ARGO-ITALY:

ANNUAL REPORT 2014

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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 Ministery 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 webb address is: www.argoitaly.ogs.trieste.it

This report summarizes the activities of ARGO-ITALY in 2014 in terms of procurements of the instruments, their preparation and their deployments. Information about data processing and archiving is also given. Plans for 2015 are included in the last section.

2. Argo float activities in 2014

2.1 Float procurement

The following Argo floats were purchased in 2014-2015 with funds of ARGO-ITALY:

1. Twenty (20) NOVA floats from MetOcean, Dartmouth, Canada (Fig. 1). The NOVA 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 (SBE 41 CP). Five of these units have dissolved oxygen sensors. Delivery is expected in late spring 2015.

Figure 1. Photograph of a NOVA, with the CTD sensors and Iridium antenna at the top and blader (to change buoyancy) at the bottom.

2.2 Float deployments

In total, **25 Italian floats** were deployed in 2014 (see Tables 1 and 2 for details). These floats were Arvor and Provor designs manufactured by NKE (France) and Apex floats produced by Teledyne Webb Research (USA). The majority of the floats transmit data via Iridium telemetry (Arvor-I, Provor Bio, Provor Nut) and some have Argos telemetry (Arvor-L and Apex).

Two floats were deployed in the Black Sea and 16 units were released in the Mediterranean (Table 1 and Fig. 2). Except for float WMO 6901860, all the instruments were still operating at the end of February 2015. In the Mediterranean, most floats (Arvor-I) 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.

Most floats were deployed from research vessels of opportunity (e.g., R/V Urania, R/V SOCIB, R/V Poseidon, NRV Alliance and R/V OGS Explora for the Mediterranean and R/V Akademik for the Black Sea) with the help of colleagues from NATO, Italy, Spain, Germany and Bulgaria.

Float WMO 6901837 is an Arvor-I profiler purchased by the Consorzio Laboratorio di Monitoraggio e Modellistica Ambientale per lo sviluppo sostenibile (LaMMA) as part of co-funding for their project DRIVE-FLOATS. It was deployed in the northern Tyrrhenian Sea in November 2014. Colleagues from LaMMA have changed its cycling period between 1 and 10 days to assess the effectiveness of assimilation of temperature and salinity profiles in a local operational forecasting model.

Three floats equipped with biogeochemical and optical sensors (Provor Bio and Provor Nut) were deployed in the southern Adriatic - northern Ionian and in the eastern Alboran Sea, during the ADREX and ALBOREX cruises, respectively, of the EC FP7 Perseus project (Fig. 3). 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). The Provor Nut float is a Provor Bio float with additional sensors: an Aanderaa optode oxygen sensor and a SUNA nitrate sensor. The floats were initially programmed to sample profiles from, and drift at, 1000 dbar near local noon time every day. After about a month, the period was changed to 5 days and the parking depth was set to 350 dbar, using the Iridium downlink.

Prior to the ADREX and ALBOREX experiments, the Provor Bio and Provor Nut floats were throughly tested: we checked the main mission parameters, performed an auto-test, checked the technical parameters (internal vacuum, battery voltage, sensors, time) and verified the GPS and Iridium communication. The dump of the configuration was produced and sent to the French colleagues of the Laboratoire d'Océanographie de Villefranche-sur-Mer (LOV).

Seven Italian floats were deployed in the Pacific Ocean sector of the Southern Ocean and ice-free Ross Sea (Table 2) with the help of Italian colleagues onboard R/V Italica. These floats included two refurbished units from NKE (a Provor CTS 2 and an Arvor-L) and 5 new Apex floats from Teledyne Webb Research (Fig. 4). In the Southern Ocean, they cycle between the surface and 2000 dbar every 10 days and drift at the parking depth of 1000 dbar. Out of six floats deployed in the Southern Ocean, three units were still operational at the end of February 2015.

Model	WMO	Deploy date	Lat	Lon	Cycles	Last_TX date	Lat	Lon	Status	Cycle
Provor Bio	6901860	12-Feb-2014 13:47	38.5	19.93	107	06-Feb-2015 10:35	38.24	19.16	D	5
Arvor I	6901829	13-Feb-2014 19:11	38.53	18.47	80	24-Feb-2015 23:55	38.49	18.69	A	5
Arvor I	6901830	14-Feb-2014 08:19	39.25	18	78	25-Feb-2015 23:58	38.96	18.4	A	5
Provor Nut	6901865	18-Feb-2014 17:28	41.83	17.76	108	28-Feb-2015 10:35	38.65	17.45	A	5
Arvor I	6901879	05-Apr-2014 05:31	42.12	10.76	72	26-Feb-2015 05:15	41.28	10.02	A	5
Arvor I	6901846	13-Apr-2014 05:32	35.6	17.25	69	01-Mar-2015 00:06	36.4	17.19	A	5
Arvor I	6901847	15-Apr-2014 17:36	34.75	22.42	67	26-Feb-2015 00:00	37.68	18.82	A	5
Arvor I	6901848	17-Apr-2014 06:10	34.4	26.02	65	27-Feb-2015 23:54	34.37	24.37	A	5
Arvor I	6901839	17-May-2014 12:56	42.96	10.15	61	28-Feb-2015 00:19	43.38	9.83	A	5
Provor Bio	6901861	25-May-2014 19:54	36.9	-0.9	66	27-Feb-2015 11:15	36.6	1.83	A	5
Arvor I	6901835	06-Jun-2014 22:51	41.5	9.67	56	28-Feb-2015 00:21	41.87	9.96	A	5
Arvor I	6901836	08-Jun-2014 19:31	39.9	7.95	56	25-Feb-2015 00:09	43.39	8.9	A	5
Arvor I	6901831	18-Jul-2014 06:51	49.17	29	48	25-Feb-2015 00:11	43.01	36.36	A	5
Arvor I	6901845	18-Aug-2014 12:25	33.5	33	41	26-Feb-2015 00:13	35.38	32.03	A	5
Arvor I	6901832	12-Sep-2014 06:20	43.17	29	36	26-Feb-2015 00:15	42.57	33.47	A	5
Arvor I	6901823	14-Sep-2014 08:45	41.37	9.88	36	28-Feb-2015 00:16	40.32	11.46	A	5
Arvor I	6901837	14-Nov-2014 12:50	42.22	10.85	30	26-Feb-2015 00:12	40.41	9.98	A	5
Apex	6901868	01-Dec-2014 12:43	32.73	33.63	18	26-Feb-2015 00:07	35.37	35.45	A	5

Table 1. Status information for the 18 Italian floats deployed in the Mediterranean and Black Sea (grey rows) during 2014.

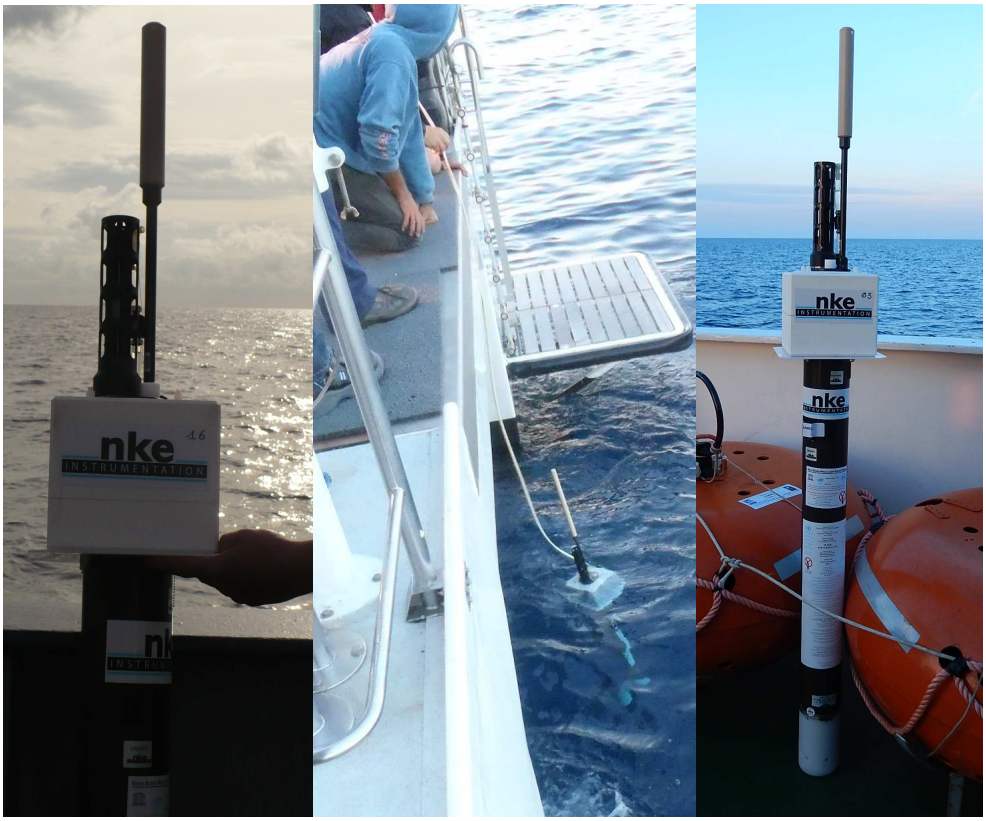

Figure 2. Arvor floats deployed in the Western Mediterranean from R/V Poseidon (left), R/V SOCIB (middle) and NRV Alliance (right).

