

ARGO-ITALY: ANNUAL REPORT 2012



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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, and the Mediterranean and Black seas, 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 MOON (Mediterranean Operational Oceanography Network) and MyOcean (FP7 European project) and is essential for the production of marine core and downstream services products of 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.

This report summarizes the activities of ARGO-ITALY in 2012 in terms of procurements of the instruments, their preparation and their deployments. Information about data processing and archiving is also given, along with details on related activities like the attribution of sub-contracts for small research programs using ARGO-ITALY data and the development of a dedicated ARGO-ITALY web site. Plans for 2013 are included in the last section.

2. The ARGO-ITALY web site

A dedicated web site was first 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.inogs.it .



Figure 1. Main page of the Argo-Italy web site (www.argoitaly.inogs.it).

3. Argo float activities in 2012

3.1 Float procurement

The following Argo floats were purchased in 2011-2012 with funds of ARGO-ITALY:

1. Twelve (12) Arvor-L floats from NKE, Lorient, France. The Arvor-L uses the standard Argos system for positioning and data transmission. It is similar to the Arvor, except that it is lighter (18 kg versus 20 kg) and has less autonomy (max number of cycles of 160 instead of 255). However, it is more economical.
2. Twenty (20) Arvor-I floats from NKE, Lorient, France. This float uses the Iridium global telephone network for data telemetry and has a GPS receiver for position.

All these instruments are equipped with SeaBird CTD for the measurements of pressure, temperature and conductivity. Salinity is calculated from these parameters.



Figure 2. Photograph of an ARVOR-L float, with the CTD sensors and Argos antenna at the top and blader (to change buoyancy) at the bottom.

3.2 Float deployments

In total, 19 Italian floats were deployed in 2012 (see Tables 1 to 3 for details). These floats were Arvor designs manufactured by NKE (France), some with Iridium (Arvor-I) and others with Argos telemetry (Arvor-L). In the Mediterranean, 13 units were deployed (Table 1) but unfortunately two of them (WMO 6901039 and 6901820) never transmitted data after deployment, despite normal and positive test and deployment procedures. Except for these 2 floats, all the other instruments are still operating at the end of February 2013. They have a parking depth at 350 dbars and profiling depths alternating at 700 and 2000 dbars. They all have cycles of 5 days, except WMO 6901044 which is cycling at daily intervals in the Malta Channel. Most floats were deployed from research vessels of opportunity, including R/V Nase More (Fig. 3), Pourquoi Pas, Urania and Explora, with the help of colleagues from Croatia, France, Italia, Cyprus and Malta. In total 572 CTD profiles have been obtained in the Mediterranean Sea with Argo-Italy floats between 10 March 2012 and 26 February 2013.



Figure 3. Deployment of an Arvor-L float in the southern Adriatic Sea in March 2012 by Croatian colleagues onboard R/V Nase More.

