Argo National Data Management Report – Italy (2021) - MedArgo

1. Status

- **Data acquired from floats:** more than 79000 Argo profiles were acquired in the Mediterranean and in Black Seas between 2001 and September 2021. The temporal and spatial distribution of these profiles is depicted in Figure 1, sorted by the different float types used (Core-Argo, Core-Argo with DO, Bio-Argo, Deep-Argo and BGC-Argo); the monthly and yearly distribution is shown in Figure 2. More than 80 floats per month have been operated simultaneously in the basins in 2021 and more than 5500 profiles have been acquired (up to September 2021) by different float models (Figure 3).

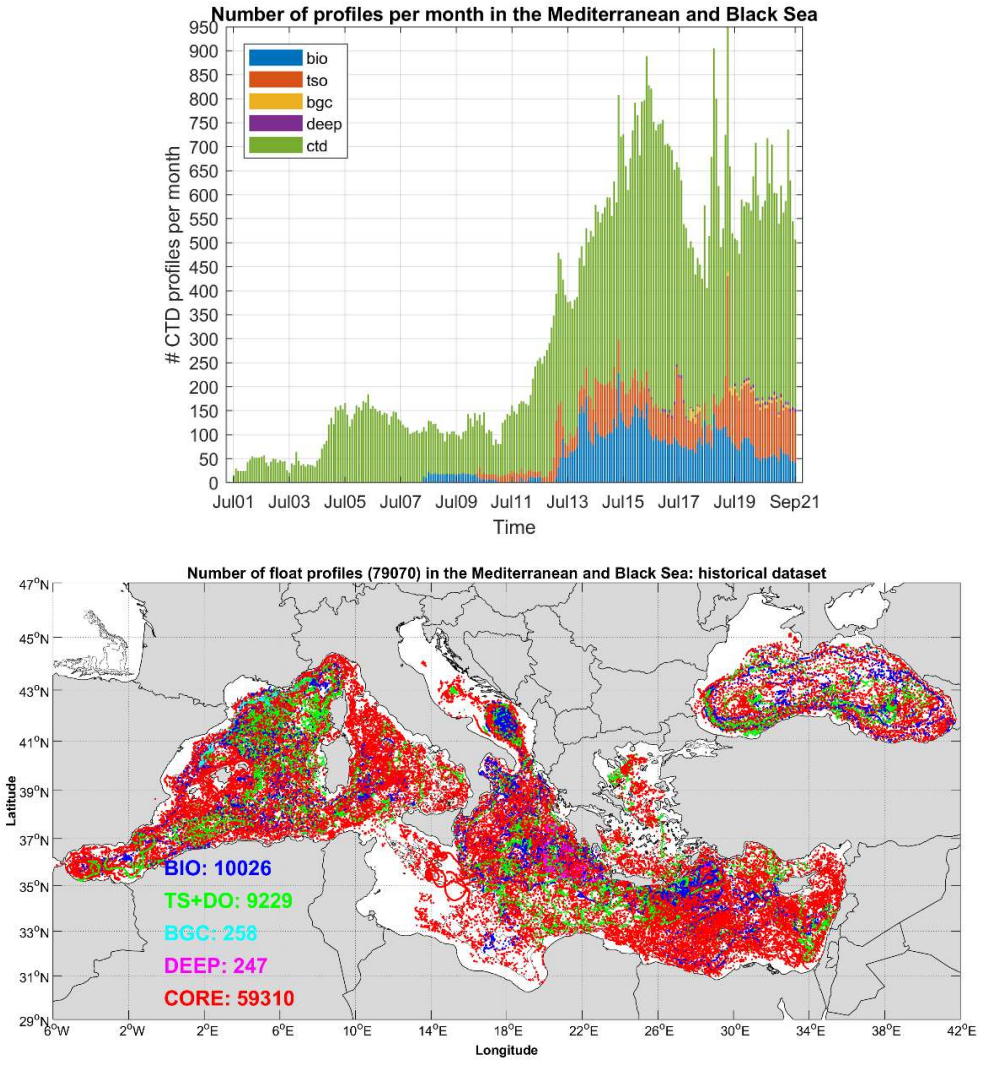

Figure 1. Temporal (upper panel) and spatial (bottom panel) distribution of float profiles in the Mediterranean and Black Sea between 2001 and 2021.