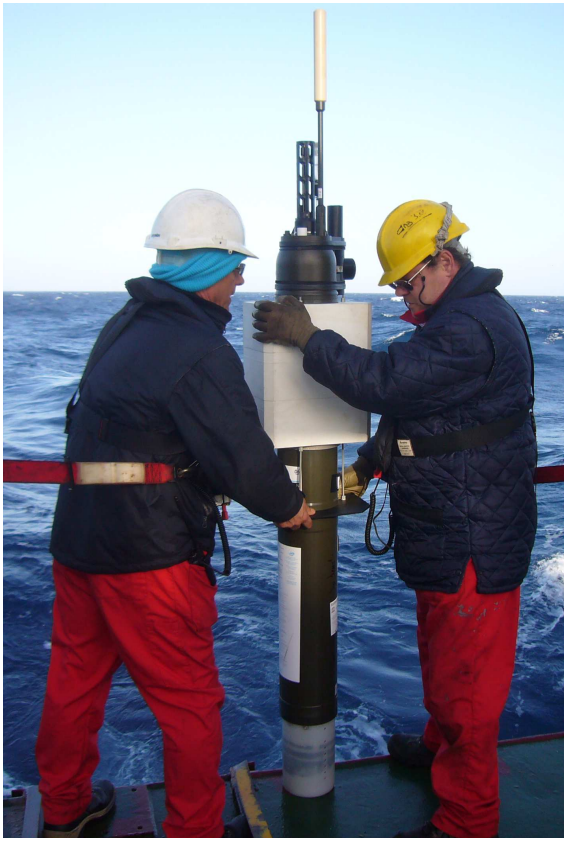

Figure 3. Provor Nut float (WMO 6901865) ready to be deployed in the southern Adriatic Sea on the deck of R/V OGS Explora.

Model	WMO	Deploy Date	Lat	Lon	Cycles	Last Date	Lat	Lon	Status	Cycle
Apex	6901856	30-Dec-2013 18:48	-51	175.74	38	25-Feb-2015 04:21	-51.08	-171.77	A	10
Apex	6901850	01-Jan-2014 19:24	-60.98	-177.6	43	27-Feb-2015 04:11	-60.7	-160.58	A	10
Apex	6901849	02-Jan-2014 07:59	-62.98	-176.01	33	07-Feb-2015 06:44	-57.37	-146.08	D	10
Apex	6901855	02-Jan-2014 21:33	-65	-176.08	4	07-Feb-2015 23:21	0	0	D	10
Apex	6901857	02-Jan-2014 22:55	-58.95	-178.9	42	26-Feb-2015 19:09	-57.37	-157.37	A	10
Arvor L	6901853	11-Jan-2014 00:50	-75.16	-164.46	0	26-Jul-2012 10:29	14.87	342.47	D	10
Provor	6901854	15-Feb-2014 06:30	-67.52	178.99	0	11-May-2014 05:57	-66.75	-172.54	D	-

Table 2. Status information for the 7 Italian floats deployed in the Southern Ocean and Ross Sea (grey row) during 2014.

Figure 4. Apex float (WMO 6901821) ready to be deployed in the Southern Ocean (Pacific Sector) on the deck of R/V Italica.

There were some technical problems with some of the floats:

- In the Mediterranean, the Provor Bio float WMO 6901860 reported erroneous irradiance and PAR values from the beginning of its mission. A systematic negative offset of salinity as large as 0.2 appeared systematically after 26 March 2014 (cycle number 41). This offset can be easily corrected during delayed mode quality control. On 21 July 2014, all the biogeochemical and optical sensors stopped functioning.

- In the Southern Ocean, the Apex floats WMO 6901849 and WMO 6901855 were incorrectly programmed and did not stay at the surface enough time to transmit their data via the Argos satellite system. As a result, float WMO 6901849 provided only 19 incomplete profiles (out of 37 cycles) and no data were obtained from float WMO 6901855. The problem was discussed with Teledyne Webb Research but there was nothing that we could do to solve the problem since the floats were at sea and Argos telemetry does not allow downlink commands.

- The provor CTS 2 WMO 6901854 which was refurbished by NKE apparently went into "end of mission" mode just after deployment and stayed at surface without profiling until 11 May 2014.

- Unfortunately, float WMO 6901853, which was tethered to act as a virtual mooring in Ross Sea had transmission/floatation problems and never transmitted data.

At the end of 2014, the ARGO-ITALY program had a total of 36 active floats, including 25 instruments in the Mediterranean Sea, 5 in the Black Sea (Fig. 5) and 6 in the Southern Ocean (Fig. 6).

Since 18 February 2012, a total of 55 ARGO-ITALY floats have been deployed. In less than 3 years, they have provided about 4200 CTD profiles. The histograms of number of CTD profiles per float is shown in Fig. 7. Fourteen floats have done more than 170 profiles. In total, 5 floats (9 %) have failed just after deployment.

After less than 3 years of activities, the maximum operating life of the ARGO-ITALY floats is about 950 days (Fig. 8). The mean half life is about 350 days for all floats in the Mediterranean and Black seas. Floats with Argos positioning and telemetry appear to have a much longer mean half life (near 860 days), compared to near 270 days for the floats with Iridium. These statistics have to be interpreted with caution since most of the floats are still alive (30 floats out of 45 units).

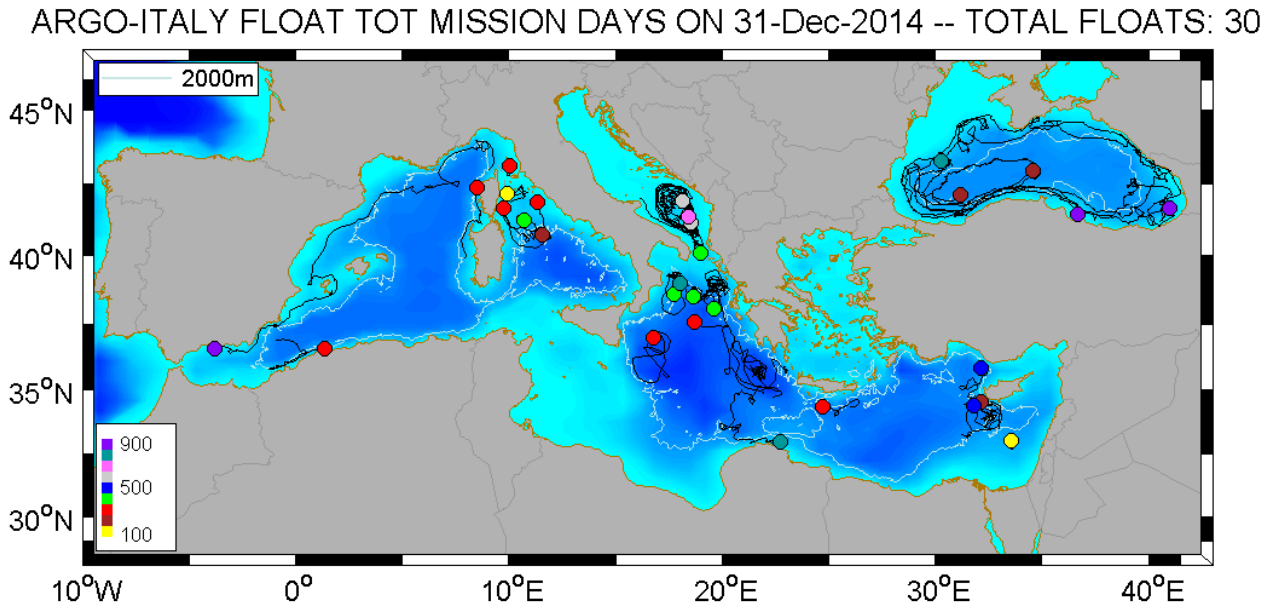

Figure 5. Trajectories and positions (circle symbols) on 31 December 2014 of the 30 ARGO-ITALY floats active in the Meditarrean and Black Sea at the end of 2014. The circle symbols are color-coded as a function of float age in days.

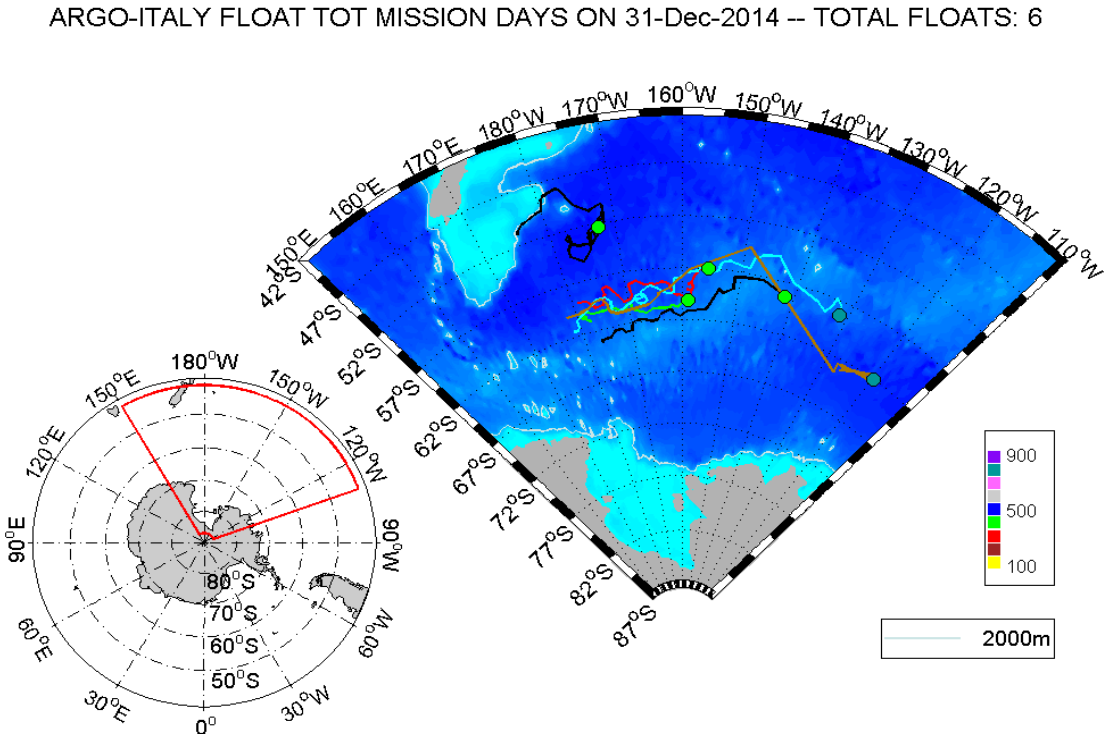

Figure 6. Trajectories and positions (circle symbols) on 31 December 2014 of ARGO-ITALY floats in the Pacific Sector of the Southern Ocean (Southeast of New Zealand). The circle symbols are color-coded as a function of float age in days.