<u>Model</u>	<u>WMO</u>	<u>Deploy Date</u>	<u>Lat</u>	<u>Lon</u>	<u>Cycles</u>	<u>Last Date</u>	<u>Lat</u>	<u>Lon</u>	<u>Status</u>
Arvor-L	6901039	18-Feb-2012 12:00	42.25	17.75	0	18-Feb-2012 00:00	0	0	D
Arvor-L	6900979	10-Mar-2012 20:18	38.98	18.31	71	25-Feb-2013 12:29	38.23	18.57	A
Arvor-L	6900980	13-Mar-2012 18:17	40	12.66	70	26-Feb-2013 07:46	38.79	10.39	A
Arvor-L	6900978	16-Mar-2012 11:41	39.4	14.01	73	26-Feb-2013 07:45	39.39	11.68	A
Arvor-L	6900981	17-Mar-2012 03:09	40.76	10.9	69	22-Feb-2013 13:02	39.15	16.01	A
Arvor-L	6901040	29-Mar-2012 15:51	42.22	17.72	66	24-Feb-2013 12:54	42.18	16.97	A
Arvor I - 2	6901041	03-Aug-2012 02:30	41.17	11.75	41	26-Feb-2013 00:16	42.02	10.52	A
Arvor I - 2	6901042	04-Aug-2012 01:25	43.02	9.08	39	22-Feb-2013 00:19	43.96	8.57	A
Arvor I - 2	6901043	18-Sep-2012 15:29	33.58	31.98	31	22-Feb-2013 00:28	32.58	33.79	A
Arvor I - 2	6901817	11-Nov-2012 13:23	34.96	22.64	23	26-Feb-2013 00:09	34.61	21.52	A
Arvor I - 2	6901820	14-Nov-2012 11:22	38.65	17.25	0	14-Nov-2012 11:32	36.36	14.3	D
Arvor I - 2	6901818	19-Nov-2012 05:34	35.9	22.91	19	24-Feb-2013 00:11	34.94	21.87	A
Arvor I - 2	6901044	14-Dec-2012 16:40	36.29	14.3	70	26-Feb-2013 00:13	0	0	A

Table 1. Status information for the 13 Italian floats deployed in the Mediterranean Sea during 2012.

Four Italian floats were deployed in the Black Sea in 2012 (Table 2) with the help of Bulgarian colleagues. They were released in the southwestern Black Sea from R/V Akademik (Fig. 4). One of them (WMO 6901960) stranded on the Bulgarian coast after 26 cycles. It was recovered, refurbished and is now ready to be re-deployed. The other floats are still collecting data as of the end of February 2013. All floats have a parking depth at 200 dbars and execute alternating CTD profiles from 700 and 1500 dbars. The cycling period is 5 days. In total, more 140 CTD profiles have been obtained in the Black Sea with Argo-Italy floats between 8 June 2012 and 25 February 2013.



Figure 4. Arvor-L onboard R/V Akademik ready to be deployed in the Black Sea in June 2012.

<u>Model</u>	<u>WMO</u>	<u>Deploy Date</u>	<u>Lat</u>	<u>Lon</u>	<u>Cycles</u>	<u>Last Date</u>	<u>Lat</u>	<u>Lon</u>	<u>Status</u>
Arvor-L	6901959	08-Jun-2012 09:36	43.47	30.09	53	25-Feb-2013 12:28	43.31	33.44	A
Arvor-L	6901960	09-Jun-2012 08:03	43.17	29.66	26	22-Oct-2012 19:37	42.3	27.79	D
Arvor-L	6901962	17-Aug-2012 01:50	43.42	30.17	39	25-Feb-2013 12:29	41.34	38.15	A
Arvor-L	6901961	06-Nov-2012 18:07	43.15	30.77	22	21-Feb-2013 13:14	41.59	31.14	A

Table 2. Status information for the 4 Italian floats deployed in the Black Sea during 2012.

The locations of the Italian floats still operating in the Mediterranean and Black seas at the end of February 2013 are shown in Fig. 5. They are also shown in Fig. 6 along with most of the floats alive in these marginal seas. It can be seen that ARGO-ITALY has now an important contribution with respect to other countries. The trajectories of the floats between their deployment and the end of February 2013 are shown in Fig. 7.

