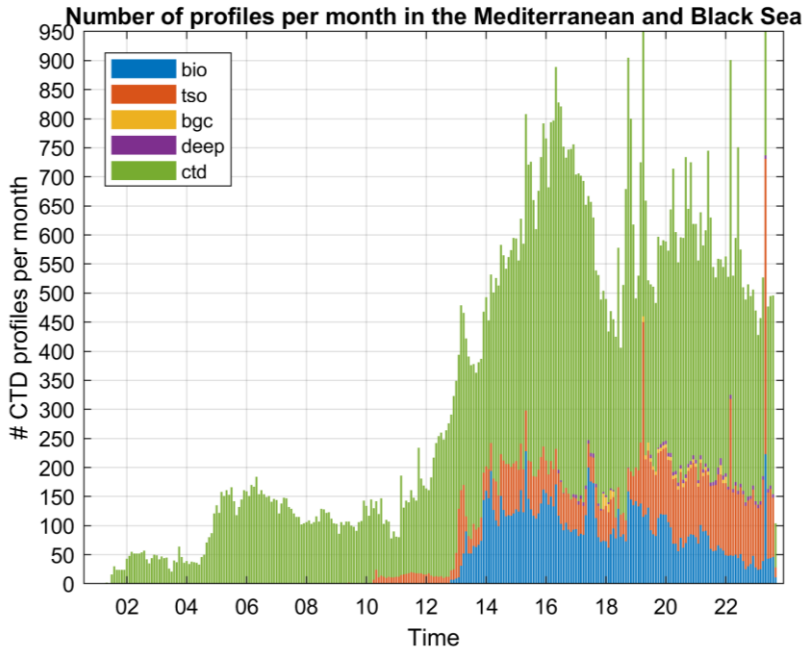
1. Real Time Status

- Data acquired from floats

More than 92500 Argo profiles were acquired in the Mediterranean and in Black Seas between 2000 and September 2023. The temporal and spatial distribution of these profiles is depicted in figure one, sorted by the different float types used (Core-Argo, Core-Argo with DO, Bio-Argo [carrying some of the BGC sensors], Deep-Argo and BGC-Argo [equipped with sensors to measure the 6 EOVs]); the monthly and yearly distribution is shown in Figure 2. About 75-80 floats per month have been operated simultaneously in the basins in 2023 and more than 4600 profiles have been acquired (up to September 2023) by different float models (figure 3).



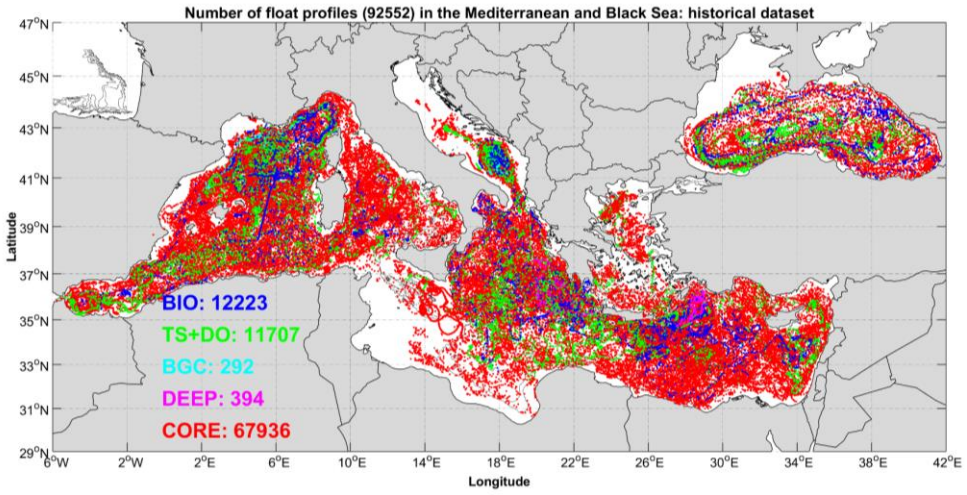


Figure 1. Temporal (upper panel) and spatial (bottom panel) distribution of float profiles in the Mediterranean and Black Sea between 2000 and September 2023.

