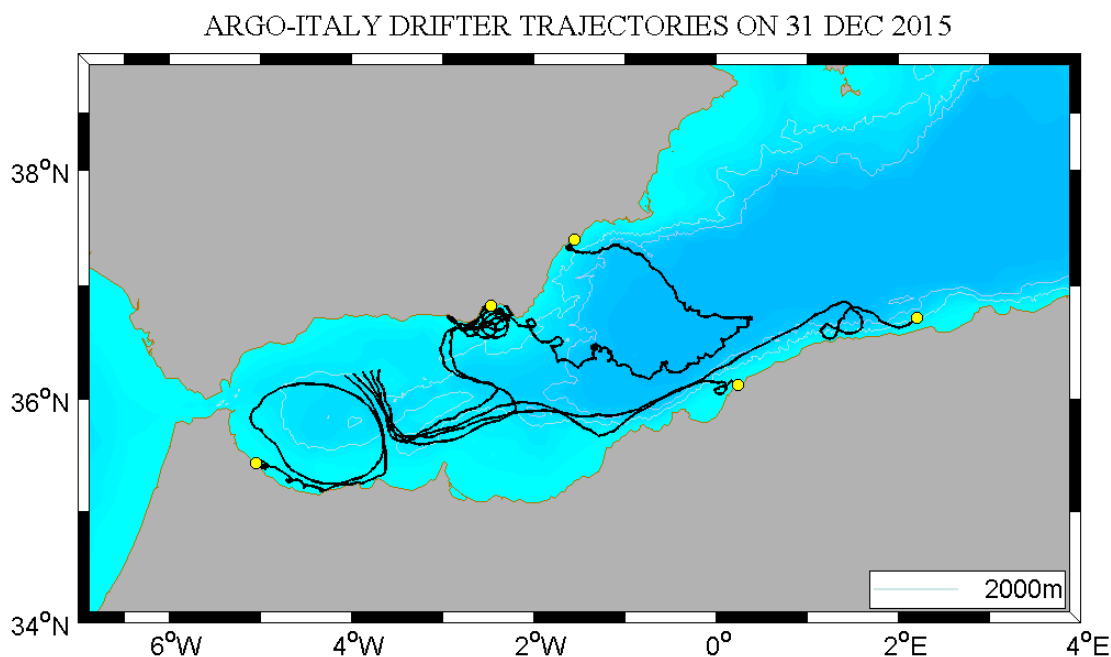


Figure 15. Trajectories and last positions (yellow dots) of the Italian drifters deployed in the Alboran Sea in October 2015.

## ARGO-ITALY DRIFTER TRAJECTORIES ON 31 DEC 2015

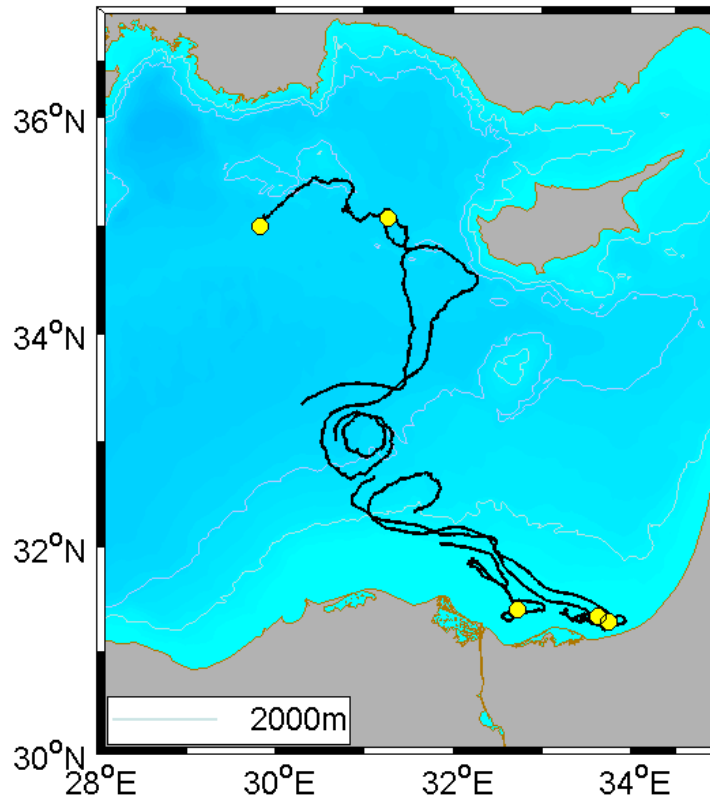


Figure 16. Trajectories and last positions (yellow dots) of the 5 Italian drifters in the Levantine Sea from M/Y Morning Glory in November 2015



