OGS National Institute of Oceanography and Applied Geophysics

Mediterranean Shallow Coastal floats

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Arctic and Baltic Seas DMQC workshop
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OUTLINE

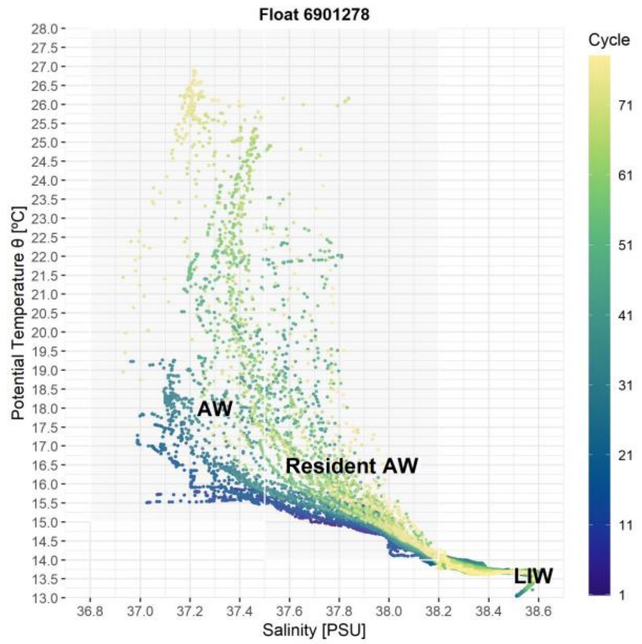
- Overview of the Mediterranean sea
- DMQC workflow for Argo floats
- Example of two shallow coastal Argo floats
- Conclusions

Overview of the Mediterranean Sea

The Mediterranean Sea is a semi-enclosed basin connected to the Atlantic Ocean by the narrow Strait of Gibraltar and to the Black Sea by the Dardanelles Marmara Sea-Bosphorus system

The circulation in the Mediterranean is the result of a complex interaction between the mesoscale variability, the seasonal variability and the seasonal and interannual scales

The portion of the water column in the Mediterranean Sea that has a uniform θ-S relationship is mostly at pressure larger than 700 dbar



Example of TS diagram

Figure 31. Potential temperature versus salinity (θ/S) diagram.