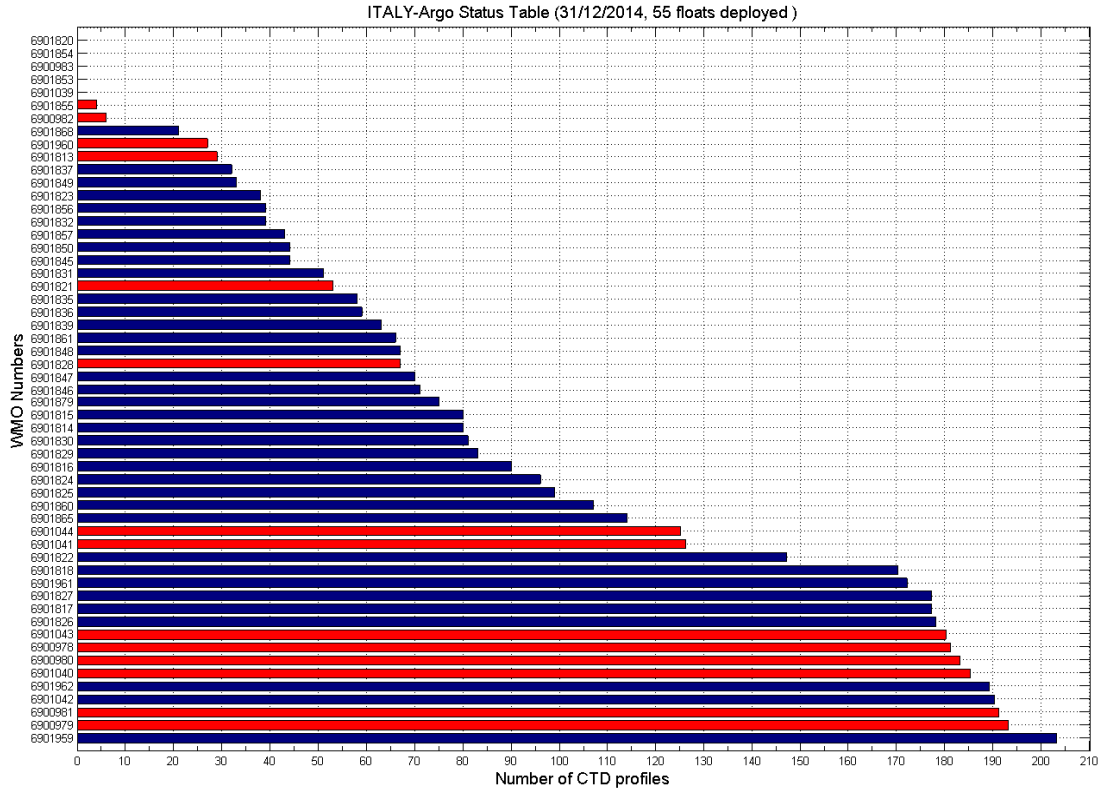

Figure 7. Histogram of the number of CTD profiles per float (red: dead float, blue: alive at the end of 2014).

Table 3 summarizes the main statistics of the Argo Italy floats for the period 2012-2014. In 2014, more than 2300 CTD profiles were obtained with Italian Argo floats, which is more than the amount of profiles obtained in 2012 and 2013, combined (see Table 3). These profiles provided data on total vertical distance of more than 2400 km in 2014. For the period 2013-2014 the 55 floats of Argo Italy provided data on a total vertical distance of more than 4000 km.

2.3 Other float activities

An Arvor I float (WMO 6901041) stranded on the Spanish coast near Tarragona in April 2014. With the help of Spanish colleagues of the Institut de Ciències del Mar (ICM), Consejo Superior de Investigaciones Cientifícas (CSIC) in Barcelona, the float was recovered and shipped to OGS in Trieste. The calibration of the float Sea-Bird CTD was performed at OGS. It appeared that the CTD sensor was still within the range of the original calibration after 125 cycles and more than 2 years in water (Pacciaroni et al., 2014; Nair and Medeot, 2014). The float was then send to NKE in France for maintenance and refurbishing.

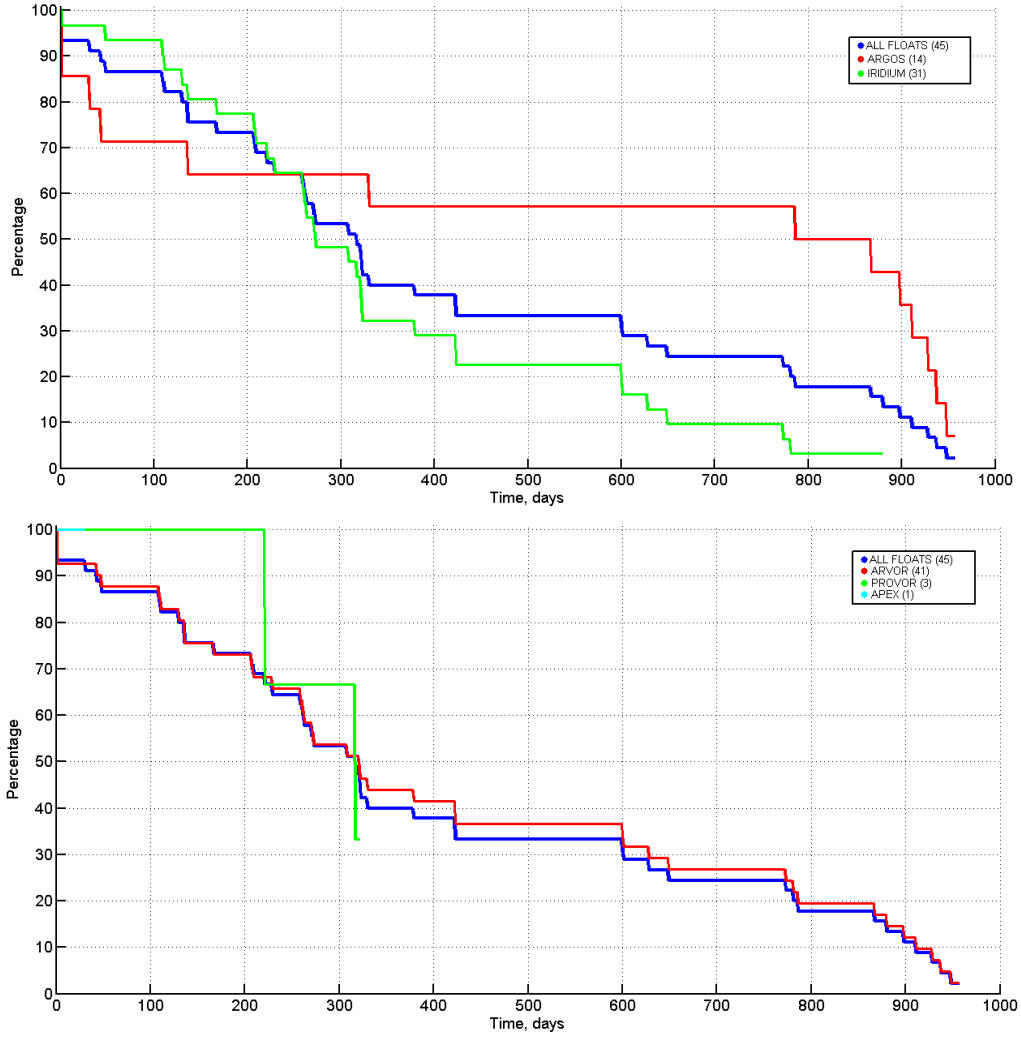

Figure 8. Survival rate diagram for all the ARGO-ITALY floats in the Mediterranean and Black seas, separated by transmission mode (top) and float type(bottom).

Year	2012	2013	2014	2012-2014
Deployments				
CTD floats deployed in Med	13	7	13	33
CTD floats deployed in BS	4	1	2	7
CTD floats deployed in SO and Atlantic	2	3	7	12
Bio floats deployed in Med	0	0	3	3
Total floats deployed	**19**	**11**	**25**	**55**
CTD profiles				
CTD profiles in Med	400	1099	1560	3059
CTD profiles in BS	105	236	323	664
CTD profiles in SO and Atlantic	6	90	205	301
Bio profiles	0	0	244	244
Total profiles	**511**	**1425**	**2332**	**4268**
Vertical distances (km)				
Distance in Med	440	902	1485	2827
Distance in BS	71	210	283	564
Distance in SO and Atlantic	2	125	380	507
Distance of bio floats	0	0	199	199
Total distance (km)	**513**	**1237**	**2347**	**4097**

Table 3. Statistical information on the performance of the ARGO-ITALY floats in 2012-2014.