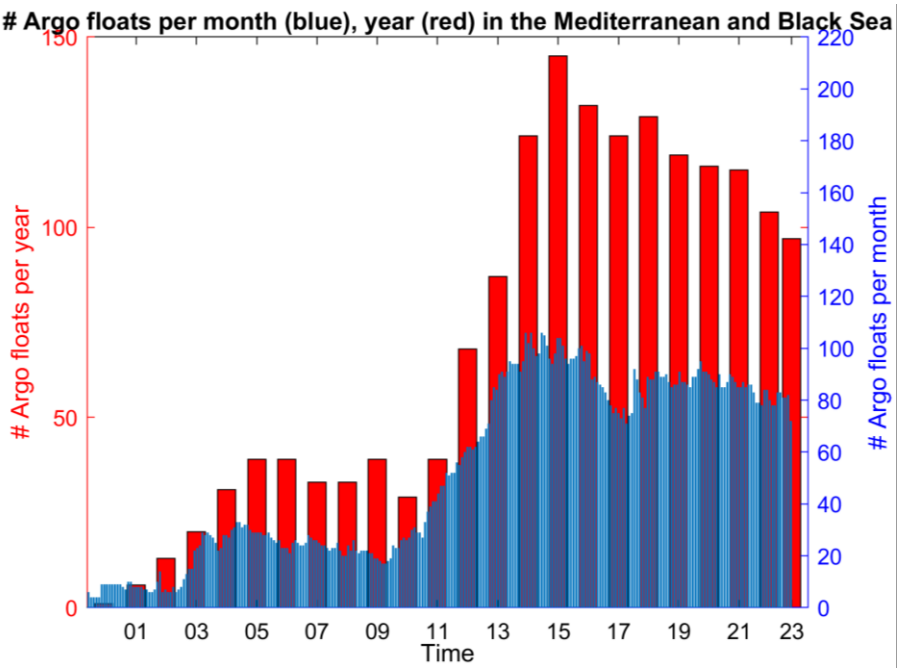


Figure 2. Monthly (blue bars) and yearly (red bars) distribution of Argo floats in the Mediterranean and Black Sea between 2000 and September 2023.

The number of profiles acquired by Argo-extension floats in 2023 is about 1850 whilst the ones collected by the core-Argo floats are about 2800 (figure 3). EU, Spain, Greece, France, Bulgaria (see their national reports at

https://argo.ucsd.edu/organization/argo-meetings/argo-data-management-team-meetings/argo-data-management-team-meeting-24-admt-24/) and Italy (national report available at https://argo.ogs.it/pub/Argoitaly_annual_report_2022_firmato_ricercabile.pdf) contributed to maintain the Argo population in 2023: a total of 16 new floats have been deployed both in the Mediterranean and in the Black Seas; 5 out of 16 platforms are core-Argo, 4 are core-Argo with DO, 1 is BGC and 6 are Bio. Additional deployments are planned by the end of 2023. The deployment strategy was chosen according to the project's targets and to replace dead floats or under-sampled areas.

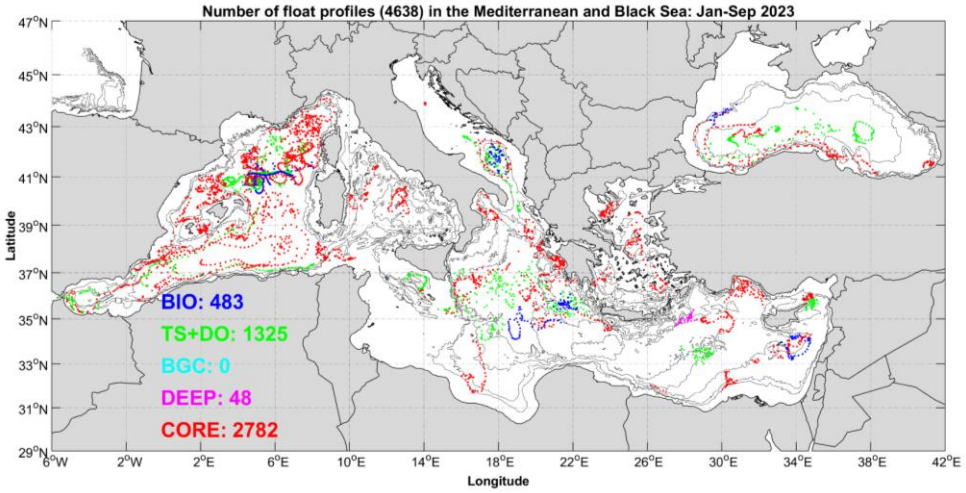


Figure 3. Spatial distribution of profiles collected by Argo floats in 2023 (January-September) in the Mediterranean and Black Sea: locations are color-coded per float type.

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 about 580 cycles, whilst the mean half-life is about 150 cycles (figure 4a). In this computation, active floats with life lower than the mean half-life and recovered floats were excluded (about 20). The vertical distance (upward profiles) traveled by floats is computed and used as an indicator of the profiler performance (figure 4b). The maximal distance observed is about 600 km, whilst

the mean distance traveled is about 125 km. The balance of the population is in figure 5a and the annual death rate in figure 5b.