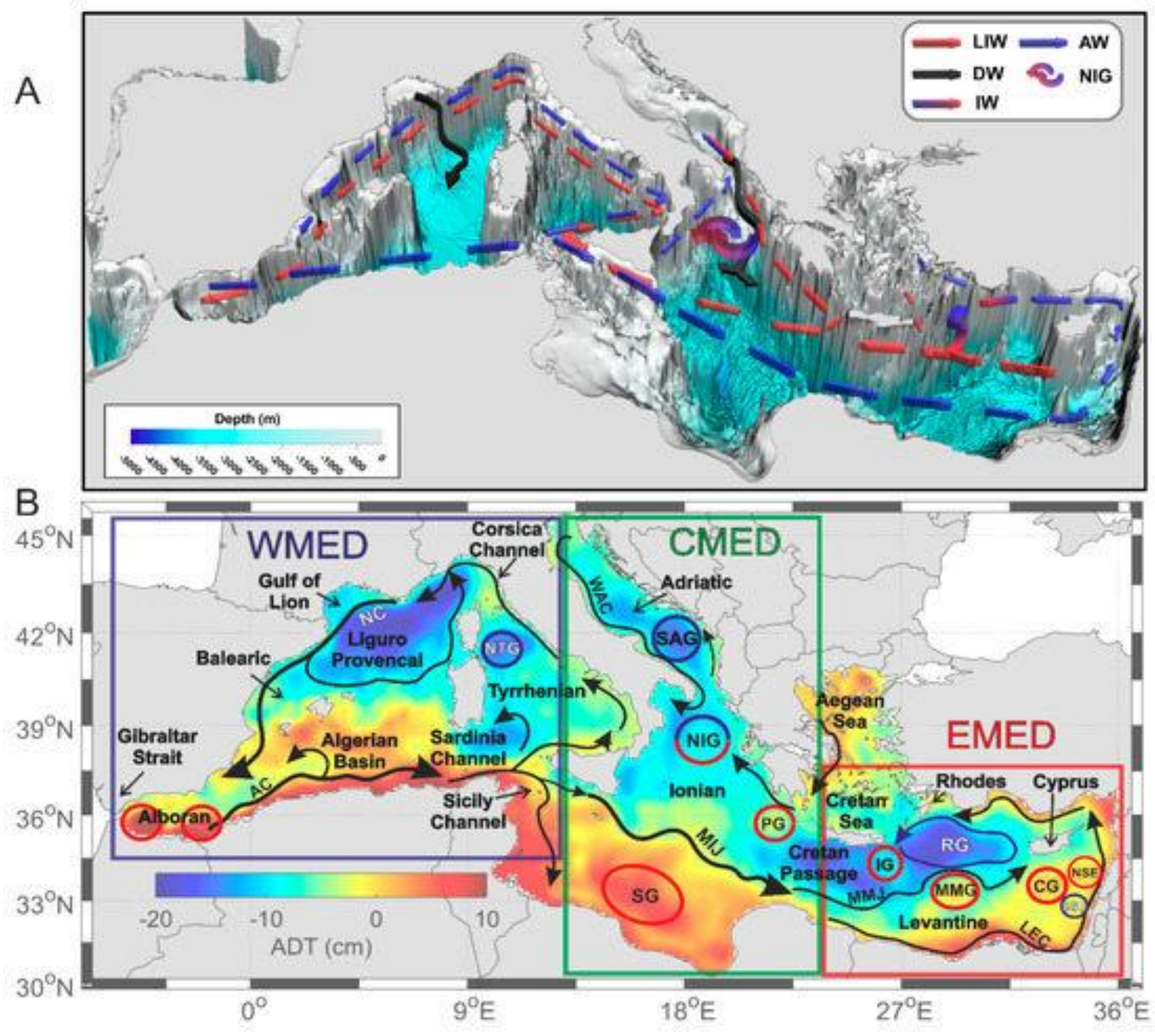
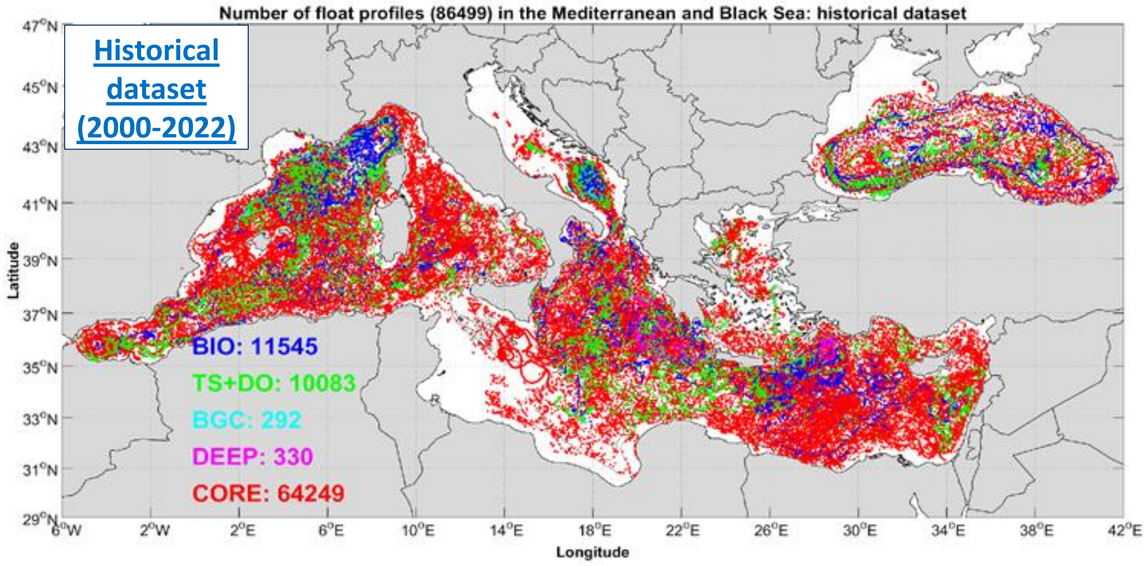