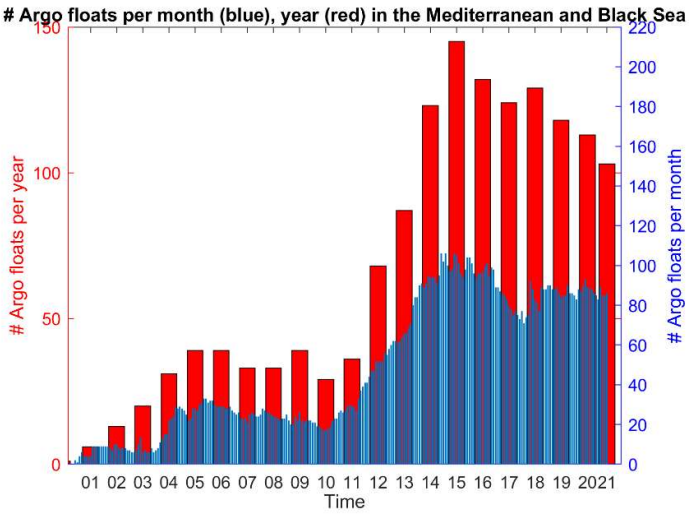

Figure 2. Monthly (blue bars) and yearly (red bars) distribution of Argo floats in the Mediterranean and Black Sea between 2001 and 2021.

The number of profiles acquired by Argo-extension floats in 2021 is about 1550 whilst the ones collected by the core Argo floats are about 4000. EU, Spain, Greece, France, Bulgaria and Italy contributed to maintain/increase the Argo population in 2021: a total of 23 new floats have been deployed both in the Mediterranean and in the Black Seas (Figure 3); 13 out of 23 platforms are core-Argo, 7 are core-Argo with DO, 1 is a Bio-Argo, 1 is a BGC-Argo and 1 is Deep-Argo. The deployment strategy was chosen according to the project's targets and to replace dead floats or under-sampled areas.

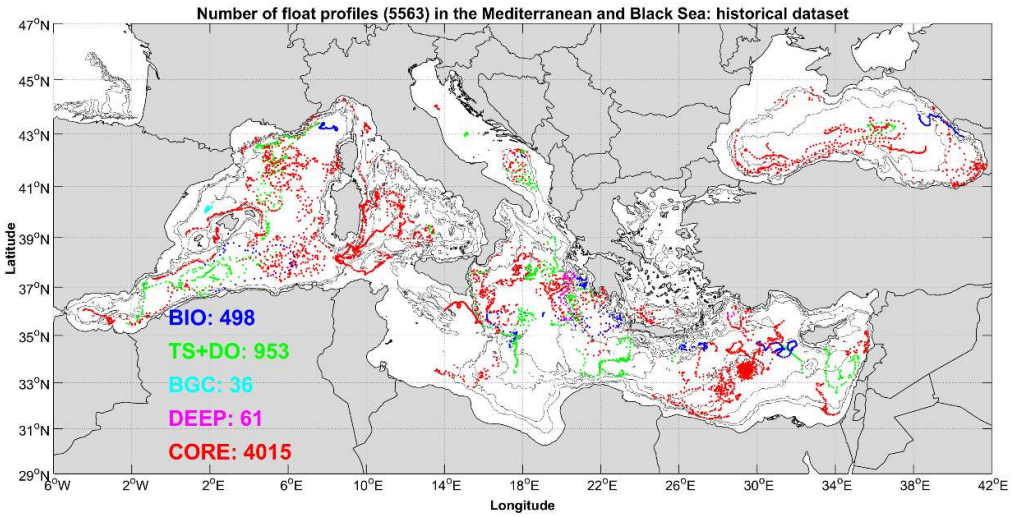

Figure 3. Spatial distribution of profiles collected by Argo floats in 2021 (January-September) in the Mediterranean and Black Sea: locations are color-coded per float type.

Statistics have been computed to assess the fleet performance. The survival rate diagrams produced are separated by transmission mode (figure 4). The maximum operating life is more than 500 cycles, whilst the mean half life is about 150 cycles (figure 4a). The vertical distance (upward profiles) travelled by floats is computed and used as an indicator of the profiler performance (figure 4b). The maximal distance observed is about 500 km, whilst the mean distance travelled is about 125 km. The balance of the population is in figure 5a and the annual death rate in figure 5b.