Figure 17. The low-cost CODE drifter manufactured at OGS.



## 4. Glider activities in 2015

### 4.1 Glider component procurement

A 1000-m forward section for the Slocum glider was purchased in spring 2015. This component can be installed on one of the Slocum glider to increase its operational depth to 1000 m.

### 4.2 Glider testing

The Slocum glider “unit 403” was equipped with the new 1000-m forward section and was tested in the Gulf of Trieste on 27 October 2015 (Fig. 18). The glider navigated properly in the shallow waters of the Gulf.



*Figure 18. Photograph of the Slocum glider “unit 403” with the new 1000-m forward section being tested in the Gulf of Trieste on 27 October 2015.*

### 4.3 Glider laboratory

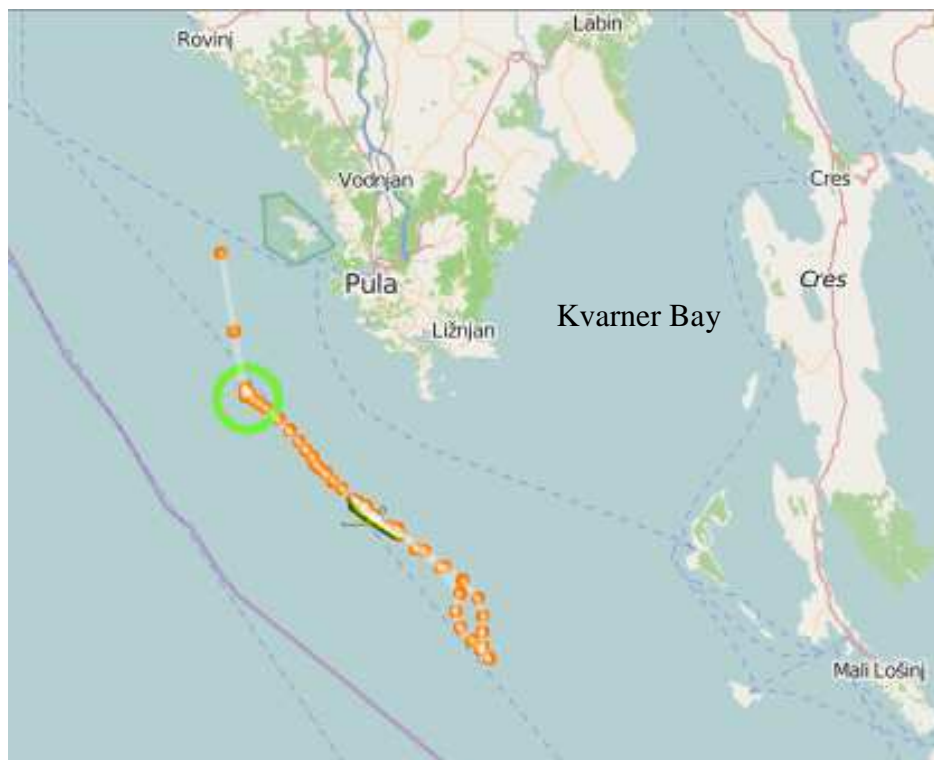
In 2015, the installation of the overhead travelling crane over the glider ballasting tank was ultimated and an additional small crane was installed in the glider laboratory to facilitate operations with gliders. Consumable goods were purchased for the OGS glider laboratory. The SeaGlider “Amerigo” returned back from factory (after about 8 months in the US for sensor calibration, replacement of the lithium batteries and firmware upgrade).