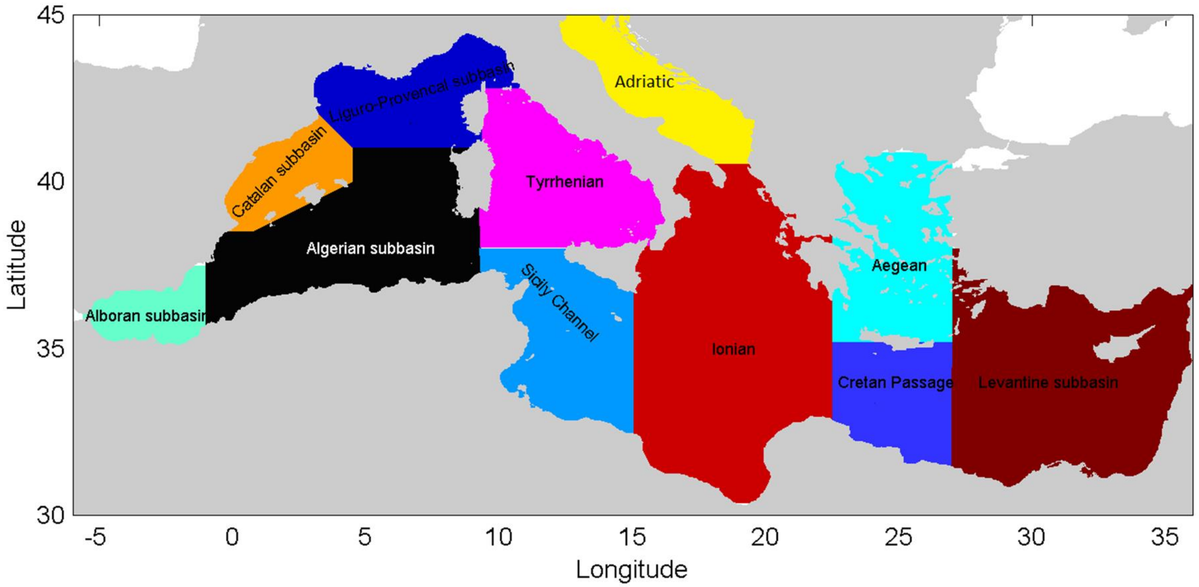
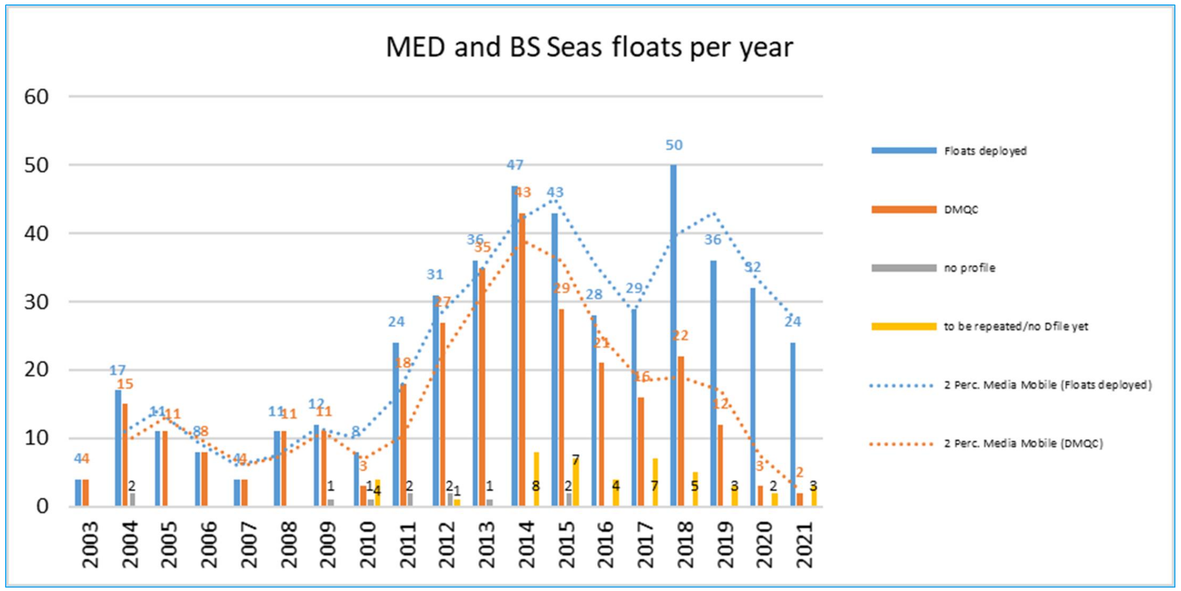