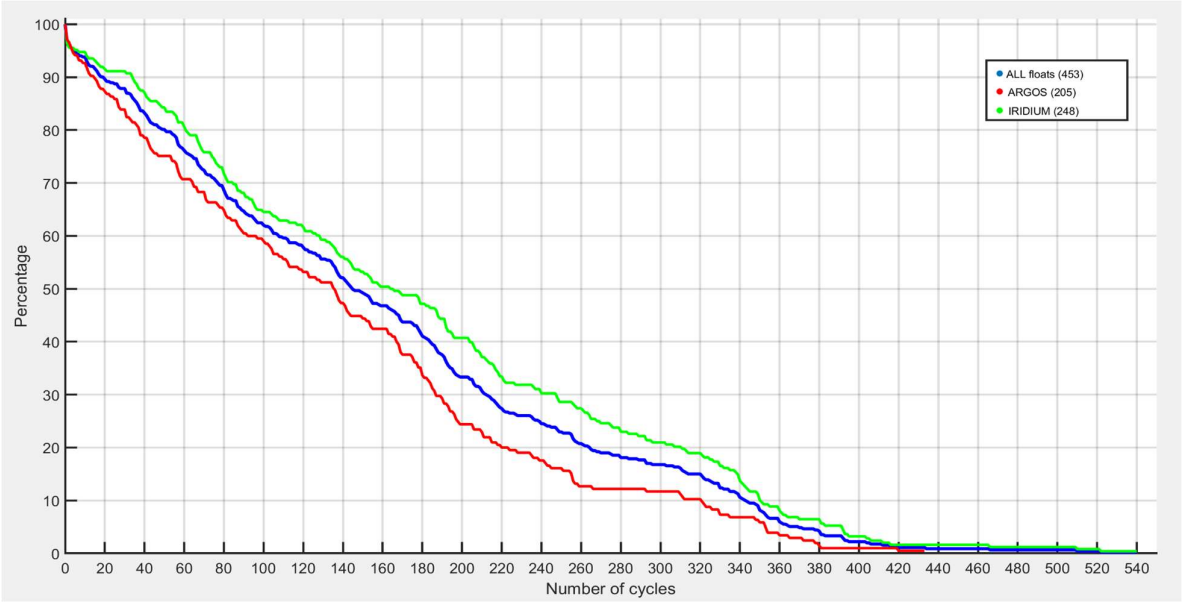

Figure 4a. Survival rate diagrams separated by telemetry system.

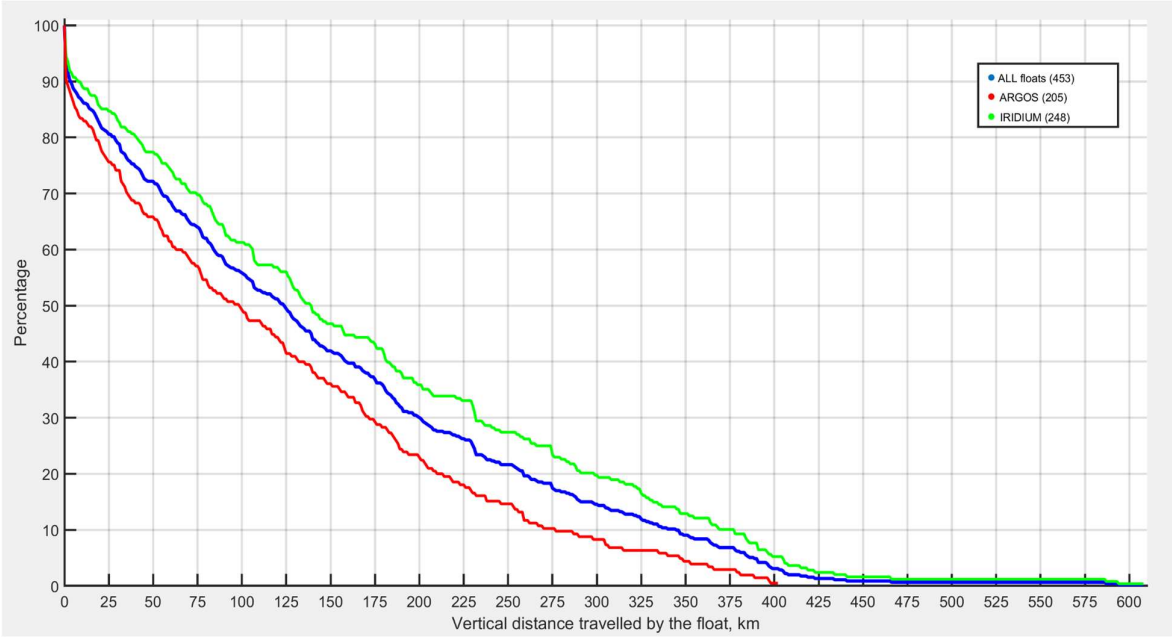

Figure 4b. Diagram of the vertical distance travelled floats, separated by telemetry system.

