Report on the Italian Argo Program for 2017

1. The status of implementation (major achievements and problems in 2017).

- floats deployed and their performance:

In total, **27 Italian floats** were deployed in 2017 (see Tables 1 and 2 for details). These floats were Arvor-L, Arvor-I and Arvor-Ice 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, Arvor-Ice, Nova/Dova) and some have Argos telemetry (Apex and Arvor-L).

Mediterranean and Black Sea deployments

Two floats were deployed in the Black Sea and 8 units were released in the Mediterranean (Table 1). In the Mediterranean, all 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.

Most floats were deployed from research vessels of opportunity (i.e., R/V Beautemps-Beaupré, R/V Minerva I, R/V Medexplorer for the Mediterranean and R/V Akademic for the Black Sea) with the help of colleagues from France, Italy, Israel and Bulgaria. In the framework of the International Seakeepers Society (http://www.seakeepers.org/), two floats were deployed in the Tyrrhenian and Ionian seas from the maxi-yatch Exuma.

Model	WMO	Argos	Deploy Date	Lat	Lon	Cycles	Last TX Date	Lat	Lon	Status*	Cycle**
Arvor-I	3901907		21/01/2017 13:53	37,49	6,48	70	08/01/2018 03:14	39,22	6,38	A	5
Arvor-I	3901908		25/01/2017 15:51	34,50	20,25	69	07/01/2018 21:10	32,68	24,01	A	5
Nova	6903221		07/02/2017 10:20	32,34	34,23	69	12/11/2017 03:32	34,20	35,34	D	5
Dova	6903222		07/02/2017 13:32	32,51	33,68	75	27/12/2017 02:50	32,06	34,21	A	5
Apex	6903202	133511	30/03/2017 12:56	42,20	10,83	10	16/05/2017 04:18	42,26	11,05	D	5
Dova	6903225		23/05/2017 18:25	39,42	14,63	47	08/01/2018 04:14	39,80	15,10	A	5
Arvor-L	6903224	114256	10/06/2017 11:15	38,52	20,16	74	08/01/2018 14:21	38,62	18,27	A	5
Dova	**6903226**		**11/10/2017 07:50**	**43,16**	**29,00**	**0**	**14/11/2017 18:41**	**42,83**	**31,88**	**AS**	**5**
Nova	**6903228**		**20/10/2017 18:49**	**43,41**	**29,52**	**9**	**04/12/2017 03:12**	**41,81**	**28,74**	**A**	**5**
Arvor-I	6903227		19/11/2017 07:09	40,59	11,76	10	04/01/2018 23:49	40,90	11,03	A	5

**Status in early January 2018: A = active, D = dead; AS = active but drifting at surface.*
***Cycle: Length of cycle in days.*

Table 1. Status information for the 10 Italian floats deployed in the Mediterranean and Black Sea (bold) during 2017.

South Atlantic, South Pacific and Southern Ocean

Ten Italian floats were deployed in the South Pacific Ocean and the Pacific sector of the Southern Ocean (Table 2) with the help of Italian colleagues onboard the R/V Italica while sailing from New Zealand to the Ross Sea. These floats included 7 Nova and 3 Arvor-Ice floats. The Arvor-Ice uses

an Ice Sensing Algorithm (ISA) based on temperature readings to abort surfacing when sea ice is present at the sea surface (Pacciaroni et al., 2017). 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. Nine of these 10 floats were still active in early 2018.

Five Italian floats were also deployed in the South Atlantic Ocean (Table 2) with the help of Italian colleagues onboard the R/V Agulhas II. These floats were all Nova instruments. 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. They were all still active in early 2018.

Two Arvor-Ice were also deployed from R/V OGS Explora south of Tasmania (WMO 6903214 & 6903215) in January 2017.

Some of the Arvor-Ice floats (WMO 6903211, 6903212 and 6903213) drifted in areas with a weak presence of surface ice in August. However it appears that the ISA did not prevent the float to perform their usual surfacing (Pacciaroni et al., 2017).