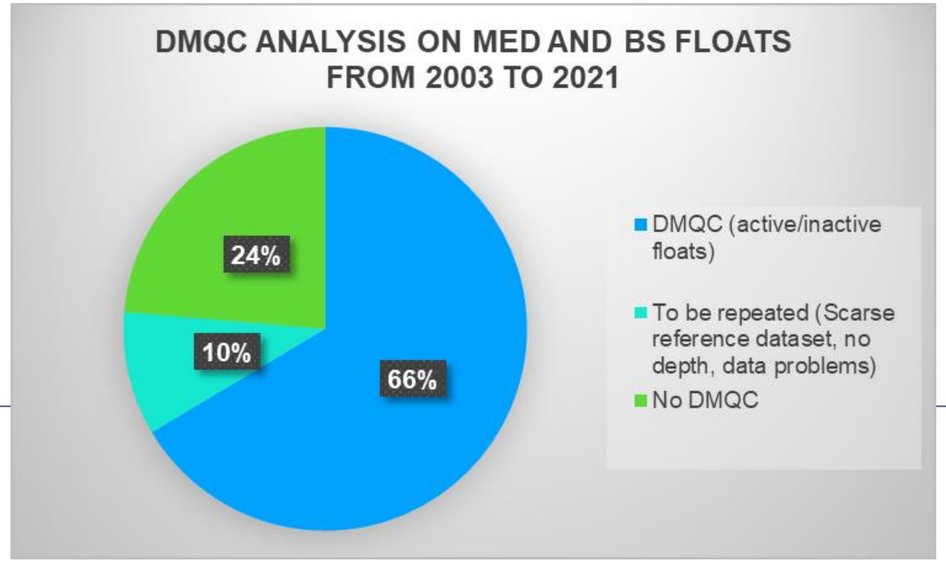
Figure by Menna et al 2022



The Mediterranean sea is divided in the various sub-basins characterized by different water masses, in order to avoid selecting historical data for calibration coming from completely different oceanographic regions.







DMQC Status

DMQC Workflow

- Verify real-time QC flags
- Visually inspect profiles (P,T); (P,S); (P/Rho); (Theta/S)
- Plots of temperature, salinity and density plotted against the nearby historical CTD profiles

Core Floats (depth 500 – 2000 dbar)

- OWC method (Owens and Wong 2009; Cabanes et al 2016)

A statistical method based on the comparison with accurate quality-controlled reference data

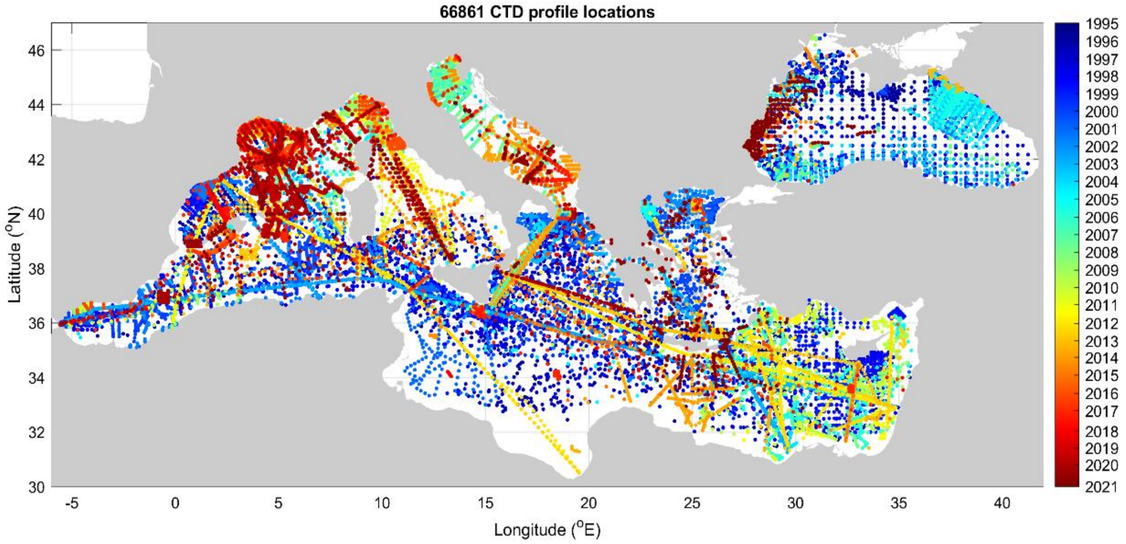
Required Accuracy
±0.01

Shallow Floats

- Statistical Qualitative analysis using climatology

Estimated Accuracy
[0.05 – 0.1]