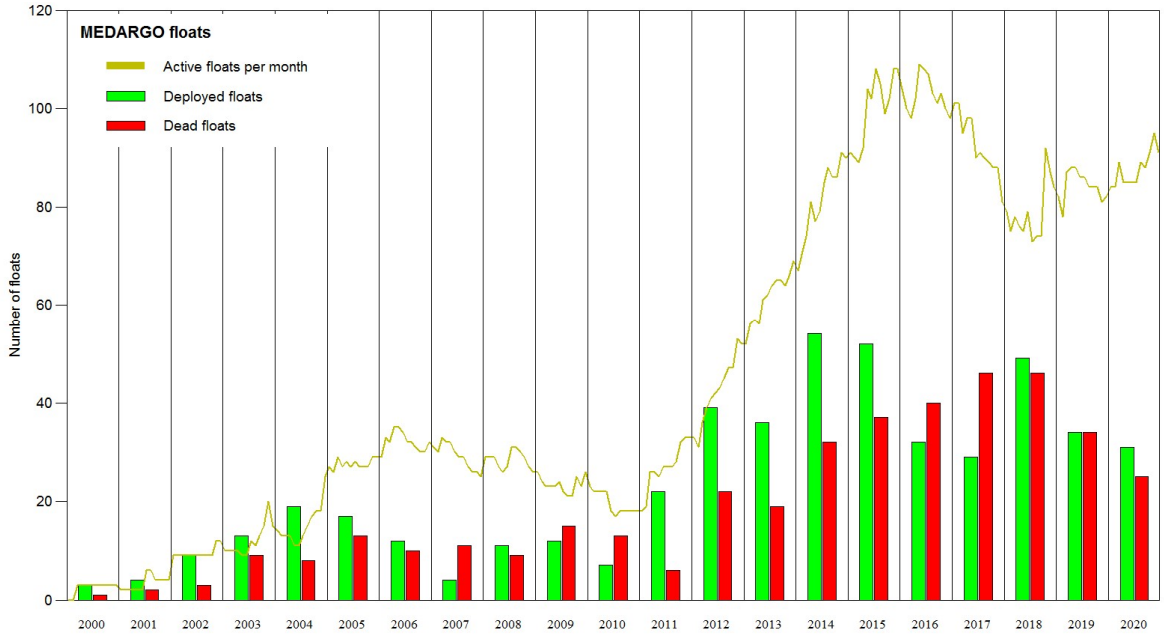

Figure 5a. Balance of the population (rate of population change related to the number of yearly deployments and dead floats).

Figure 5b. Annual death rate (ration between yearly failure and yearly average population).

- **<u>Web pages</u>:**

The MedArgo web page (new website is http://maos.inogs.it/medargo/) has been updated. The main improvements are in the drop-down menu that allows users to do more accurate selections. The main page has been cleaned, old links removed and new ones provided. Tables and graphics are updated in near real time. The floats deployed during 2021 have been added to the web page as soon as the technical information is

available. The float positions are plotted daily (Figure 6); the monthly and the whole trajectories are also provided. Links with the Euro-Argo data selection tools and GDAC center (Coriolis) are also available for downloading both the real-time and delayed-mode float profiles.

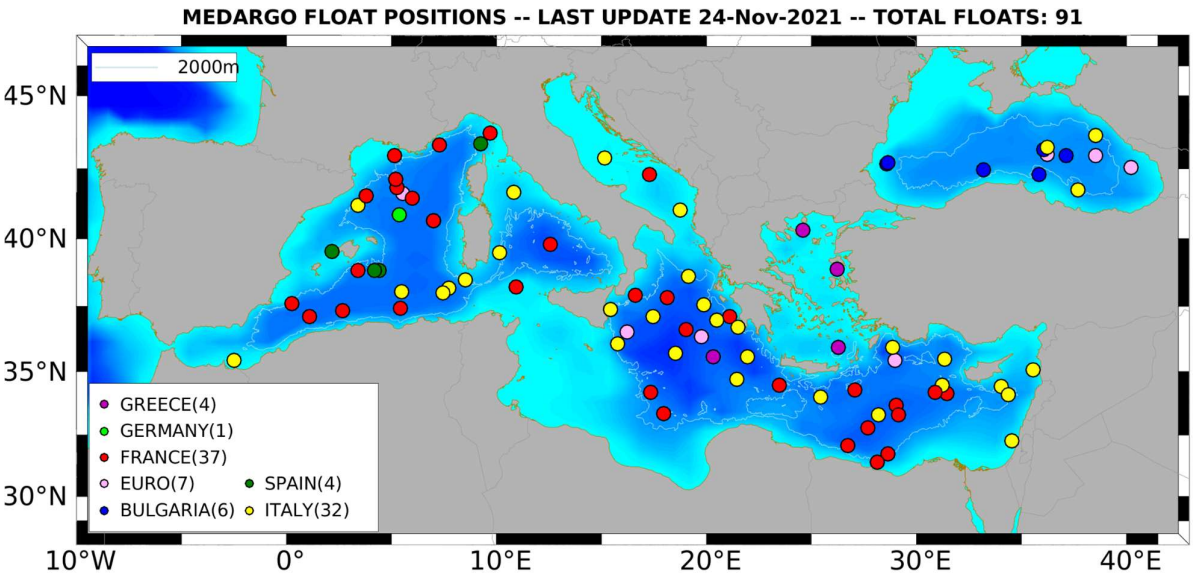

Figure 6. MedArgo float positions as of 24 November 2021 (updated daily).