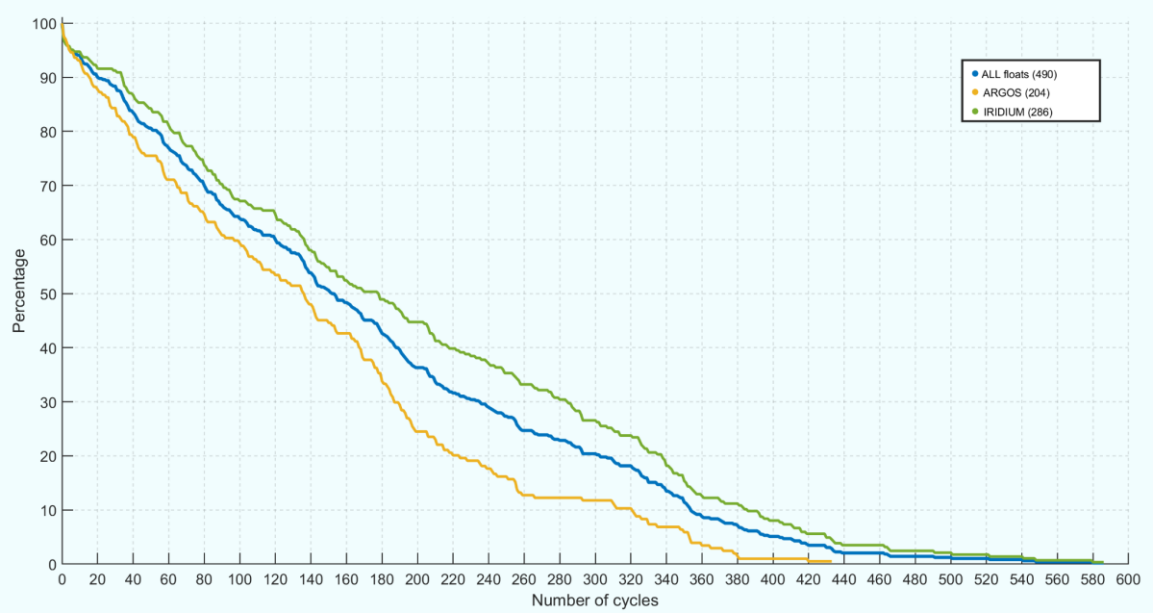


Figure 4a. Survival rate diagrams separated by telemetry system.

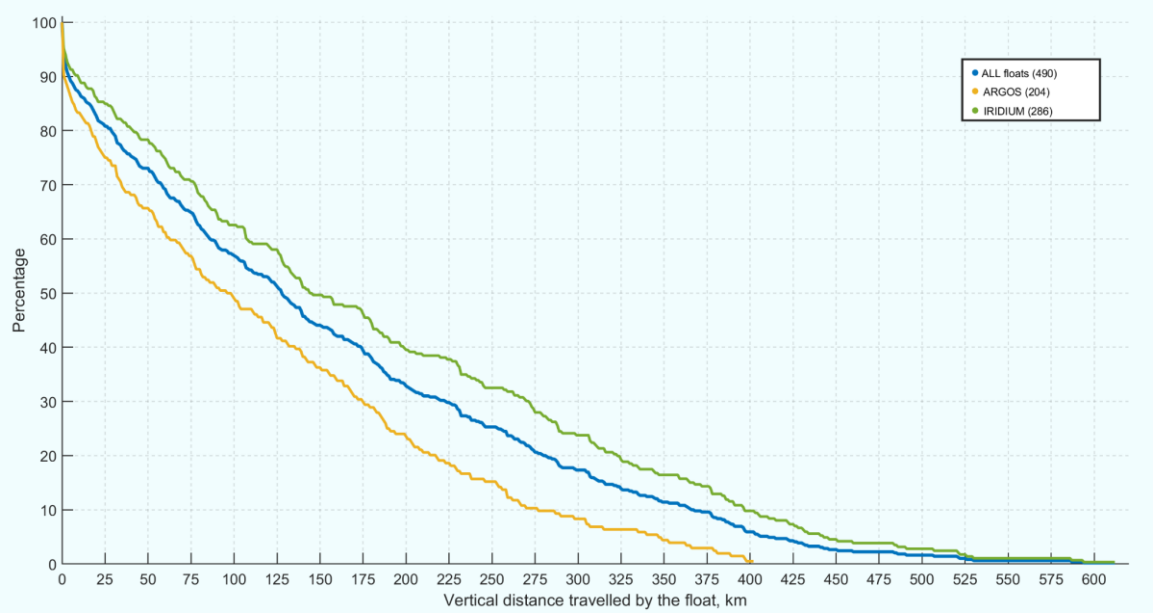


Figure 4b. Diagram of the vertical distance traveled floats, separated by telemetry system.

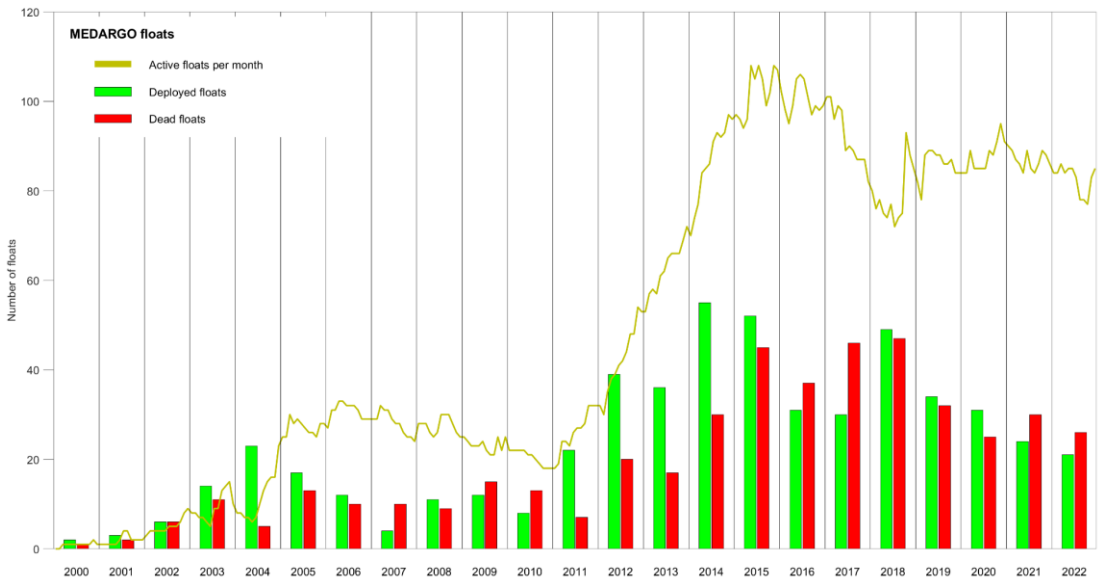


Figure 5a. Balance of the population (rate of population change related to the number of yearly deployments and dead floats).