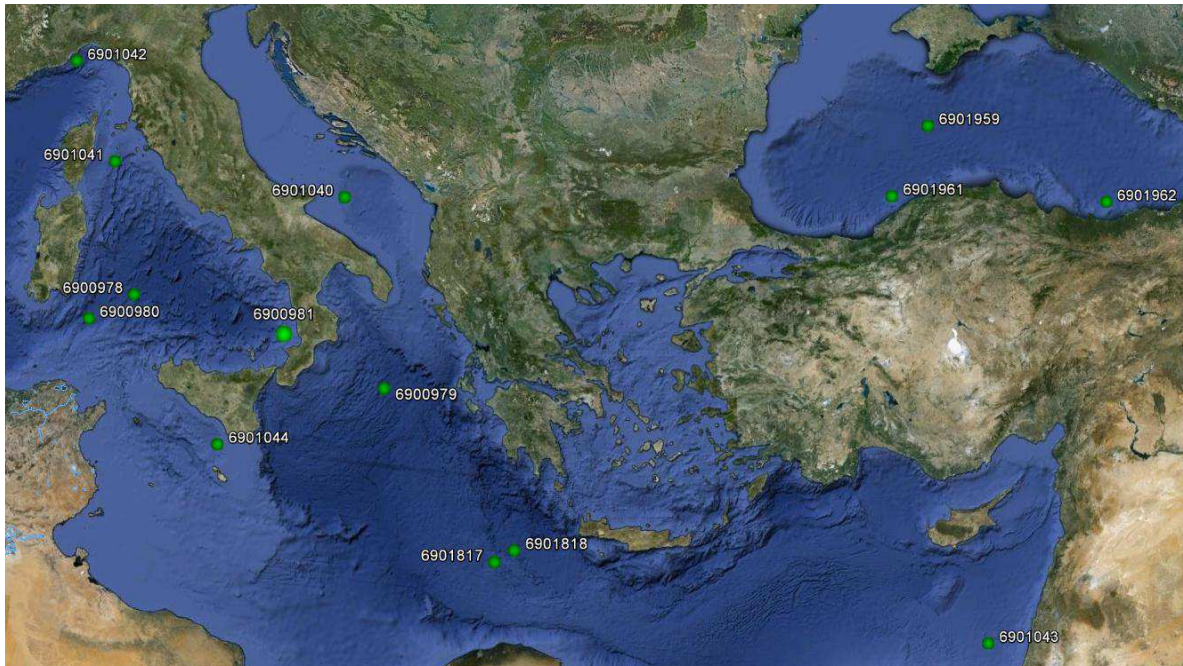


Figure 5. Positions of the 14 Italian floats operating in the Mediterranean Sea (11 instruments) and Black Sea (3 instruments) in late February 2013. The floats are identified by they WMO numbers.