- **<u>Statistics of Argo data usage</u>:** (operational models, scientific applications, number of National Pis…):
- **<u>Products generated from Argo data</u>:**
    a. Daily maps of float positions (Figure 6)
    b. Monthly maps of float positions and track
    c. Physical and Biogeochemical Argo float data are assimilated in numerical forecasting models by CMCC and OGS; 3D daily maps of Mediterranean ocean forecasting systems are produced and available on CMEMS (Figure 7).

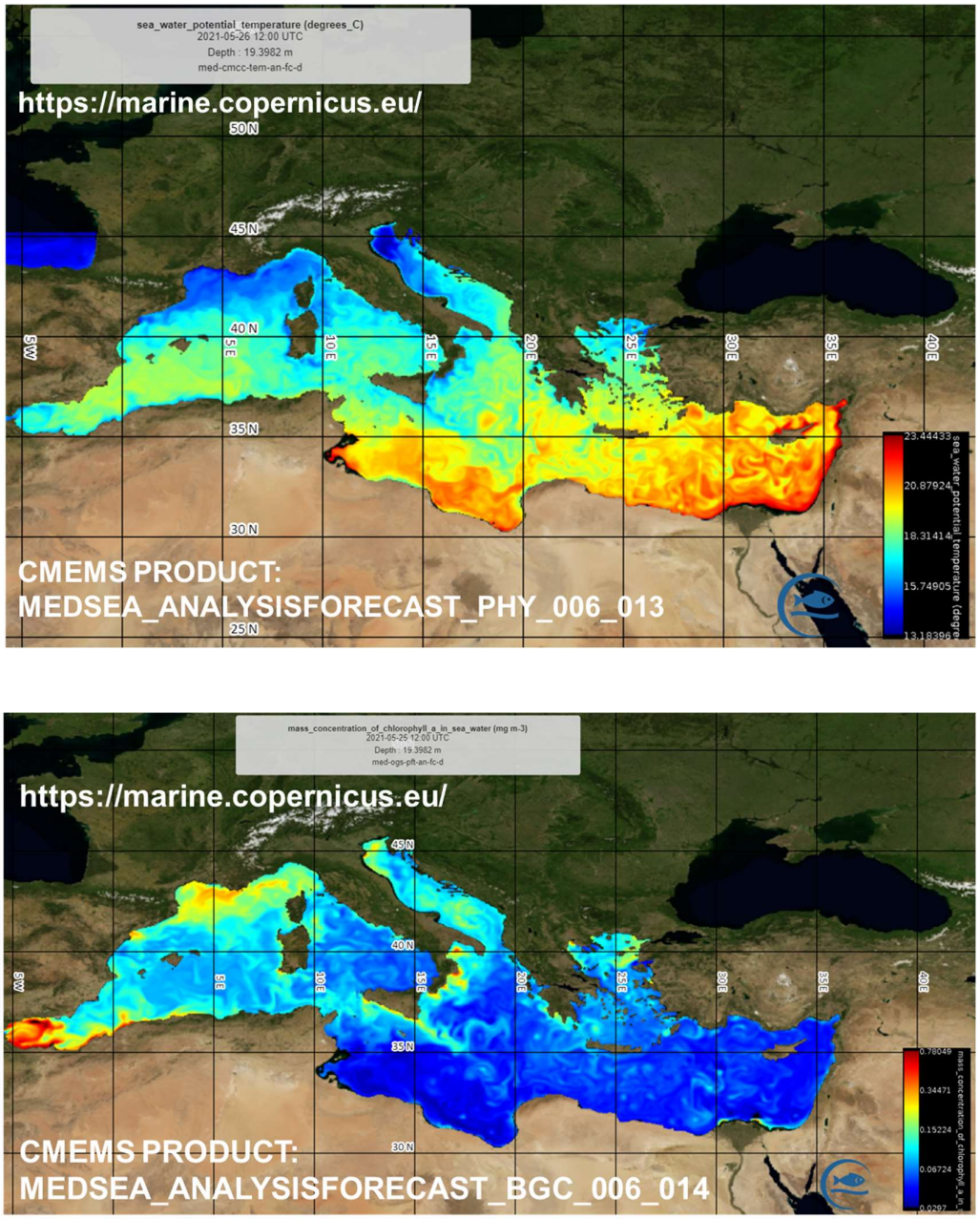

Figure 7. Forecasting models' products available on CMEMS. Physical (top) and biogeochemical (bottom) products.

d. An operational validation system has been developed by SOCIB to systematically assess the model outputs at daily, monthly and seasonal time scales. Multi-platform observations including in-situ measurements (Argo floats included) are used for this systematic validation (figure 8).