#### 4.4 Glider operations

In late winter 2015 (24-27 February 2015) the OGS Slocum glider “unit 403” was successfully operated for a short mission as part of the North Adriatic Experiment 2015 in front of the Kvarner Bay (Fig. 19). About 700 yos between 20 and 45 m were performed collecting high frequency data of pressure, temperature, conductivity, oxygen, chlorophyll, CDOM and backscatter (Fig. 20). A sharp barotropic front is evident in all the fields.

The same glider was operated (with the new 1000-m forward section) across the Southern Adriatic Sea from 20 November to 2 December 2015 (Fig. 21). The purpose of the PreCONVEX16 experiment was to study the condition preceding the winter deep water convection in the area. The glider sampled the water column characteristics down to 1000 m back and forth along the Bari- Dubrovnik transect (Fig. 22). A noteworthy feature is a salinity maximum around 50-100 m depth dominating the entire width of the basin.



*Figure 19. Glider “unit 403” trajectory during the North Adriatic Experiment in the Kvarner area (North Adriatic Sea). The glider and the green circle symbols indicate the last position of the instrument and the last waypoint, respectively. Orange symbols correspond to surfacing locations.*

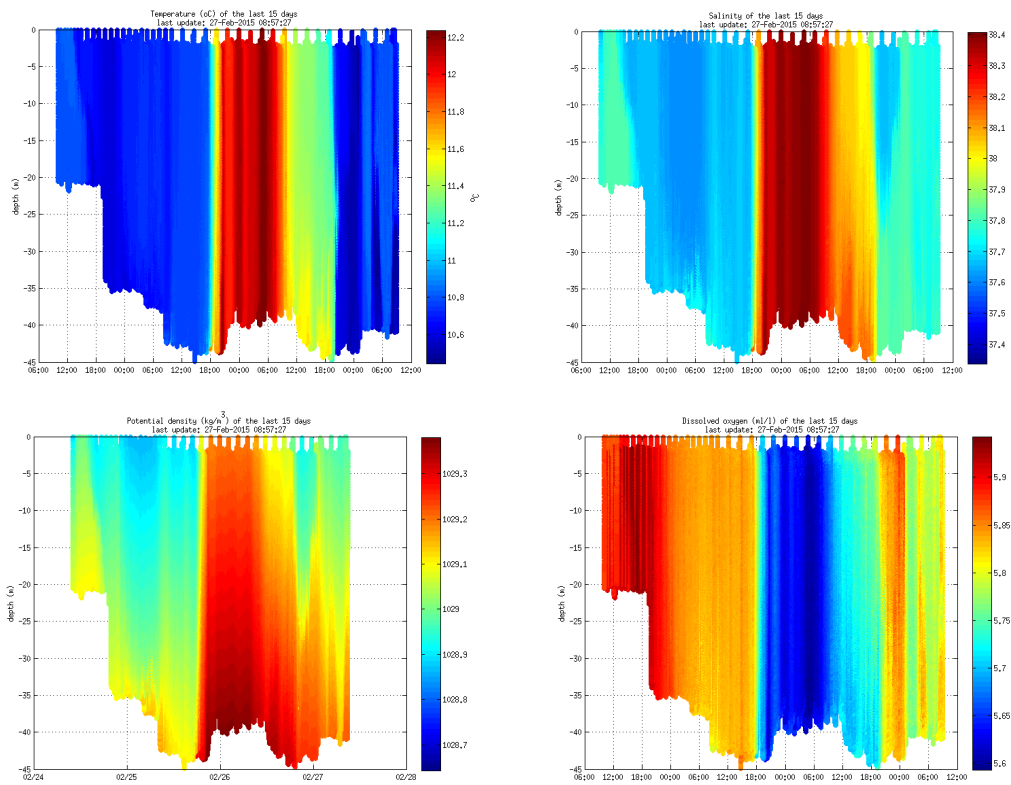


Figure 20. Color-coded vertical section along the glider path of temperature (top-left), salinity (top-right), density (bottom-left) and dissolved oxygen (bottom-right) during the North Adriatic Experiment (24-27 February 2015).