3. SVP drifter activities in 2014

3.1 Drifter procurement

In 2014, a total of 60 SVP drifters with sea surface temperature (SST) sensors and GPS receivers were purchased from Pacific Gyre in Oceanside, California. Positions and SST are transmitted via the Iridium satellite system on a hourly basis.

3.2 Drifter deployments

In total, **28 SVP drifters** were deployed in the Mediterranean Sea in 2014. Since one drifter (Argos ID 116391) was recovered and deployed twice off Sardinia, there were 29 deployments.

During 2014, deployment activities continued in the Malta Channel in collaboration with colleagues from the University of Malta. Deployment positions were in the western part of the channel (north of Gozo island) in order to obtain surface current measurements to calibrate and validate HF radar observations collected in the Malta Channel as part of the EU Calypso project (http://oceania.research.um.edu.mt/cms/calypsoweb/index.php?option=com_content&view=article&id=71&Itemid=202&lang=en). Status information about these drifters are listed in Table 4. In total, six drifters were released in March 2014. They had Iridium telemetry.

Argos/IMEI	Deploy Date	Lat	Lon	Last Date	Lat	Lon	Status
a300234011044320	22-Mar-2014 06:00	36.15	14.26	23-Nov-2014 04:02	34.02	31.12	D
a300234011047330	22-Mar-2014 06:00	36.32	14.3	02-Jul-2014 14:00	31.47	17.3	D
c300234011043350	22-Mar-2014 07:00	36.5	14.37	20-Jun-2014 21:00	32.17	19.38	D
b300234011048330	22-Mar-2014 07:00	36.59	14.4	04-Aug-2014 13:07	31.93	16.79	D
a300234011047320	22-Mar-2014 06:00	36.23	14.28	13-Dec-2014 23:00	34.12	14.4	D
b300234011041330	22-Mar-2014 07:00	36.41	14.33	06-Aug-2014 12:00	33.85	10.16	D

Table 4. Status information for Italian drifters deployed in the central Mediterranean (Malta Channel) in 2014.

The drifters deployed in the Malta Channel revealed complex patterns of surface circulation in the Ionian Sea, Cretan Passage, and Levantine Basin, including sub-basin gyres, eddies, jet and also inertial motions (Fig. 9).

In 2014, we continued our collaboration with oceanographers from the Centre National de la Recherche Scientifique du Liban (CNRSL) as part of the ENVIMED-ALTIFLOAT project. Two drifters originally deployed off the Lebanese coast were recovered by colleagues from the Middle East Technical University (METU) of Mersin in Turkey. These colleagues kindly redeployed the drifters in the Cilician basin off Mersin, Turkey (see Table 5 and Fig. 10).

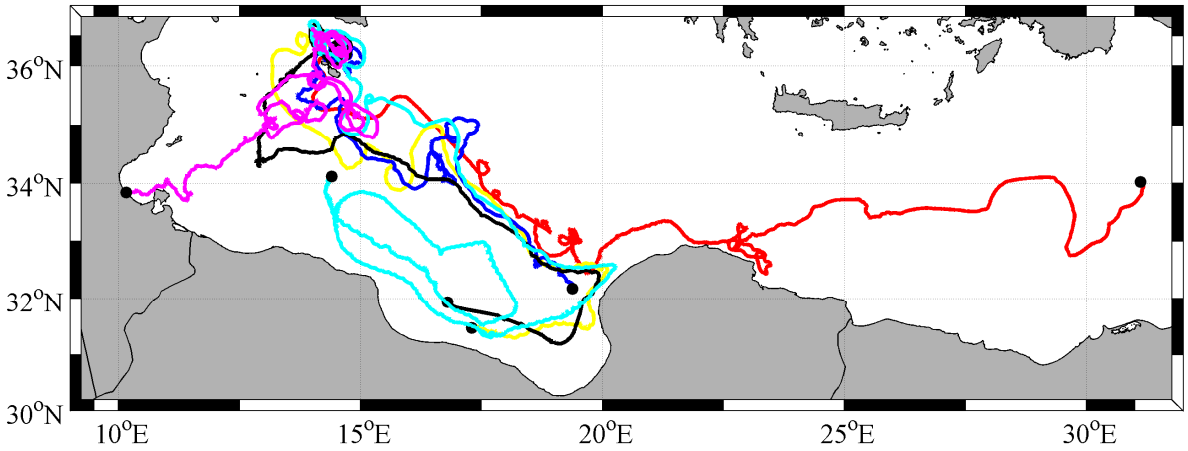

Figure 9. Trajectories and last positions (black dots) of the 6 Italian drifters deployed in the Malta Channel in March 2014.

Argos/IMEI	Deploy Date	Lat	Lon	Last Date	Lat	Lon	Status
b300234011915270	11-Mar-2014 08:34	36.5	34.36	08-Jul-2014 23:00	36.67	34.44	D
b300234011249440	04-Jun-2014 07:43	36.43	34.35	09-Jun-2014 15:00	36.12	34.85	D

Table 5. Status information for Italian drifters deployed in the Cilician Basin (South of Mersin in Turkey) in 2014.

In collaboration with the NATO Centre for Maritime Research and Experimentation (CMRE) in La Spezia, 5 drifters were released off western Sardinia from NRV Alliance in June 2014 during the REP14 sea trial (see Table 6 and Figs. 11 and 12). One drifter stranded on the southwestern Sardinian coast and was kindly redeployed off Oristano by colleagues from the Istituto per l'Ambiente Marino Costiero del Consiglio Nazionale delle Ricerche (IAMC-CNR) in October 2014 (see Fig.11, right panel).

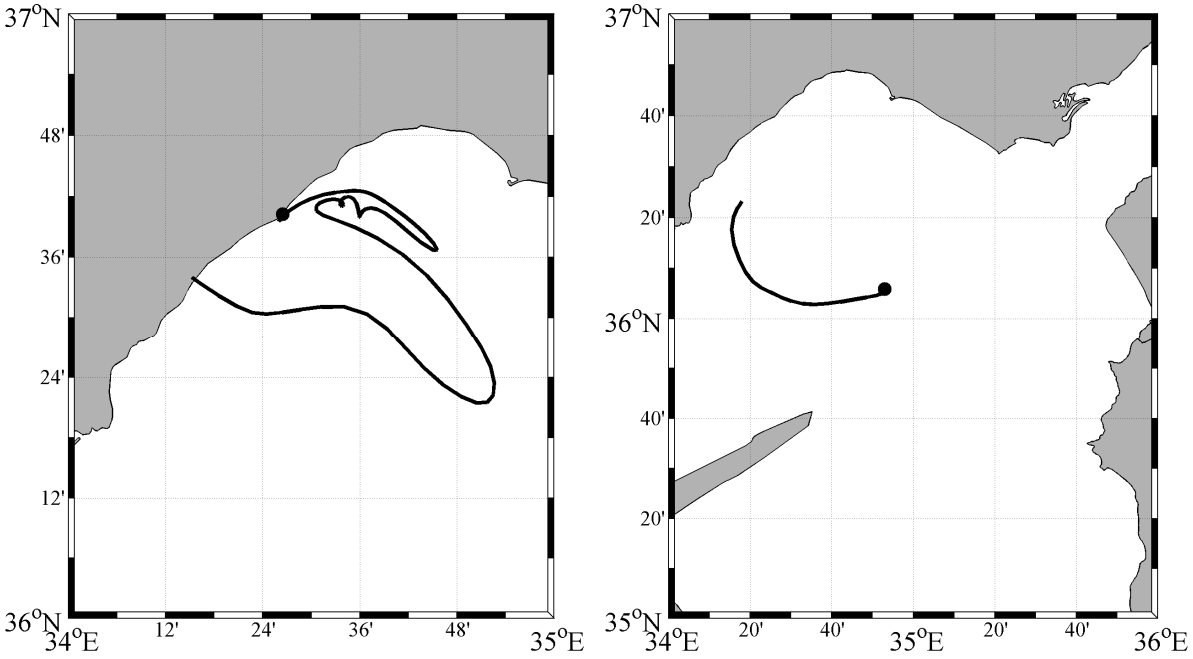

Figure 10. Trajectories and last positions (black dots) of the 2 Italian drifters redeployed off Mersin, Turkey in March 2014(left, IMEI b300234011915270) and in June 2014 (right, IMEI b300234011249440).

Argos/IMEI	Deploy Date	Lat	Lon	Last Date	Lat	Lon	Status
a116391	07-Jun-2014 14:23	39.8	7.37	04-Sep-2014 16:03	39.1	8.46	D
b116391	26-Oct-2014 10:15	40.01	8.25	08-Dec-2014 21:02	41.1	8.22	D
a116392	09-Jun-2014 01:37	39.9	7.37	18-Oct-2014 21:02	37.03	10.86	D
a116393	09-Jun-2014 14:30	39.99	7.37	09-Jul-2014 15:06	41.08	8.27	D
a116394	10-Jun-2014 22:31	40	7.37	25-Dec-2014 15:03	37.97	12.3	D
a116395	11-Jun-2014 02:01	40.2	7.37	03-Mar-2015 10:15	41.11	9.01	D

Table 6. Status information for Italian drifters deployed in the Western Mediterranean (West of Sardinia) in 2014. Drifter with ID a116395 was still alive in early 2015.