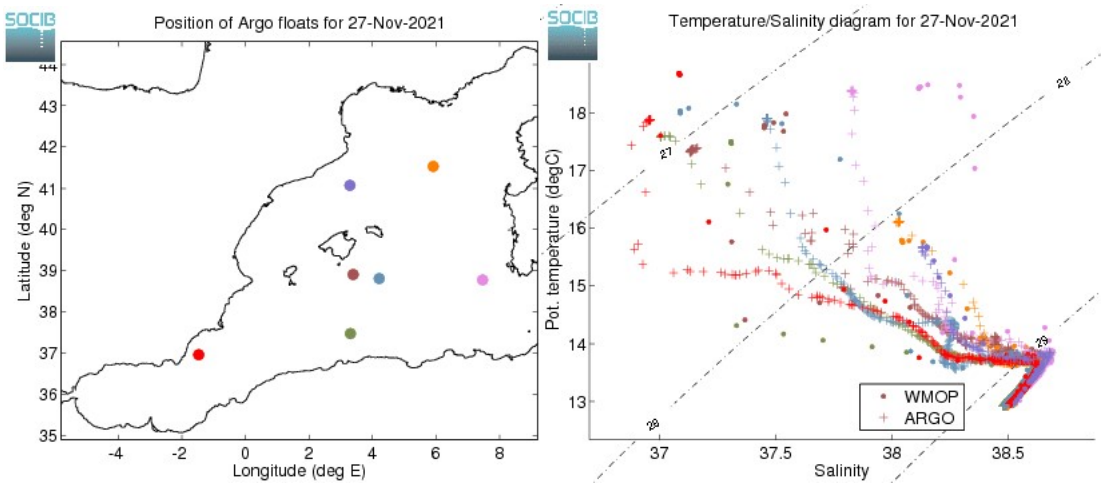

Figure 8. The WMOP temperature and salinity vertical profiles are compared to the last available vertical profiles from Argo floats.

2. Delayed Mode QC

OGS performed the DMQC activity for the Argo data in the Mediterranean and Black Seas. The OW method in conjunction with other procedures is adopted to conduct the quality control analysis for the salinity data.

- The DMQC method was applied to approximately 65% of eligible floats deployed between 2001 and 2020 in the Mediterranean and Black Seas (figures 9 and 10). The method was also applied to another 6.7% of the fleet but the analysis has to be repeated due to problems related to the reference dataset or in the data itself. Each float was quality controlled in delayed-mode for salinity, temperature and surface pressure and the respective D-files were gradually sent to GDAC. The DMQC report/info of each float can be downloaded by the MedArgo web page (http://maos.inogs.it/medargo/table_out.php?active=&med=&prj=&type=&naz=).

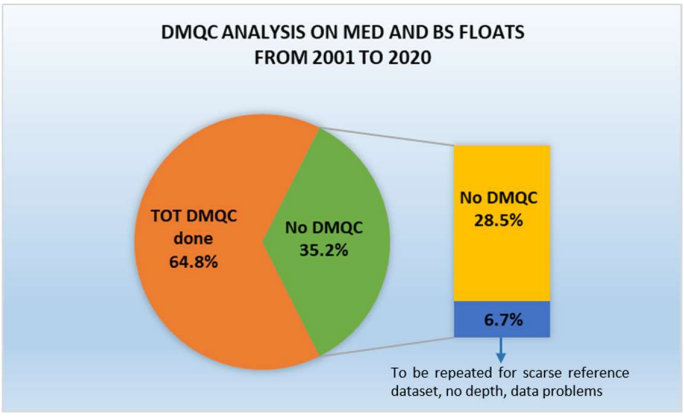

Figure 9. DMQC status.