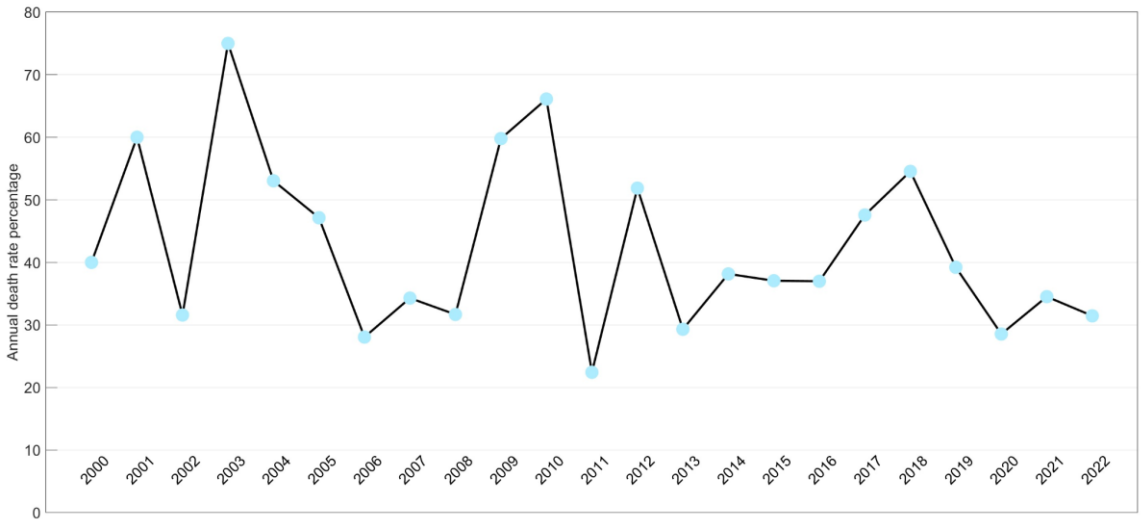


Figure 5b. Annual death rate (ration between yearly failure and yearly average population).

- Delayed mode data sent to GDACs

Most of the eligible floats were quality controlled in delayed-mode for salinity, temperature and surface pressure and the respective D-files were gradually sent to GDAC. The DMQC method was applied to approximately 86% of eligible floats

deployed between 2003 and 2022 in the Mediterranean and Black Seas (figures 6 and 7). 12% out of this percentage were quality controlled but the D-files were not sent to GDAC yet. This percentage includes analysis that has to be repeated due to problems related to the reference dataset (scarcity or old data), shallow/coastal floats. The DMQC report/info of each float can be downloaded by the MedArgo web page (http://argo.ogs.it/medargo/table_out.php).