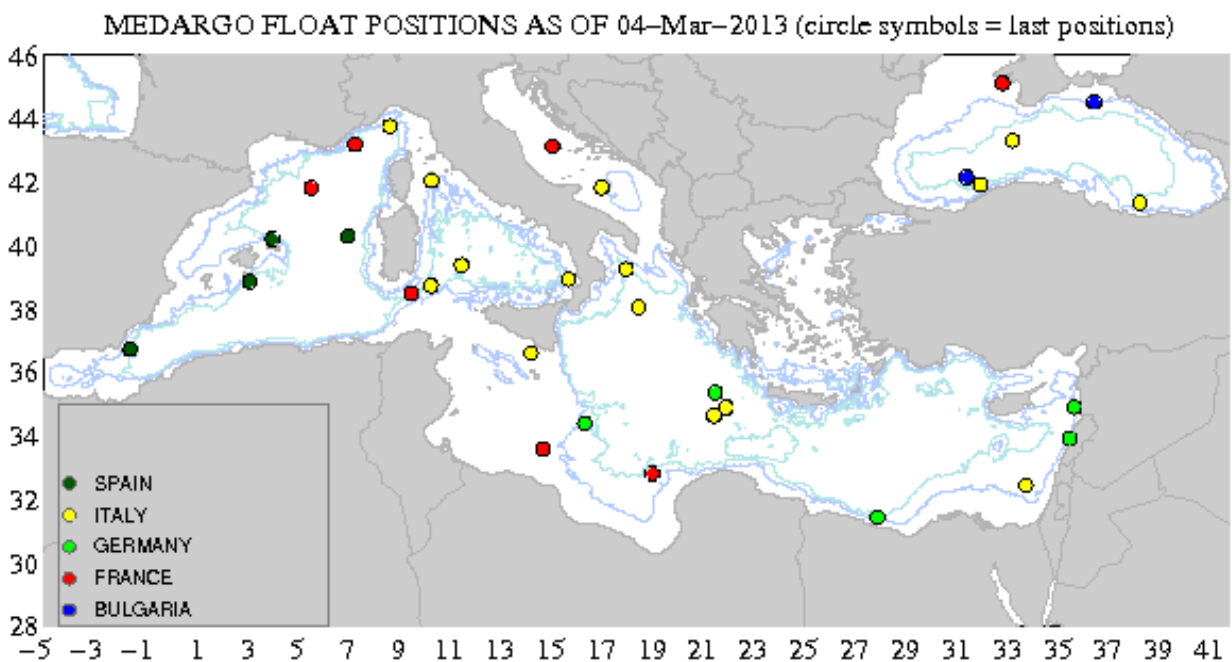


Figure 6. Positions of most of the Argo floats operating in the Mediterranean and Black seas in late February 2013. The floats are color-coded by contributing countries (map available on the Medargo web site: <http://nettuno.ogs.trieste.it/sire/medargo>)

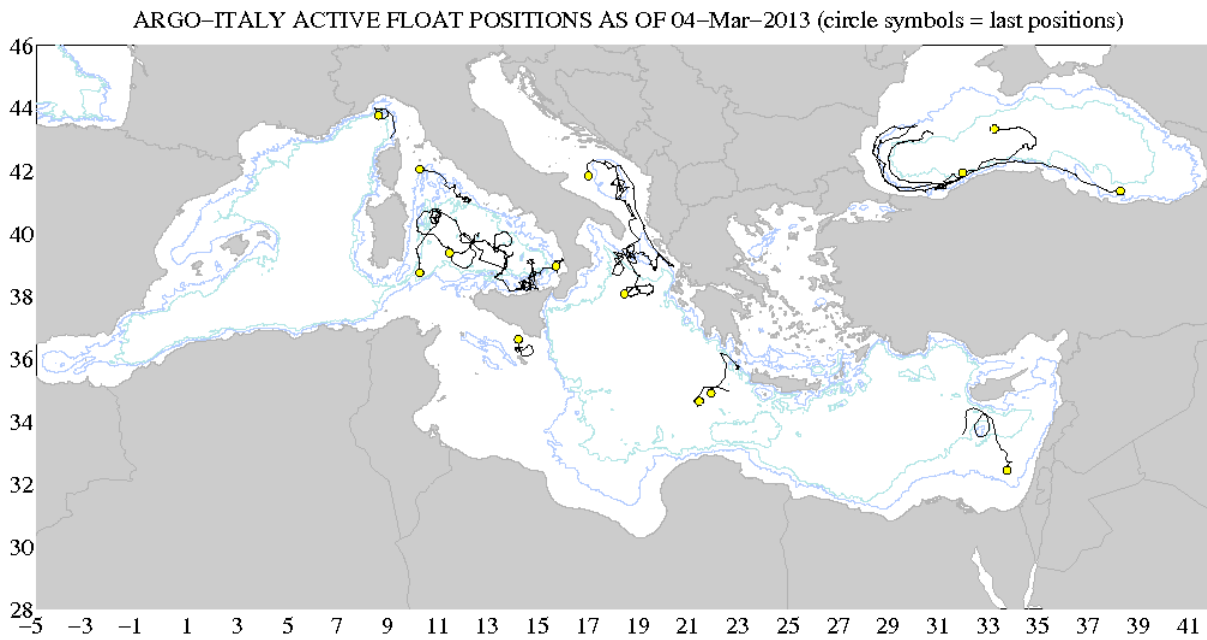


Figure 7. Trajectories and last positions (yellow circles) of the 14 Italian floats operating in the Mediterranean and Black seas in late February 2013. The floats are identified by their WMO numbers.