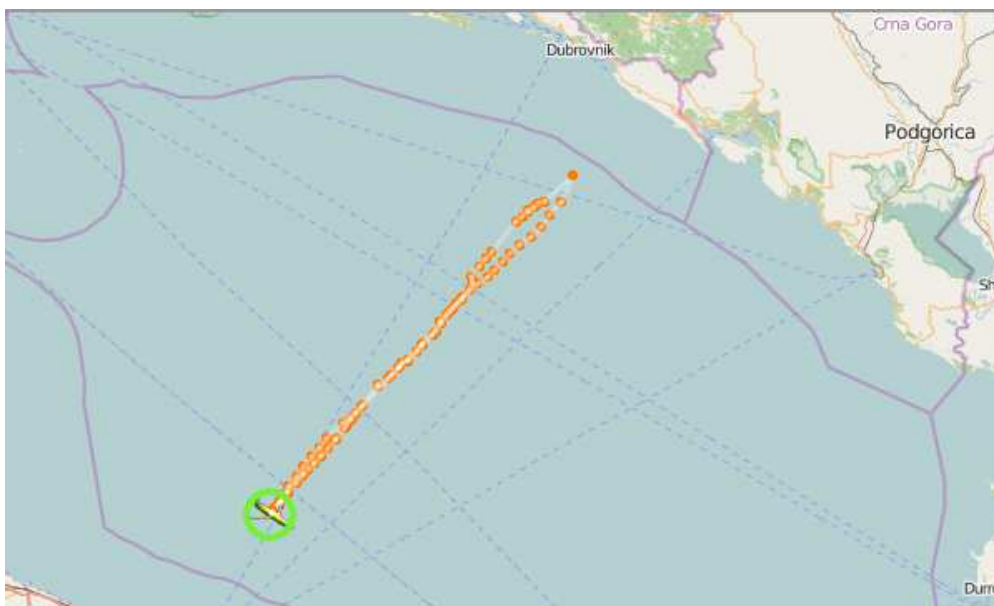
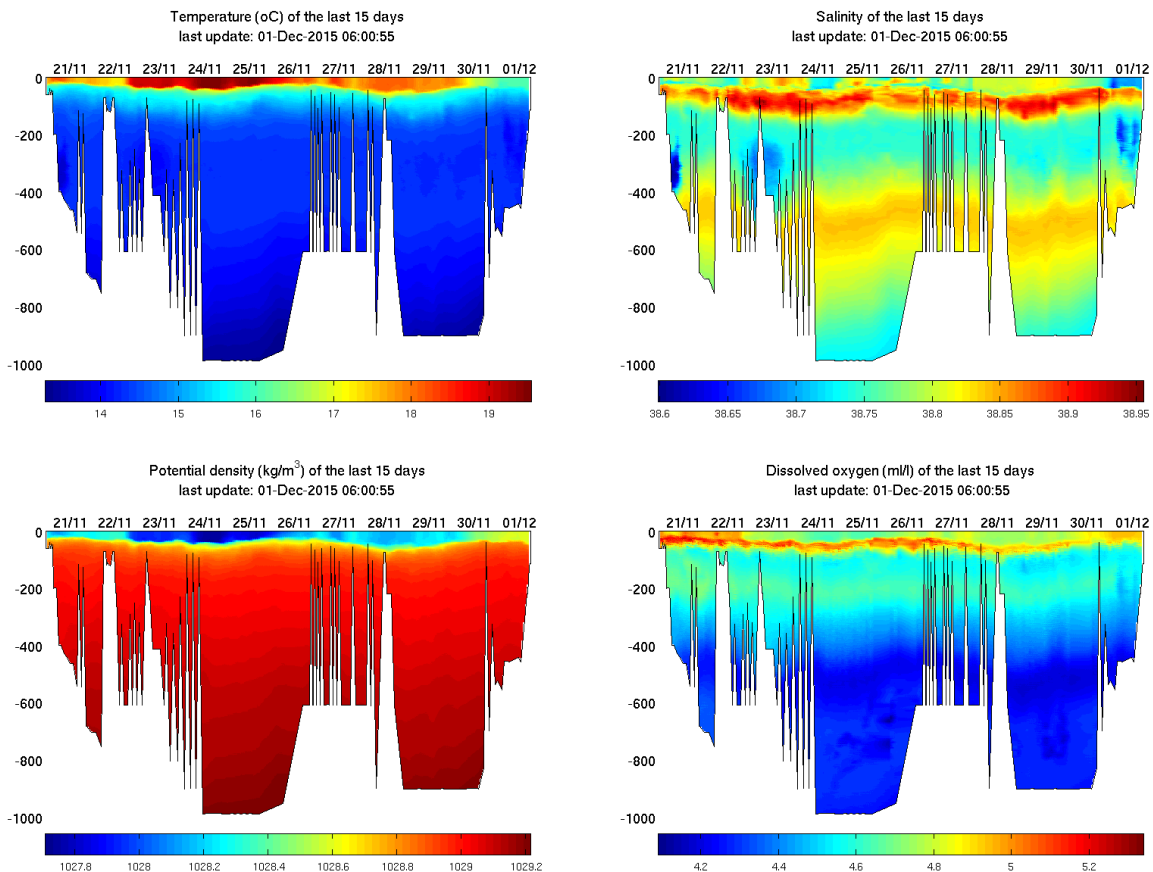