Model	WMO	Deploy Date	Lat	Lon	Cycles	Last Date	Lat	Lon	Status*	Cycle**
Nova	6903208	02/01/2017 03:57	-55,03	175,50	39	07/01/2018 04:53	-51,78	-169,58	A	10
Nova	6903209	02/01/2017 10:05	-56,04	175,77	39	07/01/2018 04:50	-52,00	-174,41	A	10
Nova	6903207	02/01/2017 15:38	-57,02	176,11	38	07/01/2018 04:46	-52,00	-157,99	A	10
Nova	6903206	02/01/2017 21:20	-58,04	176,40	8	03/03/2017 04:50	-58,19	179,14	D	10
Nova	6903210	03/01/2017 02:05	-59,02	176,75	39	08/01/2018 04:51	-57,95	-163,22	A	10
Nova	6903205	03/01/2017 07:12	-60,03	177,07	39	08/01/2018 04:51	-58,53	-167,02	A	10
Arvor-ICE	6903213	03/01/2017 11:52	-61,03	177,26	39	10/01/2018 05:48	-61,98	-172,13	A	10
Arvor-ICE	6903211	03/01/2017 16:41	-62,04	177,58	38	04/01/2018 05:45	-59,83	-171,51	A	10
Arvor-ICE	6903212	03/01/2017 21:35	-63,05	177,93	38	10/01/2018 05:55	-63,25	-173,19	A	10
Arvor-ICE	6903214	22/01/2017 06:22	-48,01	149,23	37	09/01/2018 05:15	-46,65	138,35	A	10
Arvor-ICE	6903215	23/01/2017 07:04	-52,37	148,95	37	10/01/2018 05:35	-48,30	157,80	A	10
Nova	6903216	28/01/2017 07:36	-54,00	-30,99	36	03/01/2018 04:49	-55,91	-16,80	A	10
Nova	6903217	30/01/2017 14:33	-54,00	-9,00	36	05/01/2018 04:59	-53,26	-8,68	A	10
Nova	6903218	31/01/2017 10:08	-54,00	-9,00	35	06/01/2018 04:39	-54,89	-0,56	A	10
Nova	6903220	31/01/2017 19:06	-52,00	0,01	35	06/01/2018 04:50	-51,84	30,78	A	10
Nova	6903219	01/02/2017 05:20	-50,00	1,54	36	07/01/2018 05:04	-49,36	26,50	A	10
Nova	6903223	19/02/2017 04:27	-54,01	173,00	33	05/01/2018 04:51	-53,90	-178,40	A	10

**Status in early January 2017: A = active, D = dead.*
***Cycle: Length of cycle in days.*

Table 2. Status information for the 17 Italian floats deployed in the Southern Ocean, South Atlantic and South Pacific during 2017.

Overall status at the end of 2017

In summary, at the end of 2017, the Italian Argo program had a total of 68 active floats, including 32 instruments in the Mediterranean Sea, 7 in the Black Sea (Figure 1) and 29 in the South Pacific, South Atlantic and Southern Ocean (south of 60˚S) (Figure 2).

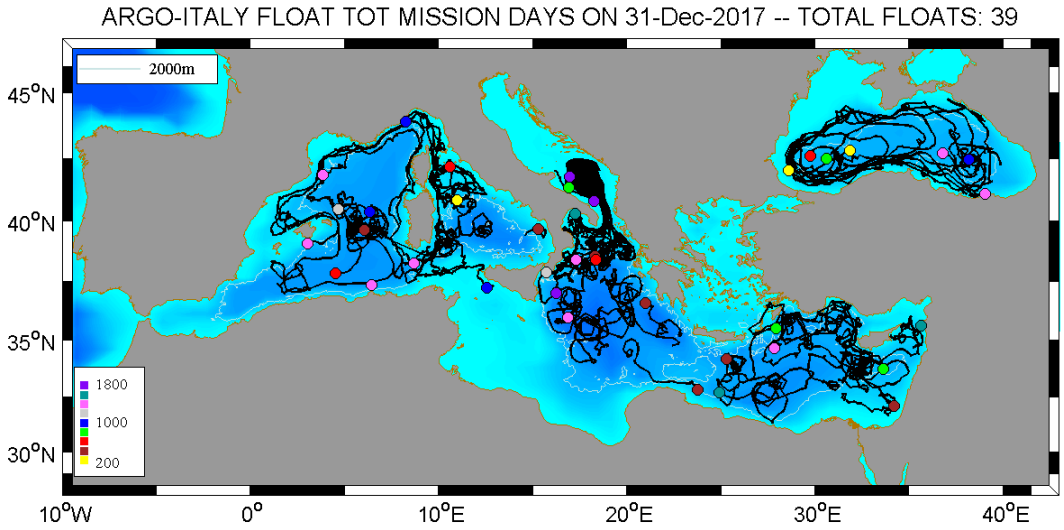

Figure 1. Trajectories and positions (circle symbols) on 31 December 2017 of the 39 Italian floats active in the Mediterranean and Black Sea at the end of 2017. The circle symbols are color-coded as a function of float age in days.