Two Italian floats were deployed in the northeastern tropical Atlantic Ocean off Senegal in 2012 (Table 3) with the help of French and Senegalese colleagues onboard R/V Le Suroit (Fig. 8). Unfortunately, float WMO 6900983 was incorrectly turned on and was deployed in “end of mission” mode. It stayed at surface and was eventually lost. The other float (WMO 6900982) executed successfully 6 cycles before stranding and being picked up on the Senegalese coast (Fig. 9). The float was recovered and shipped back to NKE for repair and refurbishing. These floats were programmed as follows: 10-day cycles, parking at 1000 dbars and maximal profiling depth of 1500 dbars.



Figure 8. Arvor-L onboard R/V Le Suroit ready to be deployed off Senegal in March 2012.

<u>Model</u>	<u>WMO</u>	<u>Deploy Date</u>	<u>Lat</u>	<u>Lon</u>	<u>Cycles</u>	<u>Last Date</u>	<u>Lat</u>	<u>Lon</u>	<u>Status</u>
Arvor-L	6900982	08-Mar-2012 01:04	14.86	-17.62	6	19-Apr-2012 14:17	14.68	342.53	D
Arvor-L	6900983	11-Mar-2012 08:30	14.34	-17.66	0	11-Mar-2012 08:30	0	0	D

Table 3. Status information for the 2 Italian floats deployed off West Africa during 2012.



Figure 9. Trajectory and profile positions (end position in yellow) of the Italian float (WMO 6900982, Argos 114261) deployed in the Atlantic Ocean off Dakar, Senegal.

4. SVP drifter activities in 2012

4.1 Drifter procurement

The following surface drifters were purchased with ARGO-ITALY funding:

1. Thirty (30) SVP drifters manufactured by MeteOcean, Dartmouth, Canada. SVP drifters have a holey-sock drogue at a nominal depth of 15 m and a sensor to measure drogue loss (strain gauge in or near the tether attachment) and sea surface temperature. They are equipped with GPS receivers to measure positions at hourly intervals and use the Iridium global telephone network for transmitting the data. Fig. 10 shows some SVP drifters stored on the deck of R/V Explora before deployments in the Ionian Sea.



Figure 10. Six Metocean SVP drifters are waiting to be deployed on the deck of R/V Explora.

4.2 Drifter deployments

Six (6) drifters were deployed in December 2012 in the Malta Channel by colleagues from the University of Malta. Deployment positions were about equally spaced across 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?lang=en>). Status information about these drifters are listed in Table 4. In early March 2013, three drifters were still alive and providing data in the Ionian Sea.

Two drifters (IMEI 46330 and 43350) were picked up by fishermen before the end of the year 2012, were taken on land in Malta and were recuperated by our colleagues of the University of Malta. They are in good condition and can be re-deployed at the next opportunity. One drifter (IMEI 45320) stopped transmitting for unknown reason less than a month after deployment. The trajectories of these drifters in the Malta Channel are shown in Fig. 11. The drifters revealed a remarkable anticyclonic circulation within the channel.

Argos/IMEI	Deploy Date	Lat	Lon	Last Date	Lat	Lon	Status
a300234011043330	14-Dec-2012 14:50	36.14	14.26	04-Mar-2013 13:00	32.91	18.61	A
a300234011045320	14-Dec-2012 15:40	36.22	14.28	10-Jan-2013 13:00	36.23	13.27	D
a300234011249430	14-Dec-2012 16:40	36.29	14.3	04-Mar-2013 13:00	31.79	19.07	A
a300234011046330	14-Dec-2012 17:30	36.34	14.33	31-Dec-2012 13:00	35.44	14.53	D
a300234011040340	14-Dec-2012 18:16	36.4	14.34	04-Mar-2013 13:00	34.99	17.87	A
a300234011043350	14-Dec-2012 19:15	36.49	14.33	19-Dec-2012 10:00	36.01	14.26	D

Table 4. Status information for the 6 Italian drifters deployed in the Mediterranean (Malta Channel) in 2012.