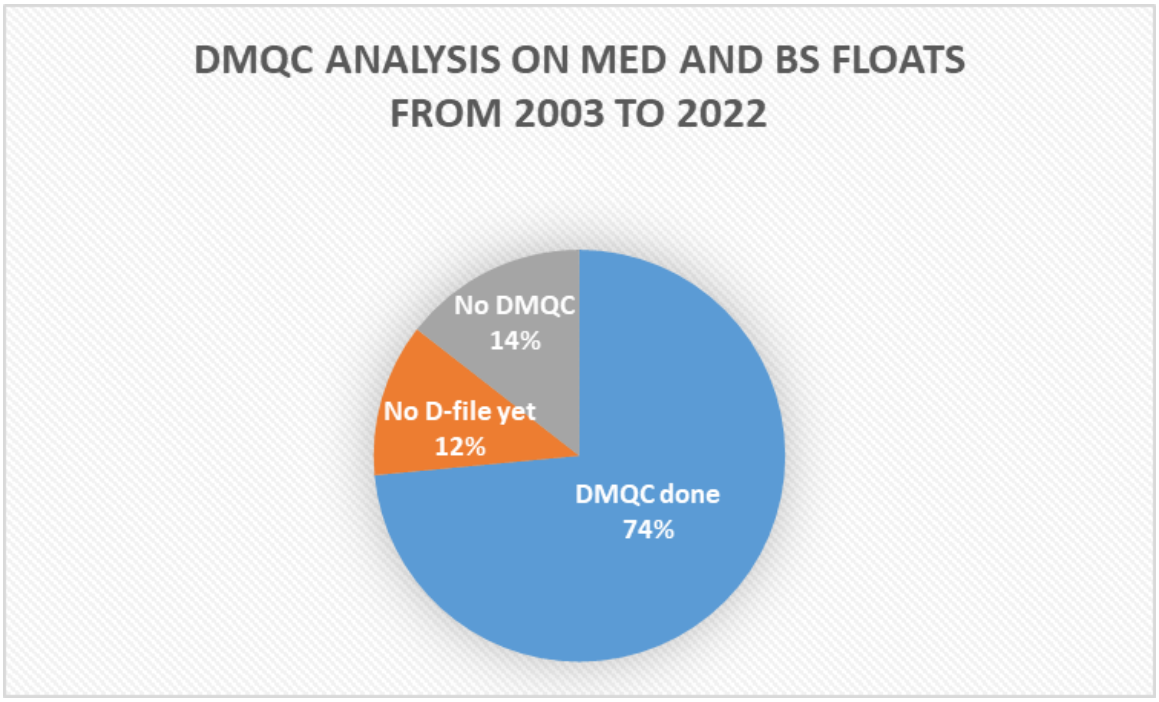


Figure 6. DMQC status.

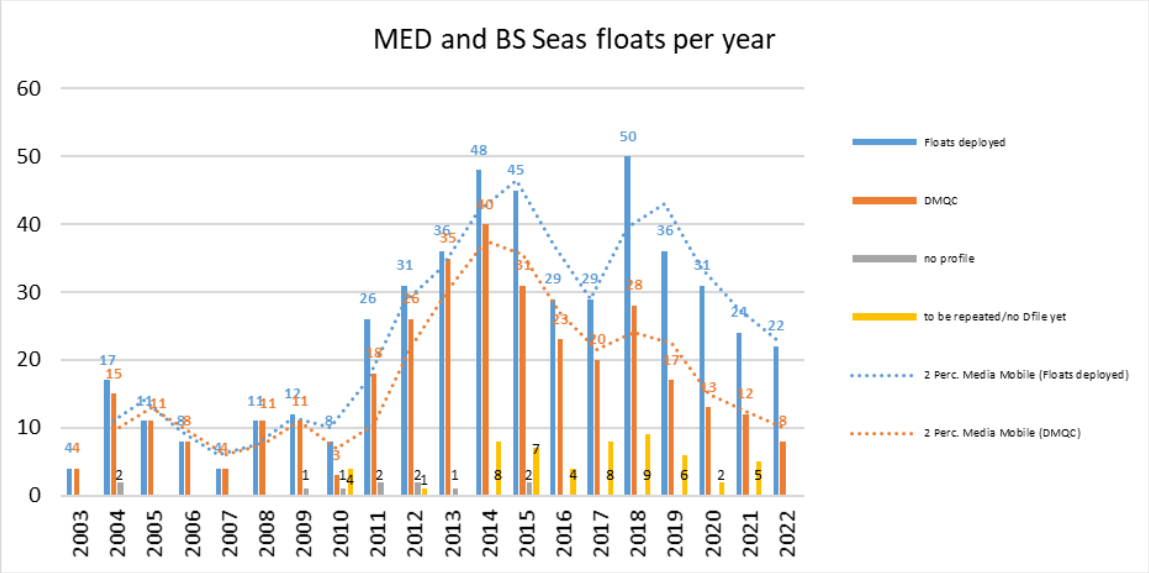


Figure 7. DMQC status per year.

2. Delayed Mode QC status

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 PCM (Profile Classification Model) method is under implementation in the Mediterranean sea. The selected reference profile based on vertical profile classification could improve the OWC results, especially in basins where the reference dataset is scarce and old (see figure 8 as an example).

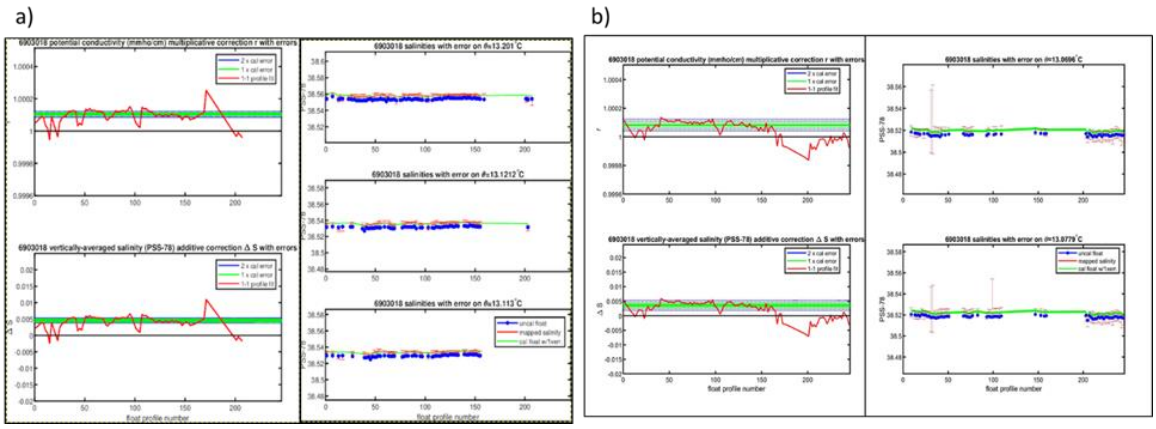


Figure 8. OWC figures obtained using PCM method (a) and not (b).