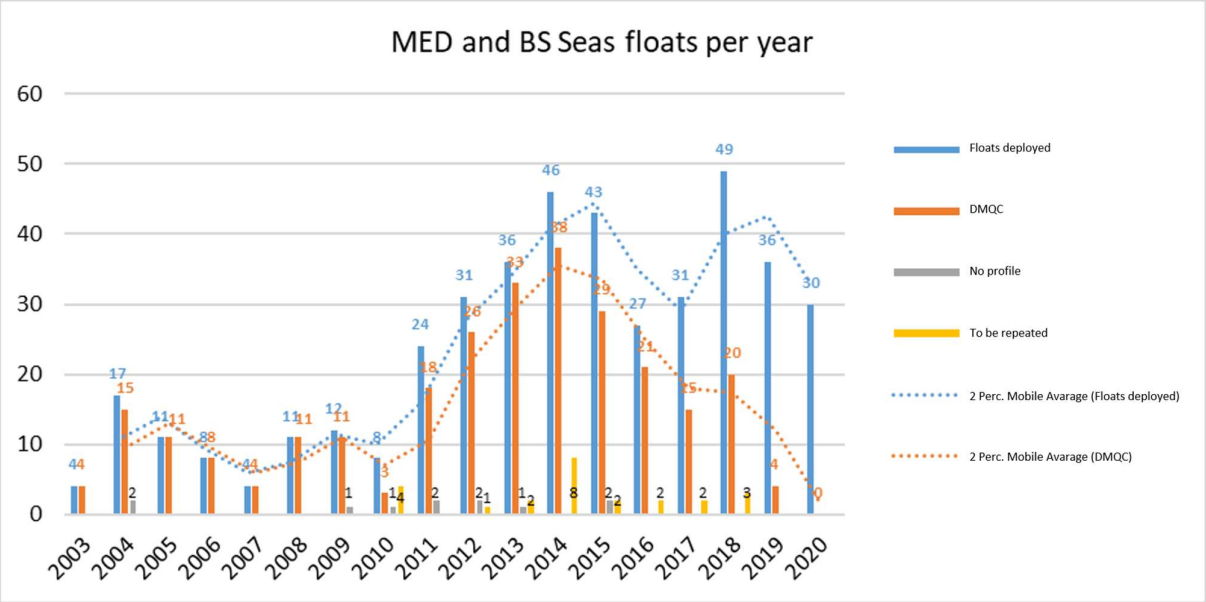

Figure 10. DMQC status per year.

- Salinity anomalies were checked to identify floats that could be affected by fast salinity drift. The results and comments has been reported in a shared spreadsheet (https://docs.google.com/spreadsheets/d/1TA7SAnTiUvCK7AyGtSTUq3gu9QFbVdONj9M9zAq8CJU/edit#gid=1096144849) that is regularly updated to monitor the impact of the rapid salty drift problem at international level.
- The DMQC analysis of deep floats has been conducted on two deep floats deployed close to the Hellenic Trench in the Mediterranean Sea. CPcor corrections have been applied and compared. Two different results were obtained. For one deep float, the best correction was obtained using the nominal CPcor (figure 11). For the second one, the closest in space and time CTD was used because there was no CTD at deployment. The best result was provided by the CPcor default value (Figure 12). Recently, two more deep floats have been deployed in the Mediterranean Sea. OGS will continue to implement delayed mode procedures for adjusting salinity data from Deep-Argo floats with the SBE CTDs in MED Sea, selecting the CPcor correction that provides the best result.

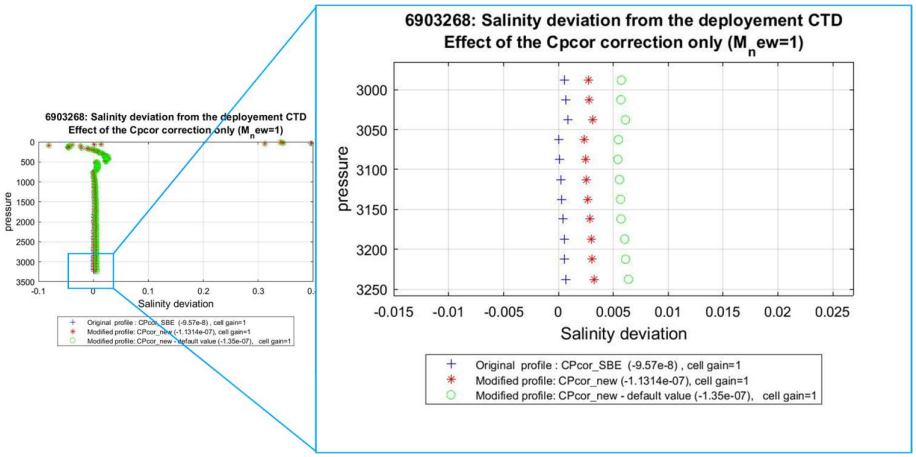

Figure 11. Deep Float 6903268. Salinity deviation from the deployment CTD due to the Cpcor correction using three values: the nominal Cpcor value from Sea-Bird, the Cpcor_new default value obtained by Argo-Deep team and the optimazed Cpcor value obtained in delayed-mode by comparing a deep float profile to a reference profile.