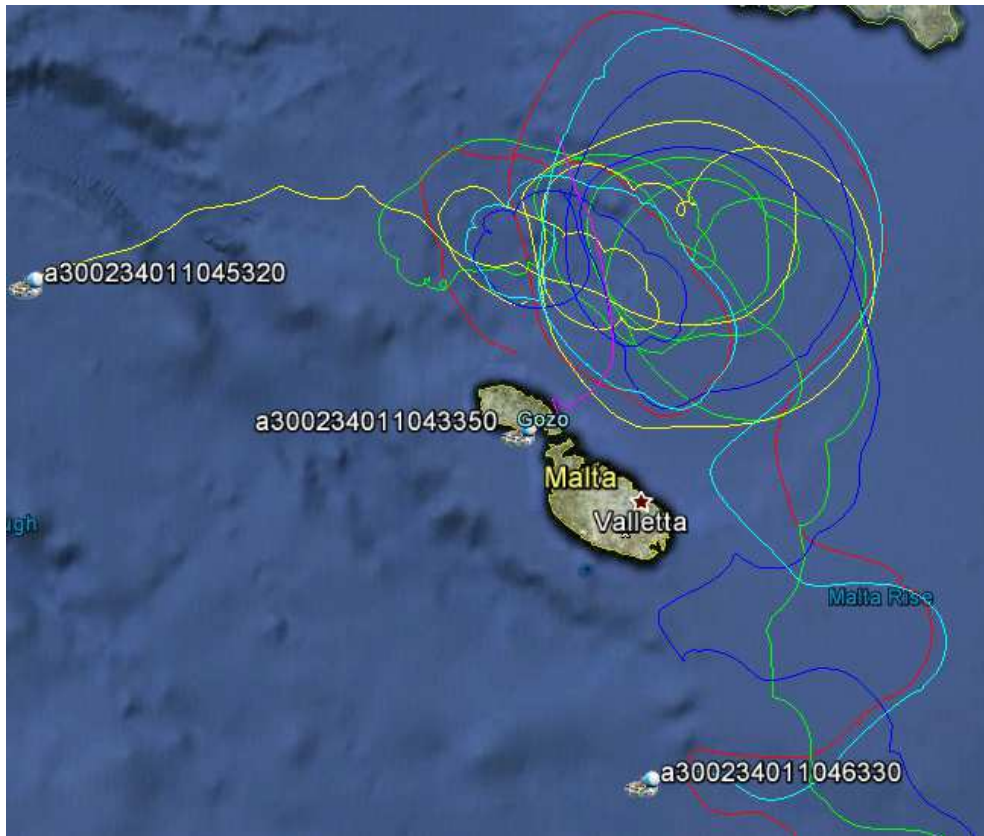


Figure 11. Trajectories and last positions (drifter symbols) of the 6 Italian drifters deployed in the Malta Channel in December 2012. The 3 units that stopped transmitting or were picked-up are identified by they IMEI numbers. The last positions of the drifters still operating in the Ionian Sea are not shown.

5. Glider activities in 2012

5.1 Glider procurement

The following glider was purchased with ARGO-ITALY funding:

1. A Seaglider manufactured by iRobot, Bedford, Massachusetts. The Seaglider has an ogive shape with five payload ports that accommodate sensors for temperature, salinity, dissolved oxygen, chlorophyll and turbidity. The glider mounts a pumped Sea-Bird CTD instead of the standard free flow. Its body size is 2 m in length with 30 cm maximum diameter and the antenna mast give an additional 1 m length. It weighs around 60 kg (dry) and his operating depth range goes from 20 to 1000 m. Typical horizontal speed is 25 cm/s (1/2 kt) and the glide angle is 16-45° (1:3.5 to 1:1 slope). The isopycnal pressure hull has no external moving parts and has a low drag; the external part consists in a flooded fiberglass fairing. The data are transmitted after every dive whereas the control and system commands can be sent before each dive via the Iridium satellite telemetry system.