CTD reference dataset



- Update in August 2022
- Data was collected from several research institutes at regional level and the main European Marine Services
- Data analysis:
  - Converted in mat format to be used in OWC procedure
  - Quality control: an additional visual check to avoid spike or duplication
  - Subset of the WMO boxes according to the climatological areas of the Med Sea
  - Improve and update the reference dataset for Mediterranean and Black Seas

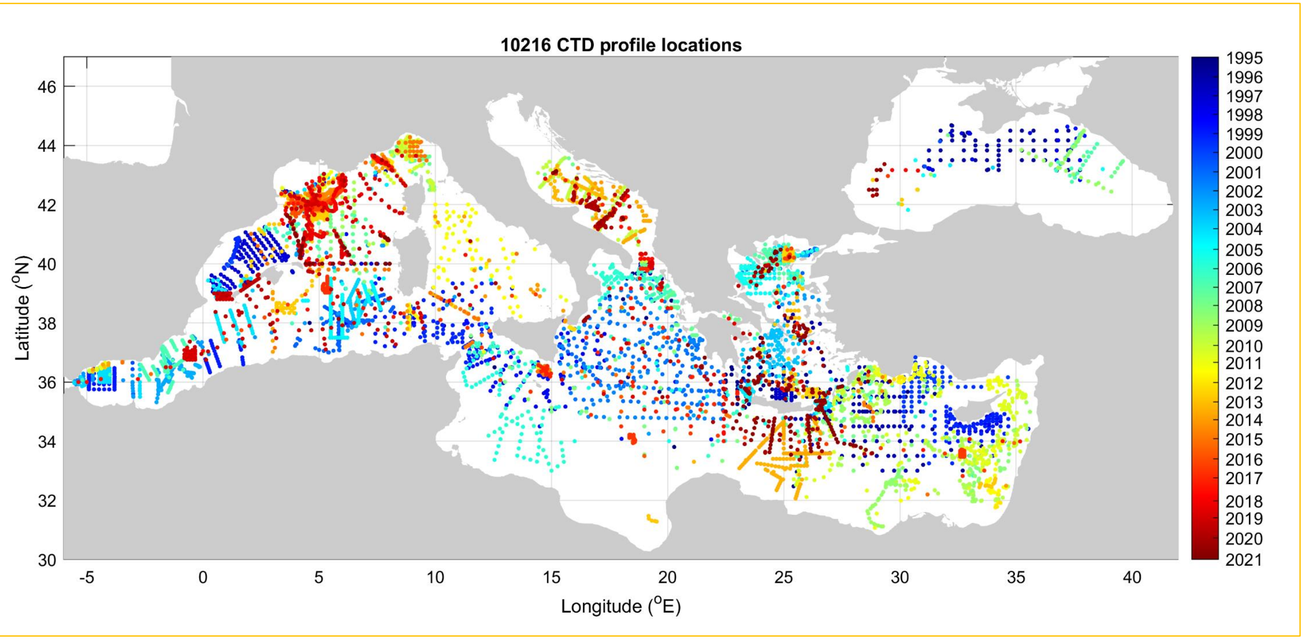
✓About 66800 CTDs

✓A good spatial distribution with a more recent/contemporaneous data compared to the previous one

✓The vertical resolution about 1 dbar

Update in February 2023

The code developed at BSH is adapted to the Mediterranean sea to accurately check for duplicates, suspicious data, large time gaps



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The combination of intrigue coastlines, and complex bathymetry in relatively shallow water environments, raises concerns and questions whether Argo platform, that has been originally designed to perform in the open ocean environment, can adequately perform in coastal regions

Under the framework of Euro-Argo RISE project and more specifically under its WP6 activities, Argo floats were tested in selected areas of the Mediterranean Sea as part of a new extension of Argo.