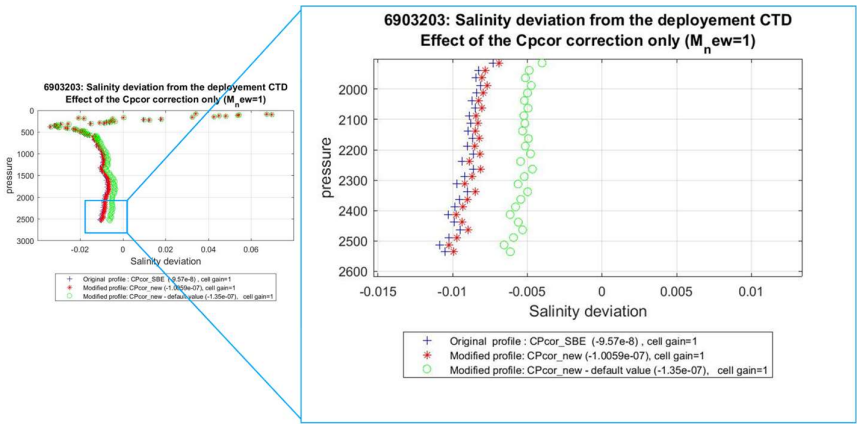

Figure 12. Deep Float 6903203. Salinity deviation from the deployment CTD due to the Cpcor correction using three values: the nominal Cpcor value from Sea-Bird, the Cpcor_new default value obtained by Argo-Deep team and the optimazed Cpcor value obtained in delayed-mode by comparing a deep float profile to a reference profile.

- The high-quality ship-based CTD reference data for QC of core variables was reviewed and improved (figures 13). Data was collected from several research institutes at regional level and the main European Marine Services. Data was

converted in mat format to be used in OWC procedure. A quality control was applied such as an additional visual check to avoid spike or duplication. Data was merged and divided in subsets of WMO boxes according to the climatological areas of the Mediterranean Sea. The updated reference dataset consists of about 67000 CTD profiles, about 10000 CTD profiles more as compared to the previous one. The spatial distribution has improved a lot especially in the Aegean and Levantine sub-basins.

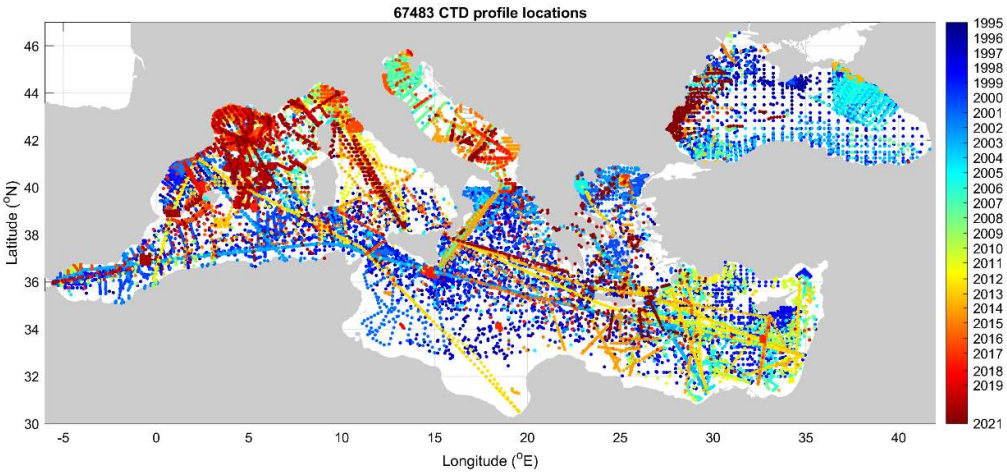

Figure 13. Spatial distribution, color-coded for time, of the CTD profiles in the final version of the CTD reference dataset of the Mediterranean and Black Seas.

3. Regional Centre Functions

- MedArgo is the Argo Regional Centre for the Mediterranean and the Black Sea. OGS, who coordinates the MedArgo activities, established several collaborations with European and non-European countries in order to set the planning and the deployment coordination of floats. Hence, a good coverage is maintained throughout the years. As part of these cooperations the float data are transferred in near real time to MedArgo and 23 new floats have been deployed in the Mediterranean and Black Sea during 2021, through a coordinated activity of deployment opportunities and thanks to scientific projects.
- There are 79 active Argo floats in the Mediterranean Sea and 12 in the Black Sea as of 29 November 2021.
- The main MedArgo partners (Italy, Greece, Spain, France and Bulgaria) are strengthening the collaboration with the riparian countries through the H2020 Euro-Argo RISE project, to improve the Argo activities (deployment plans and

opportunities, sharing reference datasets for QC, sharing expertise, joint activities). Furthermore, in the framework of this project, extension of Argo operations in shallow/coastal waters is ongoing.

- The high-quality CTD reference dataset for DMQC has been improved and updated.
- The D-files of 65% of the eligible profiles (core variables) have been submitted to the GDAC.