- The DMQC analysis was also conducted on the shallow-coastal floats deployed in the Mediterranean Sea, in the framework of the European H2020 Euro-Argo Rise project. Several additional qualitative analyses, as qualitative comparisons between floats profiles and CTD at deployment or nearest CTD in space, were computed in order to obtain a more reliable quality control (figure 9). The procedure developed for the Baltic sea (https://www.euro-argo.eu/content/download/162917/file/D2.7_MarginalSeasDMQC_V2.1.pdf) was adapted to the Adriatic sea in order to improve the qualitative analysis.

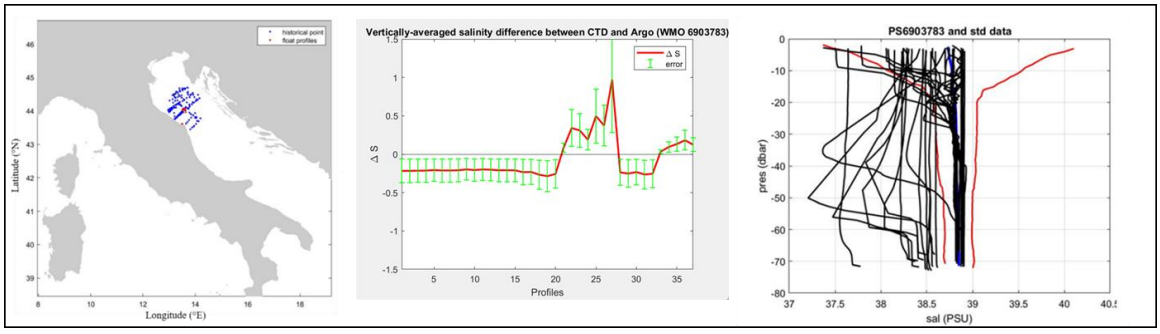


Figure 9. An example of plots obtained for the WMO 6903783 float. On the left, locations of float profiles (red dots) and reference profiles selected for statistical comparison (blue dots). In the middle, the vertically-averaged salinity difference between CTD and Argo. On the right uncalibrated float salinity profiles (black lines), standard deviation calculated with all CTDs (red lines), The mean of the most recent CTD data (blue line).

- The high-quality ship-based CTD reference data from the near-surface to depths more than 2000 m, for QC purposes of Core and Deep-Argo float data in the Mediterranean and Black seas, was improved adding some new CTD data (figures 10 and 11). 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 66800 CTD profiles.

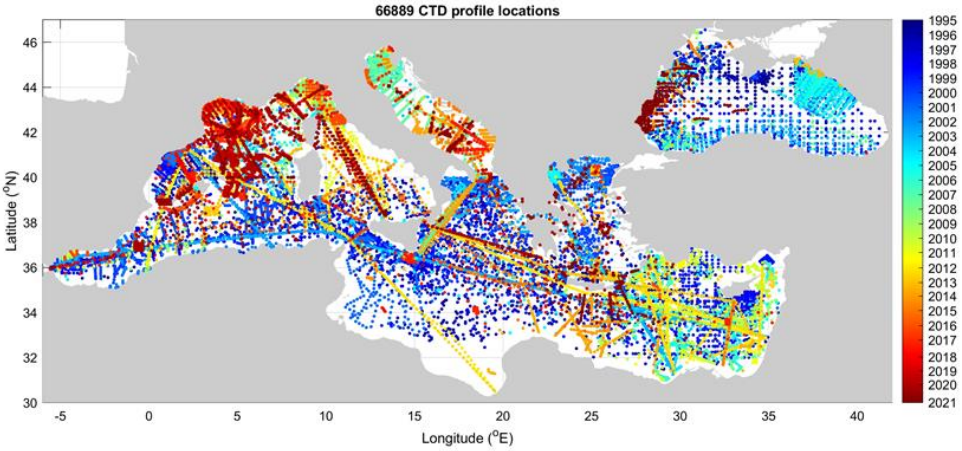


Figure 10. Spatial distribution, color-coded for time, of the CTD profiles in the final version of the CTD reference dataset of the Mediterranean and Black Seas.

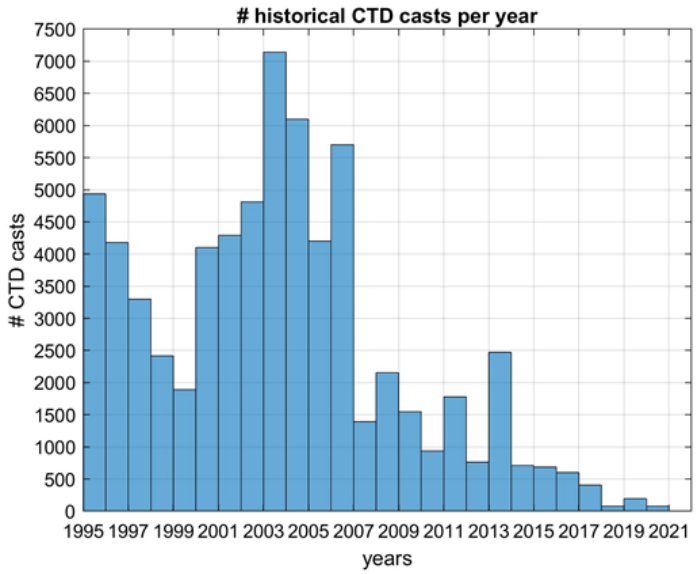


Figure 11. Temporal distribution of the CTD profiles in the final version of the CTD reference dataset of the Mediterranean and Black Seas.