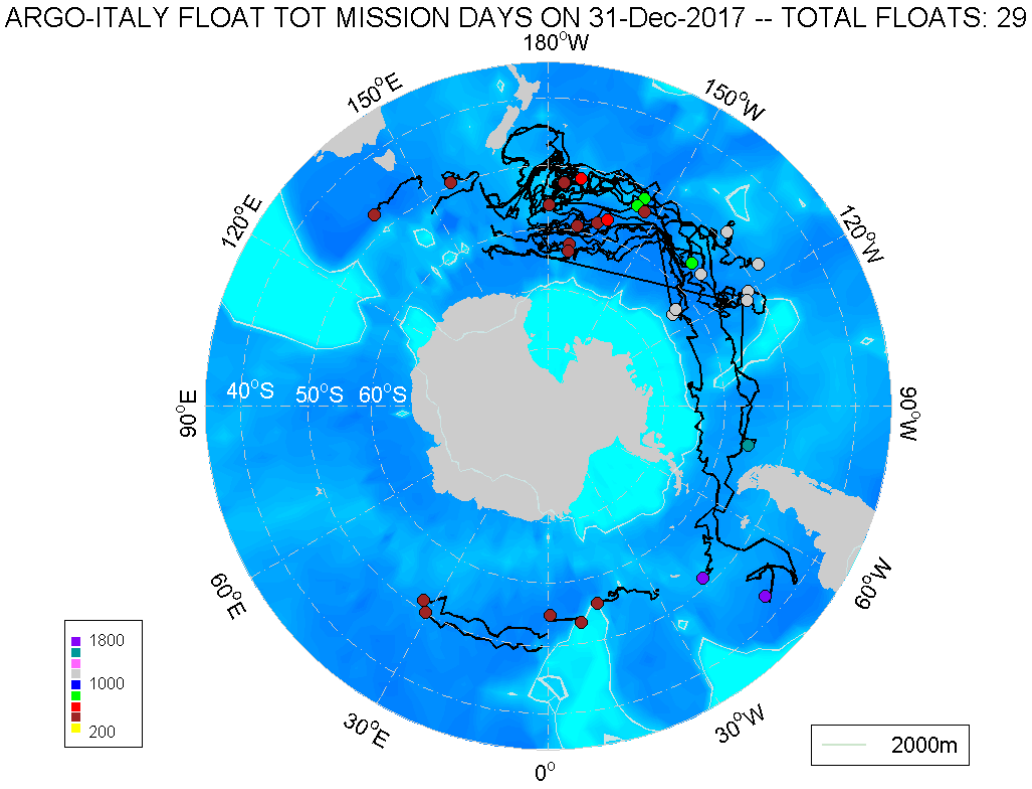

Figure 2. Trajectories and positions (circle symbols) on 31 December 2017 of the 29 Italian floats in the South Pacific, South Atlantic and Southern Oceans. The circle symbols are color-coded as a function of float age in days.

The temporal evolution of the number of active floats is shown in Figure 3 with weekly resolution, along with the annual numbers of float deployments and float deaths for the period 2012-2017. The float population in 2012-2017 is essentially increasing and reaching 70-80 active instruments in 2017. In 2015 and 2016 the annual numbers of deployments (26 and 28, respectively) were related

to annual losses of 13 in 2015 and 14 in 2016. In 2017, the number of floats which stopped transmitted was rather high (22) probably due to the natural aging of the Italian Argo network and also due to the short operating life of some float types.

Since 18 February 2012, a total of **136 ARGO-ITALY floats** have been deployed, 82 in the Mediterranean and Black seas, and 54 in the oceans of the Southern Hemisphere. In less than 6 years, they have provided about **15000 CTD profiles**. In total, 13 floats (~10 %) have failed just after deployment.