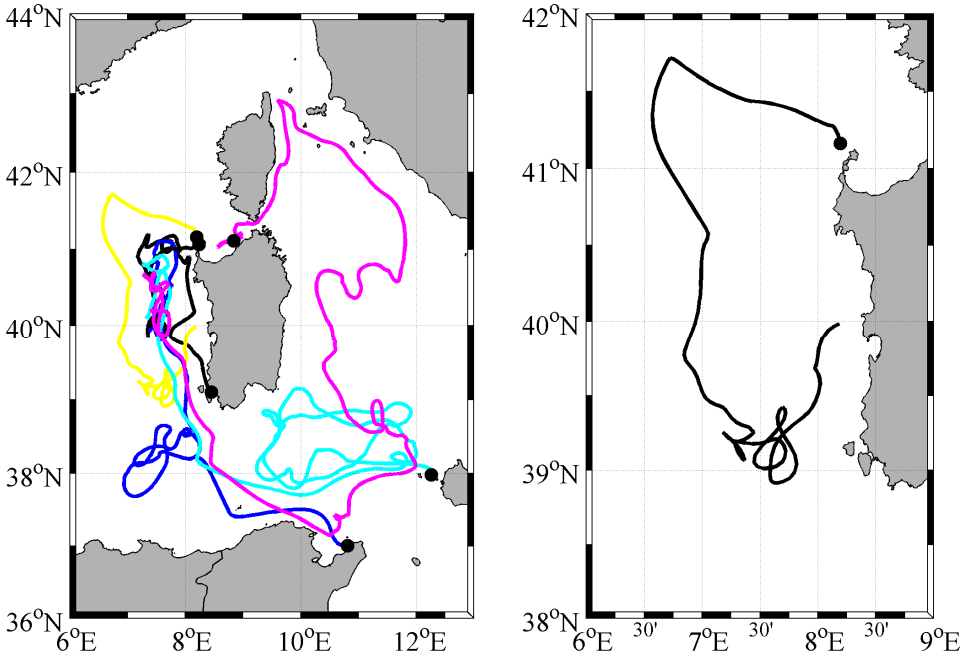

Figure 11. Trajectories and last positions (dots) of the 5 Italian drifters deployed west of Sardinia from NRV Alliance during REP14 in June 2014 (left) and of drifter 116391 which was redeployed in October 2014 (right).

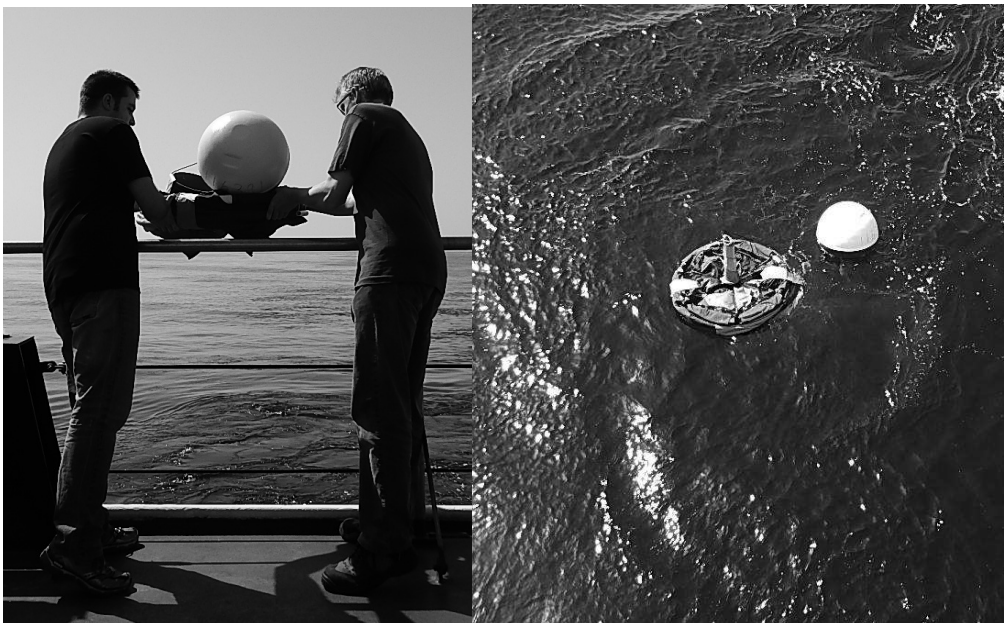

Figure 12. Photographs of drifter deployment from NRV Alliance in the Western Mediterranean off western Sardinia in June 2014: Drifter ready for deployment (left) and drifter in water with drogue about to sink (right)

As part of the EU FP7 PERSEUS project, Italian SVP drifters were released in the northern Ionian and eastern Alboran seas during the ADREX and ALBOREX campaigns, respectively.

A total of 10 drifters was deployed in the northern Ionian between 7 and 14 February 2014 (see Table 7 and Figs. 13 and 14). Their trajectories show a complex circulation patterns in the entire Ionian Sea and Cretan Passage. Several drifters ended up on the north African coast.

Argos/IMEI	Deploy Date	Lat	Lon	Last Date	Lat	Lon	Status
a116402	07-Feb-2014 17:50	37	16.5	16-Apr-2014 08:20	39.24	20.19	D
a116403	08-Feb-2014 16:25	36.99	17.5	14-May-2014 05:24	39.77	19.6	D
a116404	09-Feb-2014 20:16	36.98	18.48	08-Jul-2014 13:32	31.52	26.4	D
a116405	10-Feb-2014 09:27	36.99	19.47	23-Oct-2014 04:47	32.33	20.27	D
a116406	11-Feb-2014 07:30	36.99	20.52	26-Feb-2014 07:02	37.67	20.92	D
a116407	13-Feb-2014 04:10	38.51	19.49	25-Jul-2014 01:38	32.59	20.61	D
a116408	13-Feb-2014 19:15	38.53	18.47	26-Aug-2014 04:22	32.95	21.61	D
a116409	14-Feb-2014 03:44	38.5	17.46	19-Feb-2014 12:59	38.54	17.65	D
a116410	14-Feb-2014 08:18	39.25	18	27-Sep-2014 08:30	32.73	20.95	D
a116411	14-Feb-2014 11:56	39.58	18.78	02-May-2014 18:16	39.62	16.63	D

Table 7. Status information for Italian drifters deployed in the northern Ionian Sea during ADREX in February 2014.

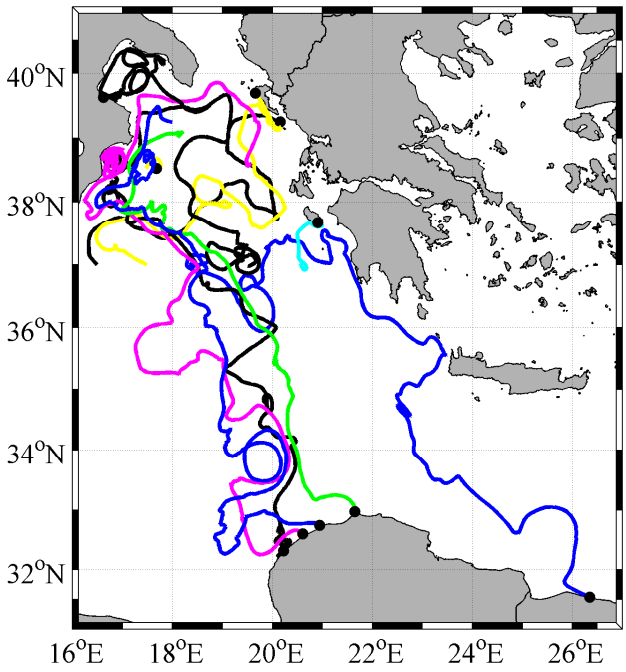

Figure 13. Trajectories and last positions (dots) of the 10 Italian drifters deployed in the northern Ionian Sea during the ADREX campaign in February 2014.

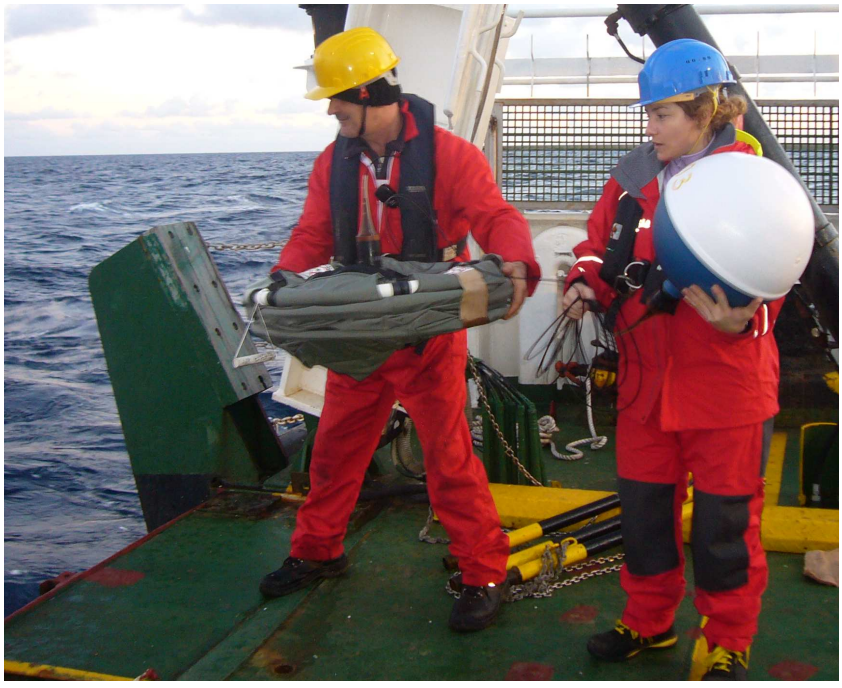

Figure 14. Deployment of an SVP drifter during the ADREX campaign from R/V OGS Explora in the northern Ionian Sea in February 2014.