In addition, the method developed by BSH was implemented and tested. Since it was developed for open oceans, it works well for profiles deeper than 600 m in the Mediterranean Sea, so it is only used in certain sub-basins.

3. Value Added items

- List of current national Argo web pages, especially data specific ones

The layout of the MedArgo web page (http://argo.ogs.it/medargo/) has been re-designed according to the OGS web page. Tables and graphics are updated in near real time. The float positions are plotted daily (figure 12); the float deployments are added to the web page as soon as the technical information is available (figure 13); 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.

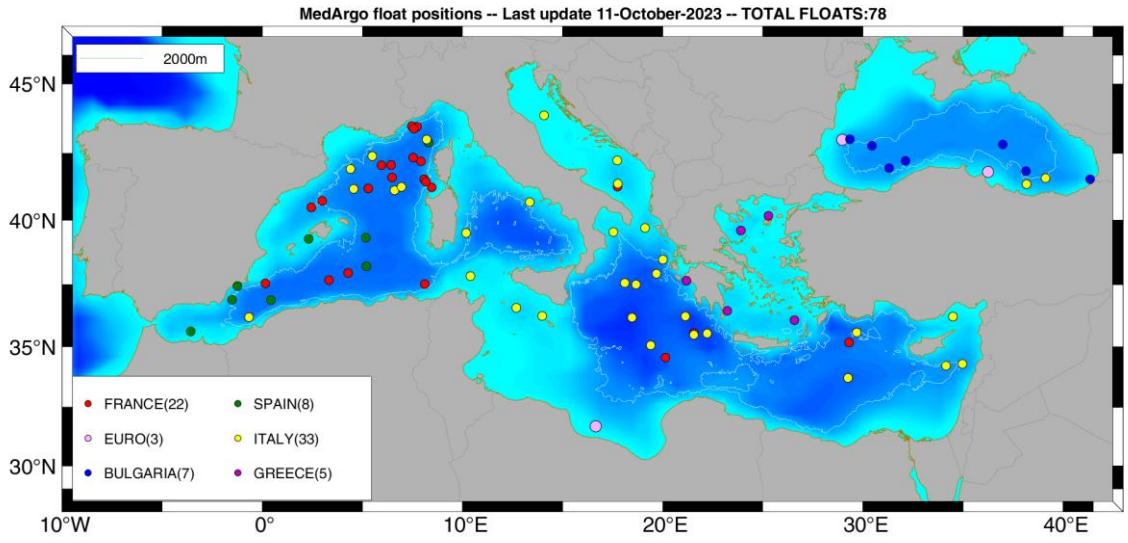


Figure 12. MedArgo float positions as of 11 October 2023 (updated daily).

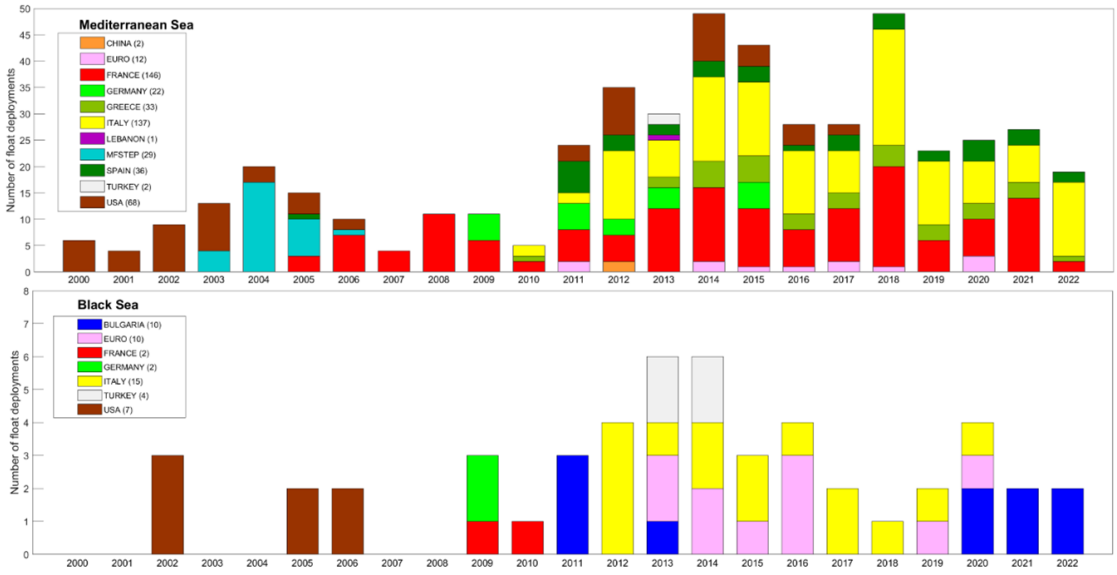


Figure 13. MedArgo number of float deployments until 2022.

- Products generated from Argo data that can be shared

a. 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 14).