Figure 8. Photograph of an iRobot Seaglider diving in the sea.

5.2 Glider preparation

The preparation of the glider and its future missions was mainly focused on the following actions:

- Setting of a primary and secondary basestation at OGS and in a different location;
- Optimization of the data flow from the basestation to the seaglider and vice versa;
- Display of the incoming scientific and technical data on a website portal.

Security issues were considered since continuous pilot connections to the basestation has to be maintained during the missions. A secondary basestation was set to ensure a secondary way glider connection in case of power shut down or failure in the primary basestation.

The optimization of connectivity between the instrument and the ground in both directions was accomplished by using the RUDICS (Router-based Unrestricted Digital Internetworking

Connectivity Solution) system that uses a solution based on the network to improve connectivity. Data are not sent from the receiving station with a modem to modem but they are exchanged through the network improving the efficiency and lowering transmission costs.

A web portal that displays the scientific and technical data was designed to allow their visualization by all scientists involved in the glider mission and to allow the pilots to check continuously the health of the glider and to adjust some parameters in order to optimize the battery consumption.

6. Other activities in 2012

6.1 Near real-time data processing

The data of drifters and floats have been 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 have been 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 have been distributed in near real-time on the Global Telecommunication System (GTS) and have been identified by a WMO number.

6.2 Delayed Mode quality control of Argo data

Delayed mode quality control (DMQC) of the data provided by the Italian floats has not been done yet. OGS will perform this activity in 2013 as part of the EC FP7 Sideri and MyOcean-2 projects. Note that OGS is responsible for the DMQC of all the floats operated in the Mediterranean and Black seas. The temperature and salinity data of 87 floats (over a total of 175 floats) have been quality controlled following the standard Argo procedure, covering the period 2000-2012.

6.3 Selection of small research projects

In order to encourage a larger Italian community to use Argo data for their research, a fraction of the ARGO-ITALY budget was set aside to support small research projects conducted by Italian researchers and related to Argo. A call for proposals was published and 4 proposals were received. A committee composed of Drs. Crise, Le Traon and Poulain evaluated positively the proposals and recommended awarding grants to all of them. Details about these projects are listed in Table 5, including the names of the P.I.'s, the level of funding and number of floats made available to the projects by ARGO-ITALY. The research topics addressed by the projects are as follows:

1. TISANA: Testing and operation of a float equipped with an imaging acquisition system and an analysis module based on pattern recognition trained to identify jellyfish (GUARD-ONE). Measurements of the horizontal and vertical distribution of jellyfish in frontal areas of the Ligurian Sea.
2. T-REX/A: Collect temperature and salinity profiles in the Terra Nova Bay polynya in the western Ross Sea (Antarctica) during the Austral summer with tethered floats operated as virtual moorings.

3. SALVE: Complement an existing plan for Lagrangian surface measurements in the Southern Adriatic Sea with Lagrangian measurements at depth provided by two Argo floats. This is part of an European project focused on the physical and biological connections among marine protected areas in the Mediterranean, aimed at elucidating patterns and processes of bio-diversity distribution.
4. DRIVE-FLOATS: Assessment of the impact and benefits of the assimilation of float data (temperature and salinity profiles, sub-surface displacements) in a sub-regional and coastal scale model of the northern Tyrrhenian Sea (Toscan Archipelago).

Institute	P.I.	Title	Amount	Floats
CNR-ISMAR	Annalisa Griffa	TISANA	27000€	1 Iridium
UNINAP	Giorgio Budillon	T-REX/A	26000€	2 Argos
CONISMA	Enrico Zambianchi	SALVE	28000€	2 Iridium
CNR-IBIMET	Carlo Brandini	DRIVE-FLOATS	19000€	2 Iridium
TOTAL			100000€	

Table 5. Details about the research projects sponsored by ARGO-ITALY, including the level of funding and the number/kind of floats provided to the P.I.'s.