Figure 21. Glider “unit 403” trajectory during the PreCONVEX16 experiment in the Southern Adriatic Sea. The glider and the green circle symbols indicates the

*last position of the instrument and the last waypoint, respectively. Orange symbols correspond to surfacing locations.*



*Figure 22. Color-coded vertical section along the glider path of temperature (top-left), salinity (top-right), density (bottom-left) and dissolved oxygen (bottom-right) during the PreCONVEX16 experiment (20 November to 2 December 2015).*

#### 4.5 Glider data processing and webpage

The glider data acquired during all the missions were processed and displayed in real time on the webpage: [http://nettuno.ogs.trieste.it/sire/glider/glider\\_mission\\_now.php?id\\_glider=4](http://nettuno.ogs.trieste.it/sire/glider/glider_mission_now.php?id_glider=4) Other webpages (password protected) with technical informations and other parameters were available in real time to the OGS glider pilots. A first data elaboration was set up following EGO (Everyone Glider Observatories) recommendations to provide a unique and coherent data set in terms of format and quality.

## 5. Other activities in 2015

### 5.1 Near real-time data processing

The data of drifters, floats and gliders were processed and archived in near real-time at OGS. This processing includes some editing and the production of graphics and tables which are posted on the ARGO-ITALY web pages. In parallel, the raw drifter and float data were sent to global Data Assembly Centers (AOML/NOAA, Miami, Florida for the drifters and Coriolis, Ifremer, Brest, France for the floats). In addition, the drifter and float data were distributed in near real-time on the Global Telecommunication System (GTS) and were identified by a WMO number.

The data of the Provor Bio and Provor Nut floats were processed by LOV and made available in near-real time (files in Argo NetCDF format with real time QC) on their server ([http://www.oao.obs-vlfr.fr/BD\\_FLOAT/NETCDF/](http://www.oao.obs-vlfr.fr/BD_FLOAT/NETCDF/)).

### 5.2 Delayed Mode quality control of Argo physical data

The delayed mode quality control (DMQC) of the physical data (pressure, temperature and salinity) provided by the Italian floats was done for 27 floats (16 D-files sent to Coriolis, 11 D-files not yet sent). OGS also carried out the DMQC of all the floats operated in the Mediterranean Sea as part of the EC FP7 E-AIMS and PERSEUS projects and of CMEMS. The temperature and salinity data of 178 floats were quality controlled following the standard Argo procedure, covering the period 2000-2015. The float salinity calibration needs an accurate reference dataset and these data have to be quite close in time and space to the float measurements. The latter is necessary, in order to reduce the effects both of the inter-annual and the seasonal variability of the Mediterranean Sea, mostly in the upper and intermediate layers of the water column. The standard statistical method adopted by the Argo community for the salinity correction is strictly affected by the natural changes in the water column of the Mediterranean Sea and hence a careful interpretation of the method results is necessary. For this reason we adopt other qualitative checks (like comparison between nearby floats and analysis of the deepest portion of the temperature-salinity diagram) in order to increase reliability of the analysis.