Five Italian drifters were deployed in the eastern Alboran Sea during the ALBOREX campaign on 25 May 2014 (see Table 7 and Figs. 15 and 16).

Argos/IMEI	Deploy Date	Lat	Lon	Last Date	Lat	Lon	Status
a116396	25-May-2014 16:07	37.08	-0.8	22-Nov-2014 18:00	0	0	D
a116397	25-May-2014 16:16	37.11	-0.8	03-Apr-2015 03:35	38.06	3.57	A
a116398	25-May-2014 16:26	37.07	-0.83	04-Nov-2014 04:52	41.2	1.75	D
a116399	25-May-2014 16:36	37.08	-0.83	28-May-2014 20:16	36.83	-0.12	D
a116401	25-May-2014 16:46	37.06	-0.83	02-Apr-2015 13:28	37.04	11.07	A

Table 8. Status information for the Italian drifters deployed in the Western Mediterranean (Eastern Alboran Sea) in 2014. Two drifters were still alive in April 2015.

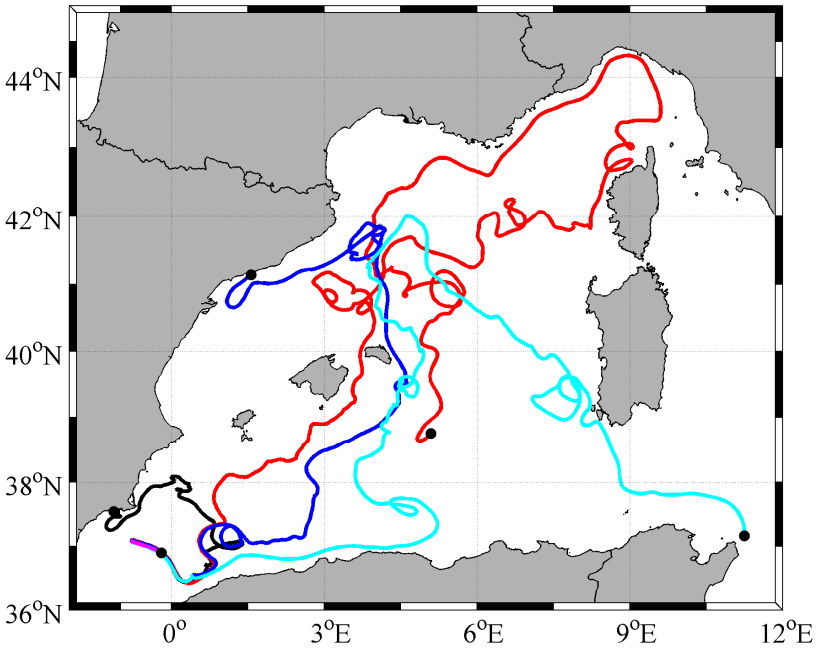

Figure 15. Trajectories and last positions (dots) of the 5 Italian drifters deployed in the eastern Alboran Sea during the ALBOREX campaign in May 2014.

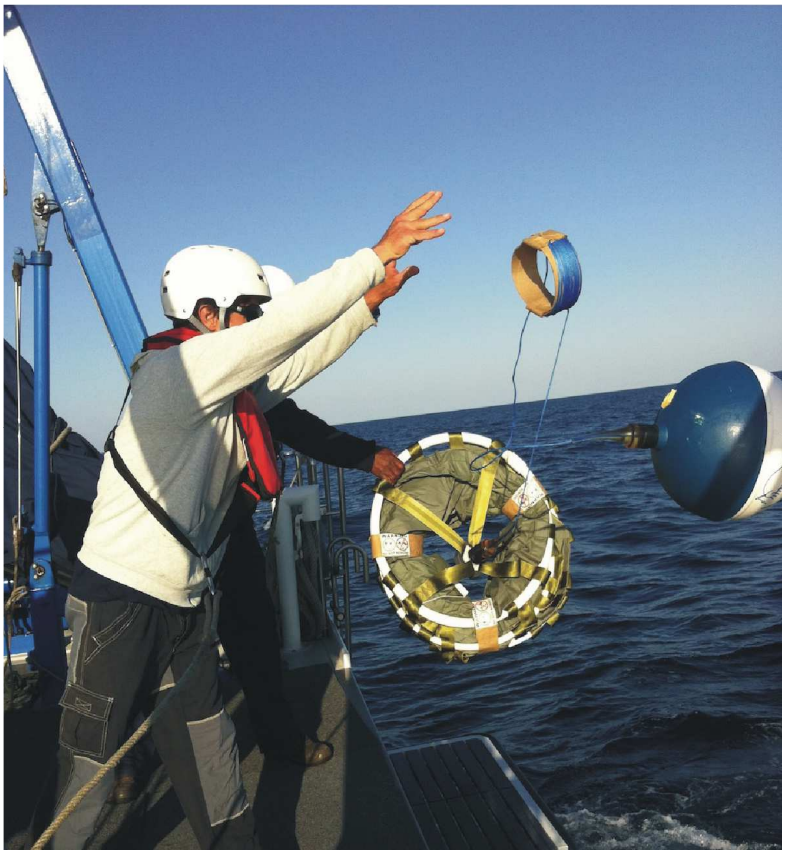

Figure 16. Deployment of an SVP drifter from R/V SOCIB during the ALBOREX campaign in May 2014.

The SeaGlider “Amerigo” was tested in the Gulf of Trieste in order to check its

performances in very shallow waters. The factory suggests to operate this glider in

40 m of water depth at least.

The tests carried out in the Gulf in June 2014 (max depth 23 m) demonstrate that the SeaGlider, if used with the standard parameters interrupts the test mission with an abort due to overtime and it remain flat (Fig. 17). After proper setting of the altimeter or eventually disabling it, let the glider navigate even in 20 m of water depth (Fig. 18).

The communication with the backup station were also tested successfully.

4. Glider activities in 2014

4.1 Glider procurement

No glider was purchased in 2014.

4.2 Glider testing

The SeaGlider "Amerigo" was tested in the Gulf of Trieste in order to check its performances in very shallow waters. The factory suggests to operate this glider in at least 40 m of water depth.

The tests carried out in the Gulf (maximal depth of 23 m) in June 2014 demonstrate that the SeaGlider, if used with the standard parmeters, interrupts its test mission with an abort due to overtime and it remains at surface quasi horizontally (Fig. 17). After proper setting of the altimeter, or eventually disabled it, the glider can navigate effectively in 20 m of water depth (Fig. 18).

The communication with the backup station were also tested successfuly.

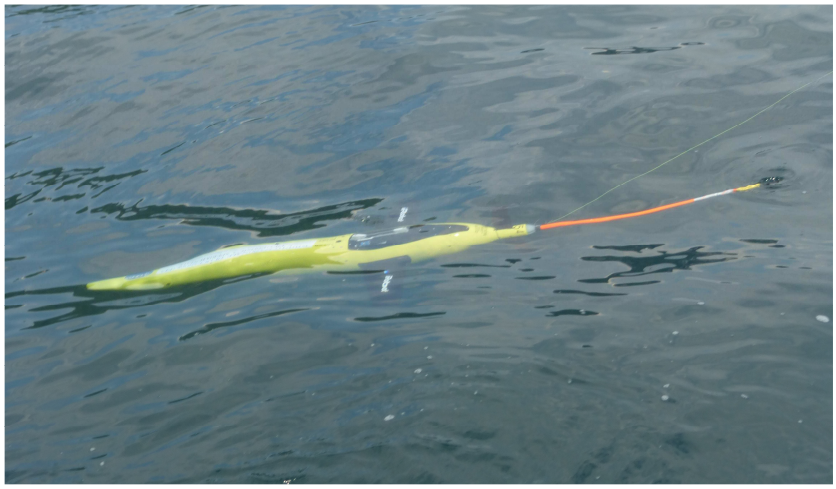

Figure 17. SeaGlider at surface (in quasi horizontal position) during the tests carried out in the Gulf of Trieste in June 2014.

The Slocum gliders have to be ballasted for the mean surface water density of the area of study. A detailed procedure was refined and adopted (Gerin and Zuppelli, 2014). Dedicated worksheets were developed in order to simplify the procedures.

The two Slocum gliders were ballasted for the Gulf of Trieste water and tested after the upgrading of their firmware (Gerin and Bussani, 2014) and after the setup of the backup station. In particular, Unit 403 "Leonardo" and Unit 402 "Galileo" were successfully tested in September and in December 2014, respectively (Fig. 19).