6.4 Italian contribution to Argo bibliography in 2012.

The following papers by Italian scientists were published in 2012. They use Argo data for basic oceanographic research and operational oceanography purposes.

Buongiorno Nardelli, B., S. Guinehut, A. Pascual, Y. Drillet, S. Ruiz, and S. Mulet, 2012: Towards high resolution mapping of 3-D mesoscale dynamics from observations. *Ocean Science*, 8, 885-901, <http://www.ocean-sci.net/8/885/2012/>

Dobricic, S., C. Dufau, P. Oddo, N. Pinardi, I. Pujol, and M. H. Rio, 2012: Assimilation of SLA along track observations in the Mediterranean with an oceanographic model forced by atmospheric pressure. *Ocean Science*, 8, 787-795, <http://www.ocean-sci.net/8/787/2012/>

Kovačević, V., B. B. Manca, L. Ursella, K. Schroeder, S. Cozzi, M. Burca, E. Mauri, R. Gerin, G. Notarstefano, and D. Deponte, 2012: Water mass properties and dynamic conditions of the Eastern Mediterranean in June 2007. *Progress in Oceanography*, 104, 59-79, <http://www.sciencedirect.com/science/article/pii/S0079661112000638>

Nilsson, J. A. U., S. Dobricic, N. Pinardi, P. M. Poulain, and D. Pettenuzzo, 2012: Variational assimilation of Lagrangian trajectories in the Mediterranean ocean Forecasting System. *Ocean Science*, 8, 249-259, <http://www.ocean-sci.net/8/249/2012/>

7. Plans for 2013 and beyond

7.1 Floats

With the funding available so far, procedures are underway for the procurement of the following floats in 2013:

1. Seven floats with biogeochemical sensors, including 2 with dissolved oxygen and nitrate sensors;
2. Twenty standard Argo floats with Argos telemetry;
3. Twenty standard Argo floats with Iridium telemetry.

The Italian deployment plans are detailed in Table 6. 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	
2013	10	Mediterranean	2	Mediterranean	16
	1	Black Sea			
	3	Southern Ocean			
2014	10	Mediterranean	3	Mediterranean	20
	2	Black Sea			
	5	Southern Ocean			
2015	10	Mediterranean	2	Mediterranean	20
	3	Black Sea			
	5	Southern Ocean			

Table 6. Italian float deployment plans for 2013-2015.

OGS is committed to carry out DMQC on all the Argo floats of the Mediterranean and Black seas as part of the SIDERI, E-AIMS and MyOcean-2 projects over the next two years (2013-2014).

7.2 Drifters

With the funding available so far, procedures are underway for the procurement of 20 SVP drifters with Iridium telemetry before the end of 2013.

Drifter deployment plans for 2013 and 2014 are described in Table 7.

Year	SVP drifters	
	Quantity	Area
2013	24	Ionian Sea
	6	Levantine Sea off Lebanon
2014	20	Mediterranean Sea

Table 7. Argo-Italy drifter deployment plans for 2013-2014.

7.3 Glider

The iRobot Seaglider is planned to be operated in the southern Adriatic in spring 2013 (April-May 2013).

7.4 Other

MIUR is committed to provide funding in order to sustain the Italian contribution to Argo beyond 2013 as member of the Euro-Argo Research Infrastructure Consortium. In addition to the Italian national funding, OGS has funding from the EC FP7 PERSEUS, SIDERI and E-AIMS projects, for multiple activities (technical development, data management, capacity building and training, EuroArgo strategy, etc.) related to Argo.

If more MIUR funding is secured in late 2013, it is planned to put out a call for Italian proposals focused on technical development issues on floats, drifters, gliders and a SOOP sensors. Some of the new funding will also be allocated for the purchase and operation of SOOP sensors, in particular for XBT probes in the Mediterranean.

8. Distribution list

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

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