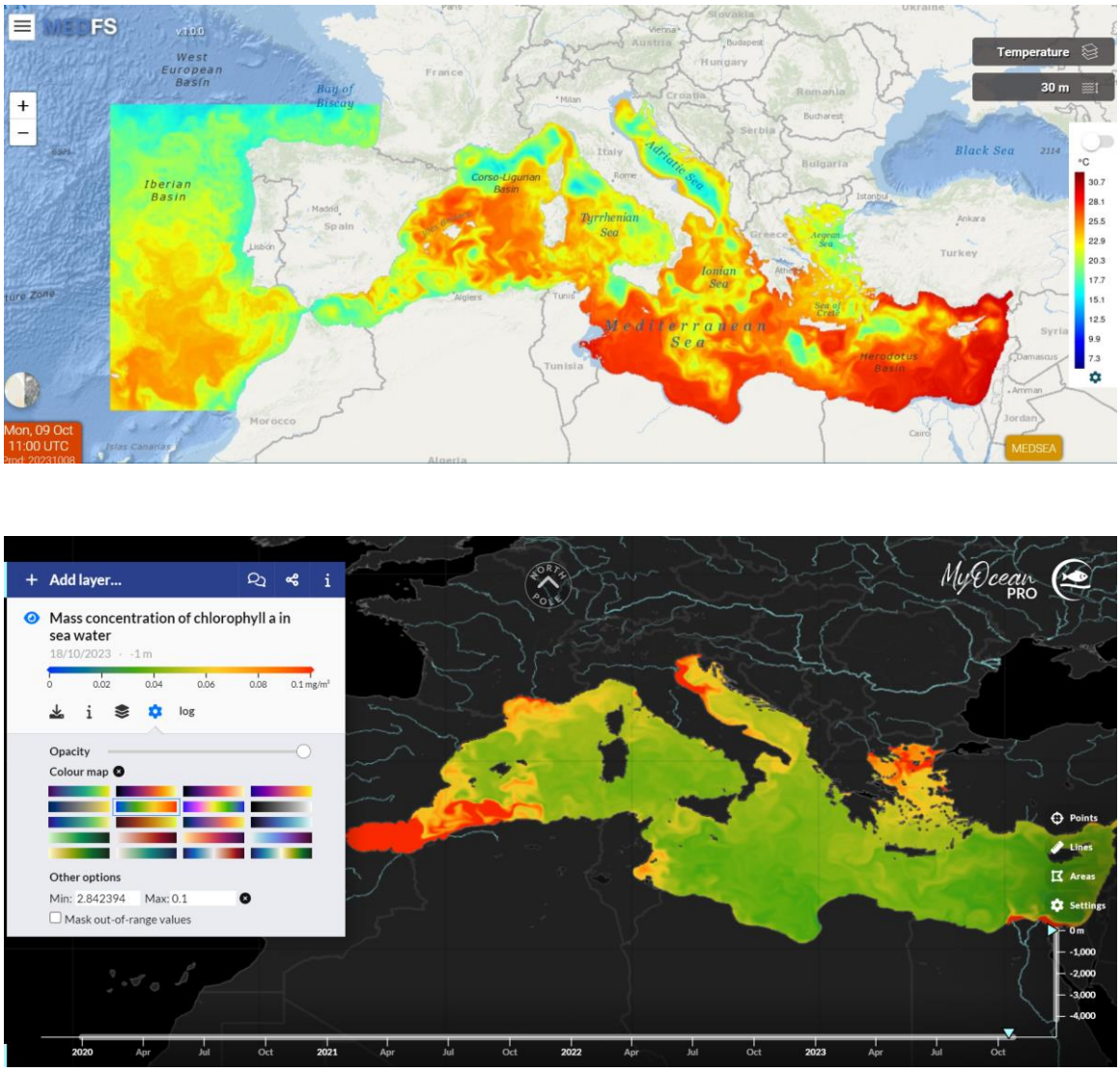


Figure 14. Forecasting models' products available on CMEMS. Physical (top panel https://medfs.cmcc.it/) and biogeochemical (bottom panel https://data.marine.copernicus.eu/product/MEDSEA_ANALYSISFORECAST_BGC_006_014/description?view=-&product_id=-&option=-) products.

4. 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 16 new floats have been deployed in the Mediterranean and Black Sea during 2023, through a coordinated activity of deployment opportunities and thanks to scientific projects. Additional floats will be deployed before the end of 2023.

✓ There are 68 active Argo floats in the Mediterranean Sea and 10 in the Black Sea as of 9 October 2023.

✓ The main MedArgo partners (Italy, Greece, Spain, France and Bulgaria) strengthened collaborations with the riparian countries through the H2020 Euro-Argo RISE project, (https://www.euro-argo.eu/EU-Projects/Euro-Argo-RISE-2019-2022) to improve the Argo activities (deployment plans and opportunities, sharing reference datasets for QC, sharing expertise, joint activities, advance in DMQC). Furthermore, in the framework of this project, extension of Argo operations in shallow/coastal was performed.

✓ The high-quality CTD reference dataset for DMQC has been updated.

✓ The D-files of 74% of the eligible profiles (core variables) have been submitted to the GDAC.

Future plans:

➢ Maintain > 60 active floats in the Mediterranean Sea, with ~20-25% BGC and Bio

➢ Maintain 2 deep floats in deep Ionian & Rhodes Gyre area

➢ Maintain > 10 active floats in the Black Sea, with ~20% Bio