Targeted deployments have been planned in near-shore and shallow waters.

Shallow/coastal deployments:

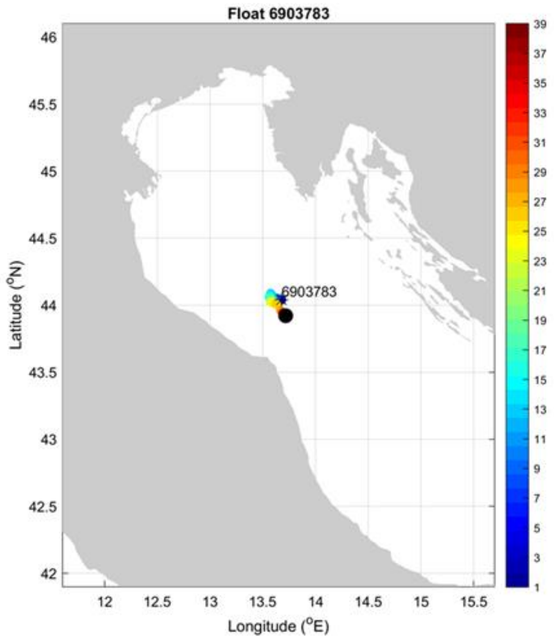
- Balearic Archipelago
- Ligurian sub-basin
- north Adriatic Sea
- north Aegean Sea

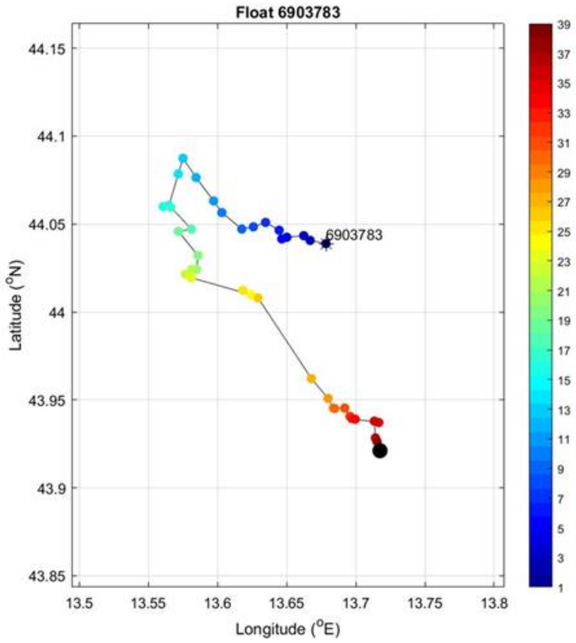
Configuration:

Park pressure at specific depths (typically quite deep and even on the seafloor)