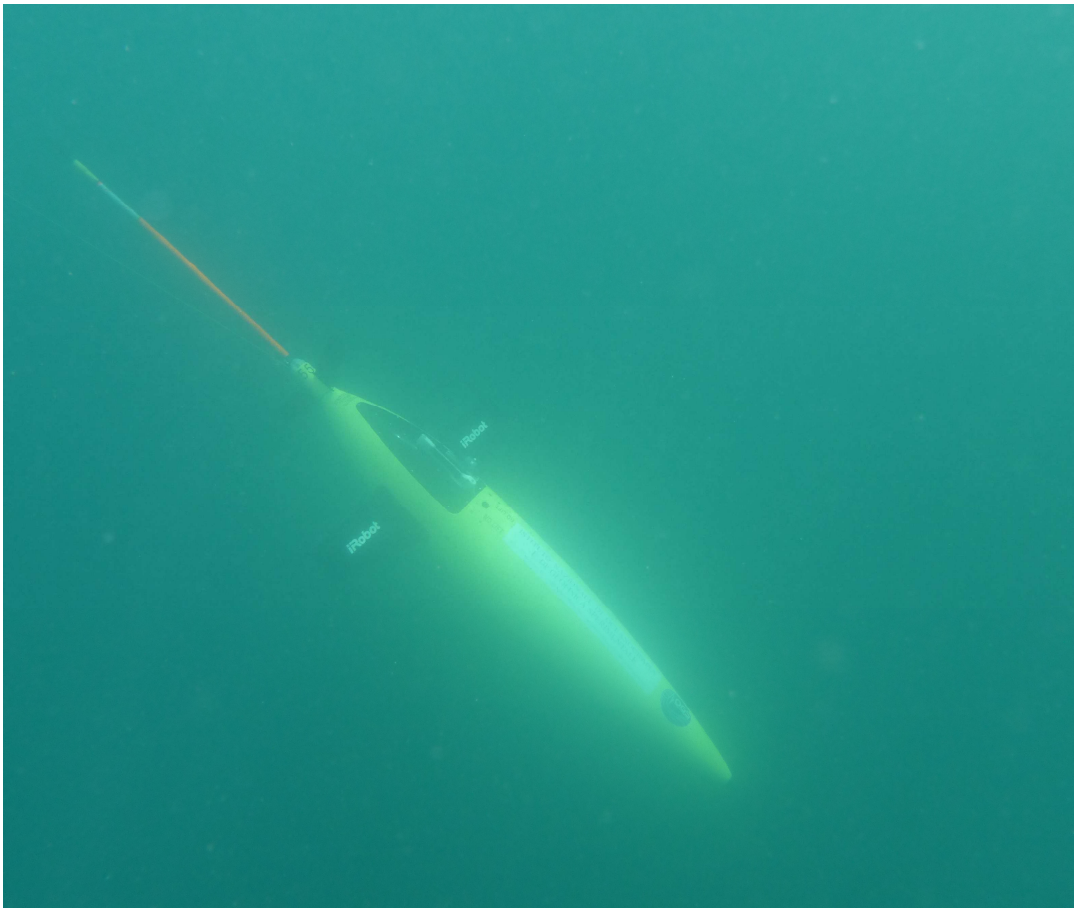

Figure 18. SeaGlider navigating in the Gulf of Trieste in June 2014.

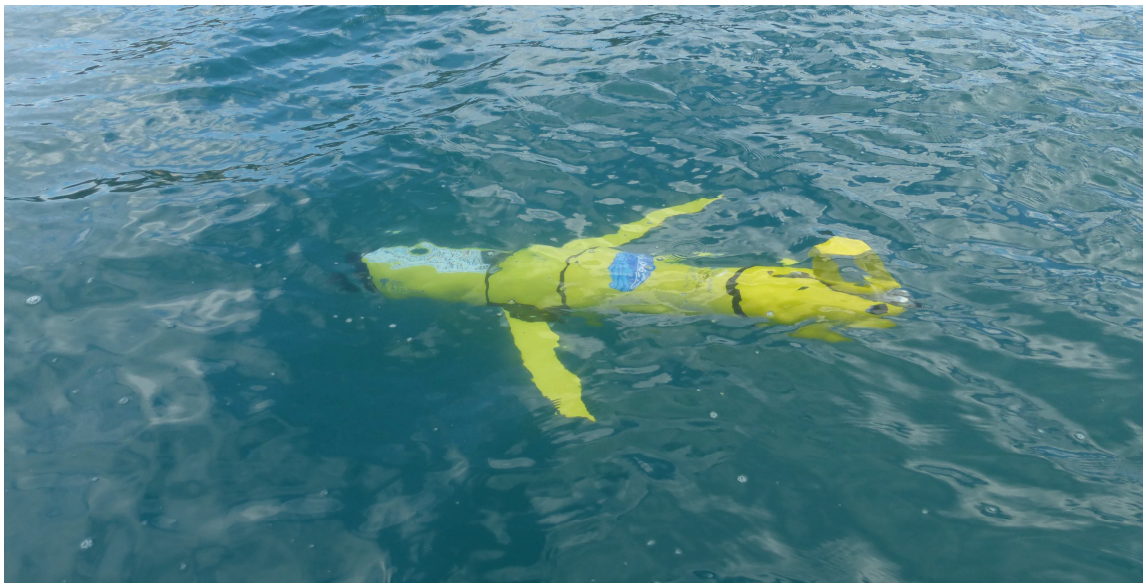

Figure 19. Slocum glider"Leonardo"tested in the Gulf of Trieste in December 2014.

4.3 Glider laboratory

In 2014, OGS began the procedure to install a small overhead travelling crane over the ballasting tank to facilitate operations with gliders. Consumable goods were purchased for the OGS glider laboratory. The SeaGlider "Amerigo" was sent to the factory for battery replacement, for sensor calibration and firmware upgrade.

4.4 Glider operations

In late winter 2014 the OGS SeaGlider "Amerigo" was successfully operated for 3 weeks (from 15 February to 6 March 2014) in the Southern Adriatic Sea (Fig. 20). The purpose of the CONVEX14 experiment was to study the winter deep water convection in the area. The glider at first covered the transect Molfetta – Dubrovnik and then it was piloted to perform an Adriatic longitudinal transect, down to almost 1000 m depth in the area of the south-Adriatic pit (Fig. 21). At the end of the mission a butterfly sampling was performed close to the OGS E2-M3A mooring.

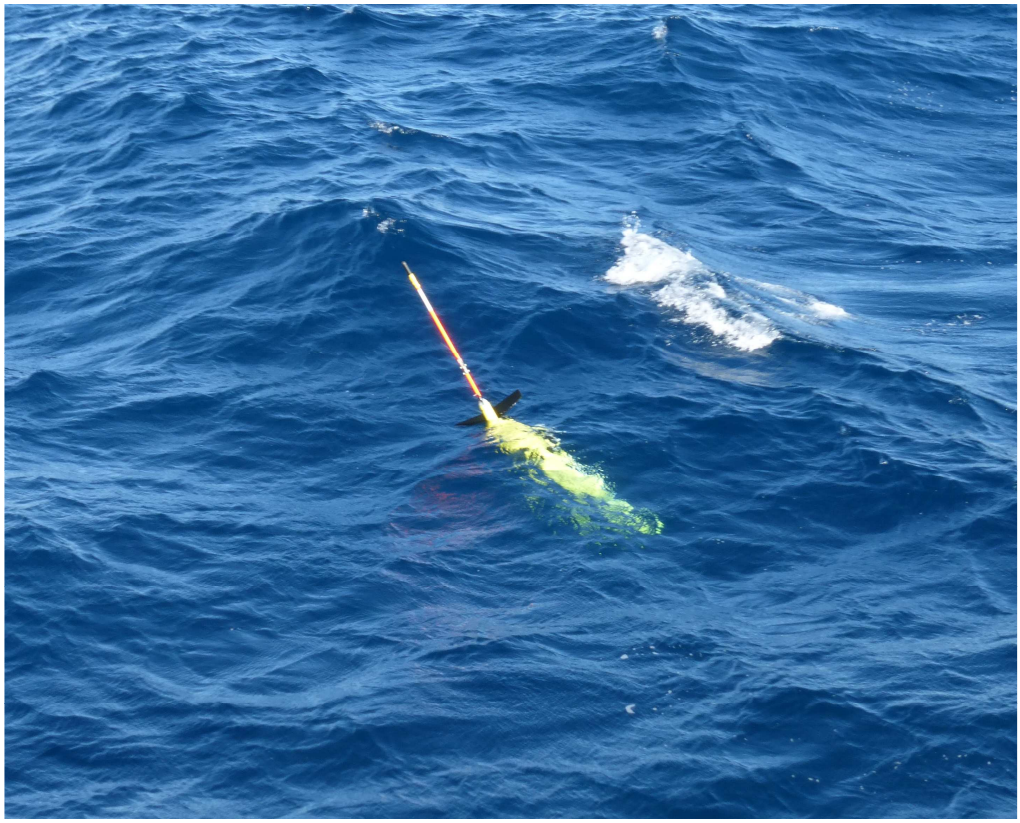

Figure 20. Photographs of the "Amerigo" Seaglider at deployment, while transmitting at the surface.

Figure 21. Track of the "Amerigo" Seaglider in the southern Adriatic Sea between 15 February and 6 March 2014. The glider symbol indicates the last position.