### 5.3 Italian contribution to Argo bibliography in 2015.

The following papers involving Italian scientists were published in 2015. They use Argo data for basic oceanographic research and operational oceanography purposes.

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.

Poulain, P.-M. and Centurioni L. (2015) Direct measurements of World Ocean tidal currents with surface drifters, *J. Geophys. Res. Oceans*, 120, doi:10.1002/2015JC010818.

Mauri, E., R. Gerin and P.-M. Poulain (2016) Measurements of water-mass properties with a glider in the south-western Adriatic Sea. *Journal of Operational Oceanography*, in press.

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>

#### **5.4 OGS technical reports related to ARGO-ITALY published in 2015.**

Gerin R. (2015) Strumenti a supporto del pilotaggio dello Slocum Glider per la missione Pre-Convex 2016, 131 pp.

Gerin R. (2015) How to transfer files from/to a Slocum glider. REL. OGS 2015/18 OCE 9 MAOS, Trieste, Italy, 5 pp.

Gerin R., Bussani A. and Zuppelli P. (2015) Procedure operative per l'impiego dei glider, 16 pp.

Gerin R., Pacciaroni M., Kokkini Z., Bussani A., Mauri E., Zuppelli P., Kuchler S. and P.-M. Poulain (2015) The north Adriatic experiment (Kvarner area, february 2015) Rel. 2015/64 OCE 19 MAOS, 22 pp.

Gerin R. and Zuppelli P. (2015). Ballasting of the Slocum gliders #402 and #403 for the north Adriatic sea experiment (Kvarner area) planned for February 2015 with the adoption of a new worksheet for the change of the glider weight. REL. OGS 2015/14 OCE 6 MAOS, Trieste, Italy, 35 pp.

## **6. Plans for 2016 and beyond**

### **6.1 Floats**

With the funding available in 2015-2016, we plan the following purchases:

- 22 standard Argo floats with Iridium telemetry. Five of these floats will have additional oxygen sensors.
- 2 deep Argo floats capable of going down to 4000 dbars.
- 3 biogeochemical floats
- 10 floats with Iridium telemetry and sea-ice detection system.

The Italian deployment plans are detailed in Table 9. The main areas of interest are still in 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 9. Italian float deployment plans for 2016-2017.*

OGS is committed to carry out DMQC on all the Argo floats of the Mediterranean and Black seas as part of the E-AIMS, PERSEUS and other European projects over the coming years.

## 6.2 Drifters

With the funding available in 2015, procedures are underway for the procurement of 28 SVP drifters with Iridium telemetry. Sixteen SVP drifters are also being acquired as part of the ONR CINEL project.

Drifter deployment plans for 2015 and 2016 are described in Table 10.

Year	SVP drifters	
	Quantity	Area
2016	15	Southern Ocean
	30	Mediterranean
2017	15	Southern Ocean
	30	Mediterranean

*Table 10. ARGO-ITALY drifter deployment plans for 2016-2017.*



### 6.3 Gliders

The OGS Slocum Gliders are planned to be operated in the southern Adriatic Sea in late winter and late autumn 2016 to monitor dense water formation processes. The Seaglider “Amerigo” is planned to be operated south of Cyprus and east of Israel in collaboration with the Cyprus and Jerusalem Universities in late summer 2016.

### 6.4 Other

MIUR is committed to provide funding in order to sustain the Italian contribution to Argo beyond 2015 as a founding member of the Euro-Argo Research Infrastructure Consortium. In addition to the Italian national funding, OGS has funding from new EC (for instance the DG MARE MOCCA project) and ONR (CINEL) projects for multiple activities related to Argo.

## 7. Distribution list

This report will be distributed, amongst others, to the ARGO-ITALY International Scientific Advisory Committee:

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International Seakeepers Society, Miami, Florida

Capt Stefan Czuplak  
M/Y Alegria

Capt Zachary Bailey  
S/Y Morning Glory

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