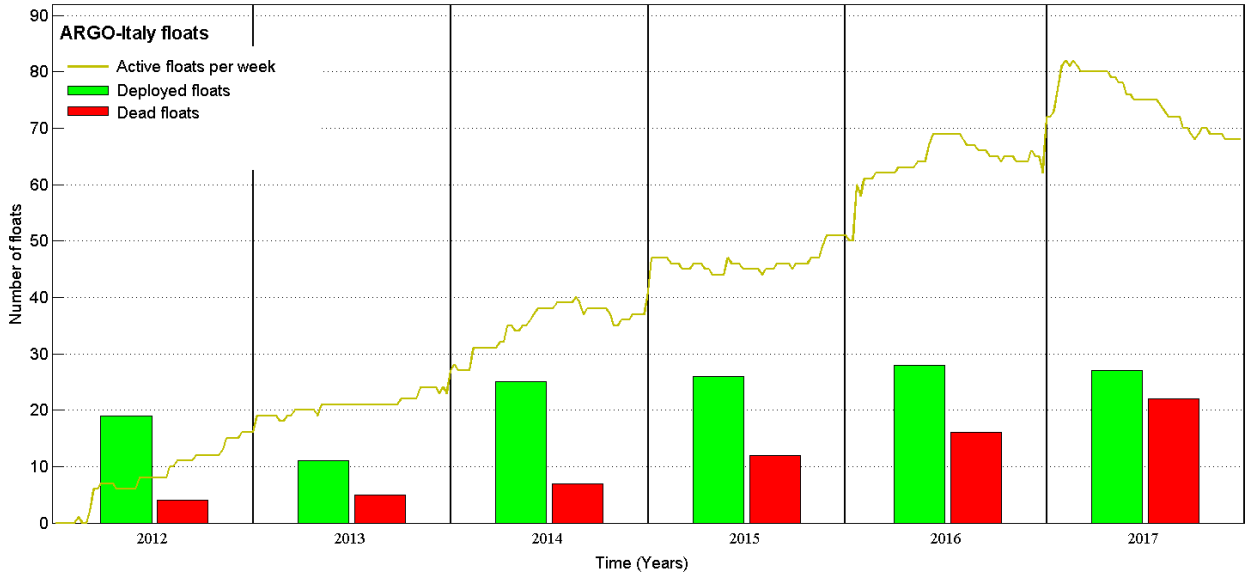

Figure 3. Temporal evolution of the number of active Italian floats with weekly resolution and histogram of the annual float deployments and losses.

- technical problems encountered and solved

Mediterranean and Black Sea

In total, 5 floats (out of 10 deployed in 2017) stopped functioning before the end of the year 2017. Nova (WMO 6903221) and Dova (WMO 6903222) floats deployed in the Eastern Levantine stopped transmitting data after 69 and 75 cycles, respectively. The Apex float (WMO 6903202) deployed in the north Tyrrhenian had a very short operational life (10 cycles). Dova float (WMO 6903226) did not work upon deployment in the Black Sea and drifted at the surface. It was not possible to reset it using the Iridium downlink. Nova float (6903228) stopped functioning after only 9 cycles in the Black Sea.

Southern Hemisphere

Nova float WMO 6903206 stopped transmitting after only 8 cycles in March 2017.

Nova/Dova floats

In general, the Nova and Dova floats have low survival rates. After a little more than 2 years since their first deployments in October 2015, only 18 floats (out of 39 units, i.e., about 46%) were still

fully operational (some of them collecting weird data!) in early 2018. We are still trying to investigate the causes of the premature malfunctioning in collaboration with MetOcean.

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

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

- status of delayed mode quality control process

The delayed mode quality control (DMQC) of the physical data (pressure, temperature and salinity) provided by the Italian floats in the Mediterranean and Black seas was done for 43 floats (all information and statistics to create the D-files sent to Coriolis). The temperature and salinity data of those floats were quality controlled following the standard Argo procedure, covering the period 2010-2016. 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 (i.e., the comparison between nearby floats and analysis of the deepest portion of the temperature-salinity diagram) in order to increase the reliability of the analysis. The DMQC of the Italian floats deployed in the Southern Ocean, the South Pacific and South Atlantic will be done by OGS in early 2018.

References

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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 21 floats in 2017, including 3 instruments with dissolved oxygen sensors and 3 BGC floats. In addition, the Italian human resources per year devoted to Argo-Italy was about 50 man-months for technical, administrative and scientific personnel involved in the project in 2017. It is expected that the same level will be maintained in 2018, including the procurement of 20 additional standard floats and 3 deep floats. The Italian Ministry of Research is committed to provide funding in order to sustain the Italian contribution to Argo beyond 2018 as founding member of the Euro-Argo Research Infrastructure Consortium. In addition to the Italian national funding, OGS has funding from EC (CMEMS, MOCCA) and the Italian Ministry of Foreign Affairs (MELMAS) projects for several activities related to Argo.

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

The Italian deployment plans for 2018 and 2019 are detailed in Table 3. The main areas of interest are the Mediterranean and Black seas and the oceans of the South Hemisphere.

Year	T/S floats (some of them with DO)		BGC floats		Deep floats		Total
	Quantity	Area	Quantity	Area	Quantity	Area	
2018	12 1 8	Mediterranean Black Sea South Hemisphere	3 1	Mediterranean Black Sea	2	Mediterranean	**27**
2019	13 2 10	Mediterranean Black Sea South Hemisphere	1	Mediterranean Black Sea	1	Mediterranean	**27**

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

On the longer time frame, Italy is interest to maintain contributions to the Argo Core mission and the BGC and Deep Argo extensions with numbers similar to those listed in Table 3. OGS is committed to carry out the DMQC for all the Argo floats of the Mediterranean and Black seas and for some floats in the World Ocean as part of the CMEMS and MOCCA projects over the next years.

The website for the Italian contribution to Argo (Argo-Italy) was improved and upgraded (http://argoitaly.ogs.trieste.it/). The link to the Mediterranean & Black Sea Argo Centre (MedArgo) is http://nettuno.ogs.trieste.it/sire/medargo/. A completely new web site for Argo-Italy is in development and will be operational in spring 2018.

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 (along 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) and which is a component of the Copernicus Marine Environment Monitoring Service (CMEMS). 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) in both the Mediterranean Sea and the Southern Ocean (see bibliography below).

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 2017.

N/A

7. Italian contribution to Argo bibliography in 2017.

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