Report on the Italian Argo Program for 2014

1. The status of implementation (major achievements and problems in 2014).

 - <u>floats deployed and their performance</u>:

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). 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, Cyprus and Bulgaria.

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. 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.

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. 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	Deployment 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.

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 in the Southern Ocean and Ross Sea (grey row) during 2014.

- <u>technical problems encountered and solved</u>

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 could eventually 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 actually 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.

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

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

 - status of delayed mode quality control process

Delayed mode quality control (DMQC) of the data provided by the Italian floats was done for 18 floats. OGS will continue this activity in 2015 as part of the EC FP7 E-AIMS and MyOcean-FO and PERSEUS 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 142 floats (over a total of 269 floats; 197 dead and 72 alive floats) have been quality controlled following the standard Argo procedure, covering the period 2000-2015.

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

The Italian Ministry of Research has provided funding to buy 20 floats in 2014, including 5 instruments with dissolved oxygen sensors. In addition, the Italian human resources per year devoted to Argo-Italy amounts to about 50 man-months for technical, administrative and scientific personnel involved in the project in 2014. It is expected that the same level will maintained in 2015, including the procurement of 22 additional standard floats and 2 special floats that can profile as deep as 4000 dbar. The Italian Ministry of Research is committed to provide funding in order to sustain the Italian contribution to Argo beyond 2015 as founding member of the Euro-Argo Research Infrastructure Consortium. In addition to the Italian national funding, OGS has funding from the EC FP7 PERSEUS, MyOcean-FO and E-AIMS projects, for several activities (technical development, data management, capacity building and training, EuroArgo strategy, etc.) related to Argo.

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

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

Year	Floats with T/S		Floats with biogeochemical sensors		Total
	Quantity	Area	Quantity	Area	
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 3. Italian deployment plans for 2015-2017.

OGS is committed to carry out DMQC on all the Argo floats of the Mediterranean Sea as part of the E-AIMS and MyOcean-FO and PERSEUS projects over the next years.

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

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

Operational ocean forecasting.

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

Ocean science.

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

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

N/A

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

N/A

7. Italian contribution to Argo bibliography in 2014.

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/.