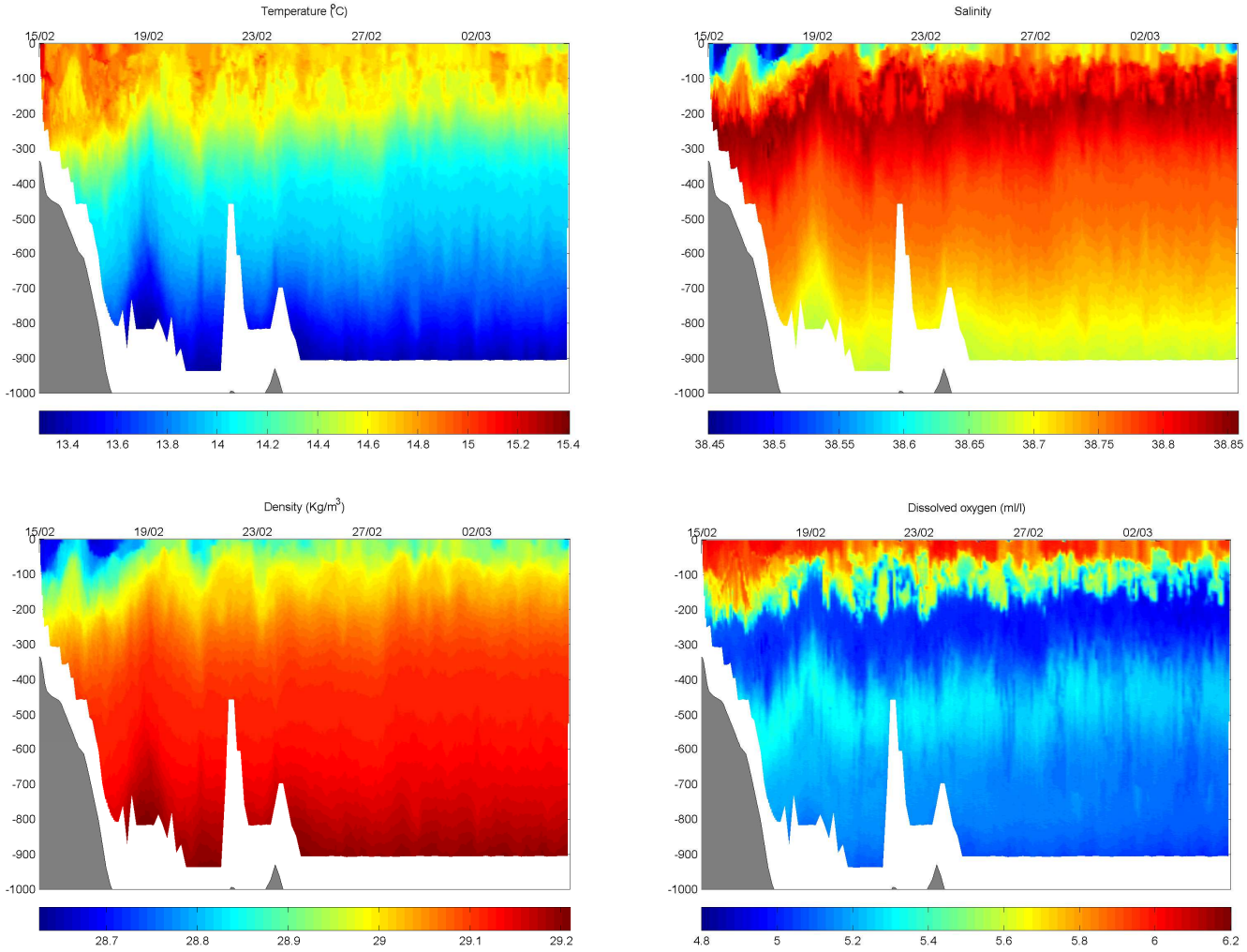

Figure 22. Color-coded vertical section along the glider path of temperature (top-left), salinity (top-right), density (bottom-left) and dissolved oxygen (bottom-right) during the CONVEX14 experiment (15 February – 6 March 2014).

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 (Fig. 22): http://nettuno.ogs.trieste.it/jungo/argoitaly/gliders.html (direct link: http://nettuno.ogs.trieste.it/sire/glider/sg554/sg554_scientific_panel.php), 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) recomendations to provide a unique and coherent data set in terms of format and quality.

5. Other activities in 2014

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 Telecomunication 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/).

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 18 floats. OGS also carried out the DMQC of all the floats operated in the Mediterranean Sea as part of the EC FP7 MyOcean-2, MyOcean-FO, E-AIMS and PERSEUS projects. The temperature and salinity data of 124 floats were quality controlled following the standard Argo procedure, covering the period 2000-2012. 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 2014.

The following papers involving Italian scientists were published in 2014. They use Argo data for basic oceanographic research and operational oceanography purposes.

Gacic M., Civitarese G., Kovacevic V., Ursella L., Bensi M., Menna M., Cardin V., Poulain P.-M., S. Cosoli, G. Notarstefano, and Pizzi C., 2014: Extreme winter 2012 in the Adriatic: an example of climatic effect on the BiOS rhythm. Ocean Sci., 10(3), 513-522, doi:10.5194/osd-11-425-2014.

Lacorata, G., L. Palatella, and R. Santoleri, 2014: Lagrangian predictability characteristics of an Ocean Model, Journal of Geophysical Research: Oceans, 119(11), 8029-8038, http://dx.doi.org/10.1002/2014JC010313.

Marullo, S., R. Santoleri, D. Ciani, P. Le Borgne, S. Péré, N. Pinardi, M. Tonani, and G. Nardone, 2014: Combining model and geostationary satellite data to reconstruct hourly SST

field over the Mediterranean Sea, Remote Sens. Environ., 146(0), 11-23, http://www.sciencedirect.com/science/article/pii/S0034425713004069.

Rio, M. H., A. Pascual, P. M. Poulain, M. Menna, B. Barceló, and J. Tintoré, 2014: Computation of a new mean dynamic topography for the Mediterranean Sea from model outputs, altimeter measurements and oceanographic in situ data, Ocean Sci., 10(4), 731-744, http://www.ocean-sci.net/10/731/2014/.

5.4 OGS technical reports related to ARGO-ITALY published in 2014.

Bussani A. (2014) Uso dello script per generazione txt/kml e spedizione e-mail/sms per segnalazione posizione glider iRobot Rel. OGS 2014/21 Sez. OCE 5 MAOS dd. 26/03/2014.

Bussani A. and Gerin R. (2014) Prodotti web e notifiche a supporto delle operazioni di recupero dei drifter OGS 2014/56 Sez. OCE 19 MAOS .

Gerin R. and Bussani A. (2014) Updating Slocum glider firmware from release 7.13 to release 7.15 (july 2014) - Rel 2014/52 OCE 17 MAOS.

Gerin R., Bussani A. and Notarstefano G. (2014) Sistema di trattamento dei dati drifter - Ritmare: SP5_WP5_AZ3_UO01_D1.

Gerin R. and Zuppelli P. (2014). How to ballast a Slocum glider in a tank: the detailed procedure. REL. OGS 2014/70 OCE 23 MAOS, Trieste, Italy, 15 pp.

Gerin R., Zuppelli P. and Bussani A.(2014) Drifter activity in Medess4ms, serious game experiment, 16-25may 2014 Rel. 2014/40 OCE 11 MAOS.

Mauri E., Gerin R., Bussani A. e Zuppelli P. (2014) Report sul design e stato di avanzamento del laboratorio glider e del sistema di gestione dei dati glider SP5_WP5_AZ2_UO02_D02.

Nair R. and N. Medeot (2014) Post-deployment evaluation and recalibration of temperature and conductivity sensors on NKE ARVOR float CTDs, Activity Report, rel. 2014/76 OCE 28 CTO-TECDEV.

Notarstefano G. (2014) Assessment of temperature and salinity data obtained from in-situ platforms in the Mediterranean and Black Sea (historical data from 1990 to 2012) 2014/10 Sez. OCE 2 MAOS.

Notarstefano G. (2014). Pre-deployment operations of a Provbio II float. 2014/86 Sez. OCE 31 MAOS.

Pacciaroni M., Poulain P.-M., Notarstefano G., Nair R, Medeot N. (2014) Argo float WMO 6901041 mission and CTD calibration. Rel. OGS 2014/87 OCE 32 MAOS.

Poulain P.-M., Menna M., Notarstefano G. and Bussani A. (2014) Lagrangian measurements in Alborex 2014 campaign Rel. OGS 2014/53 OCE 18 MAOS.

Poulain P.-M., Gerin R., Mauri E., Menna M., Notarstefano G., Jungwirth R., Bussani A., Zuppelli P. and Pacciaroni M. (2014) ARGO-ITALY: Annual report 2013 Rel. OGS 2014/39 OCE 10 MAOS.

Zu Z., Poulain P.-M. and Notarstefano G. (2014) Changes in hydrological properties of the Mediterranean Sea over the last 40 years with focus on the Levantine Intermediate Water and the Atlantic Water 2014/74 Sez. OCE 26 MAOS.

6. Plans for 2015 and beyond

6.1 Floats

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

- 20 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.

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	
2015	15 2 10	Mediterranean Black Sea Southern Ocean	2 1	Mediterranean Black Sea	**30**
2016	14 1 10	Mediterranean Black Sea Southern Ocean	3 2	Mediterranean Black Sea	**30**
2017	14 1 10	Mediterranean Black Sea Southern Ocean	3 2	Mediterranean Black Sea	**30**

Table 9. Italian float deployment plans for 2015-2017.

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 30 SVP drifters with Iridium telemetry.

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

Year	SVP drifters	
	Quantity	Area
2015	10	Southern Ocean
	30	Mediterranean
2016	10	Southern Ocean
	20	Mediterranean

Table 10. ARGO-ITALY drifter deployment plans for 2015-2016.

6.3 Glider

The OGS SLOCUM gliders are planned to be operated in northern Adriatic (in front of the Karner Bay) in winter 2015. It will be used again in winter/spring 2015 in the southern Adriatic to monitor the dense water formation.

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 will have funding from new EC projects (for instance the DG MARE MOCCA project), for multiple activities (technical development, data management, capacity building and training, EuroArgo strategy, etc.) 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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The Italian Coast Guards