The cycle time → between 1 and 5 days

Example North Adriatic sea – WMO 6903783



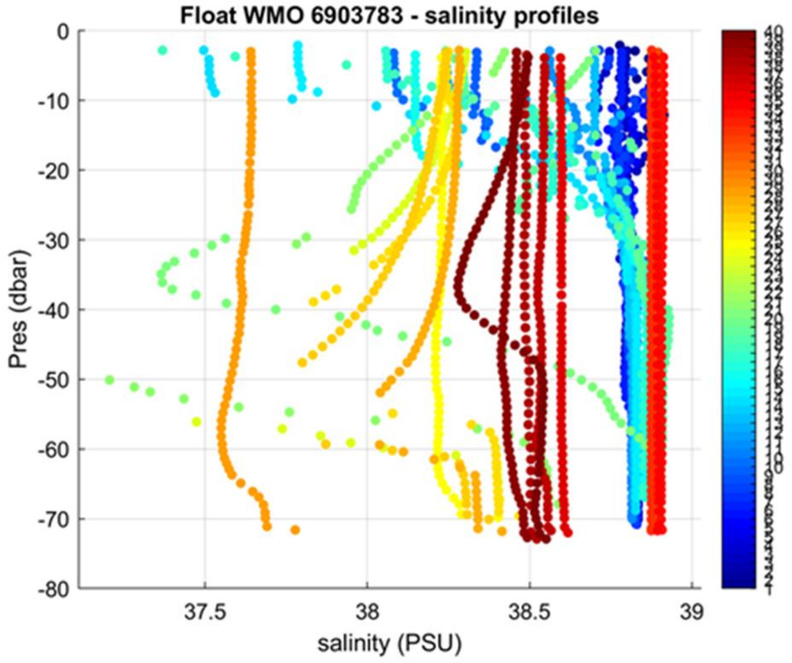


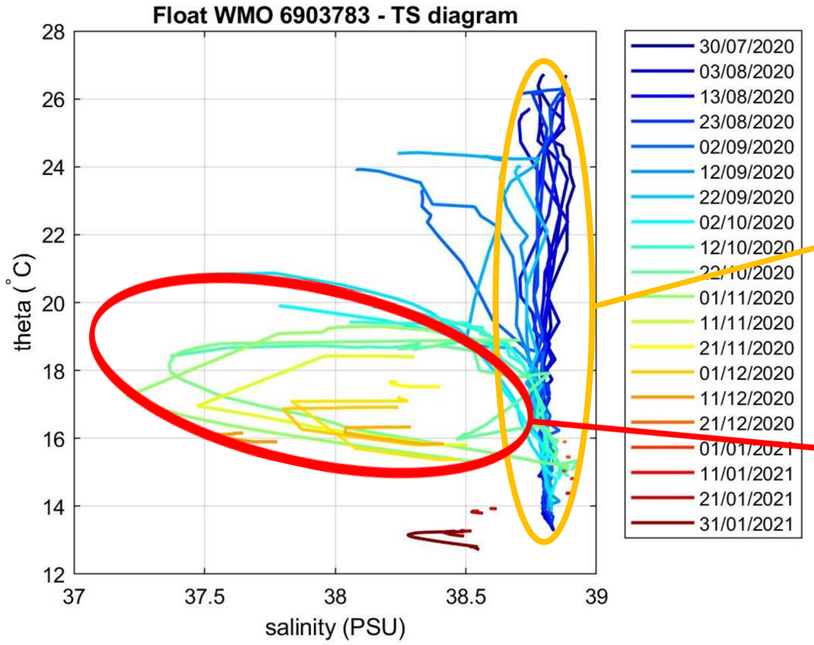
Float type	WMO	Deployment date	Last station date	Cycle
Arvor I	6903783	31 July 2020	6 February 2021	40

Flags applied are QC=1 to all cycles except for cycles 22 (QC=4) and 33 (QC=3)

Virtual mooring configuration

The cycle time was set quite short (2 days) for the first float's cycles extended to 5 days



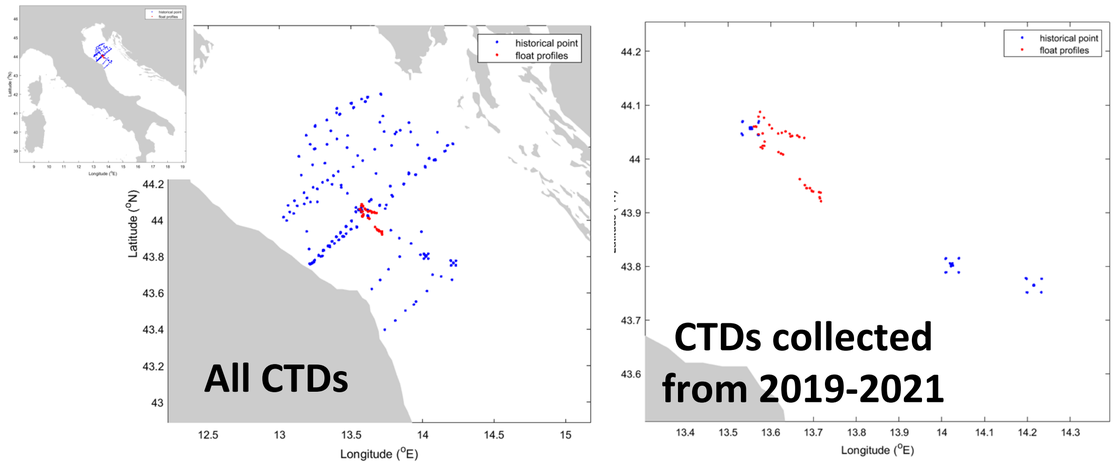


Levantin water

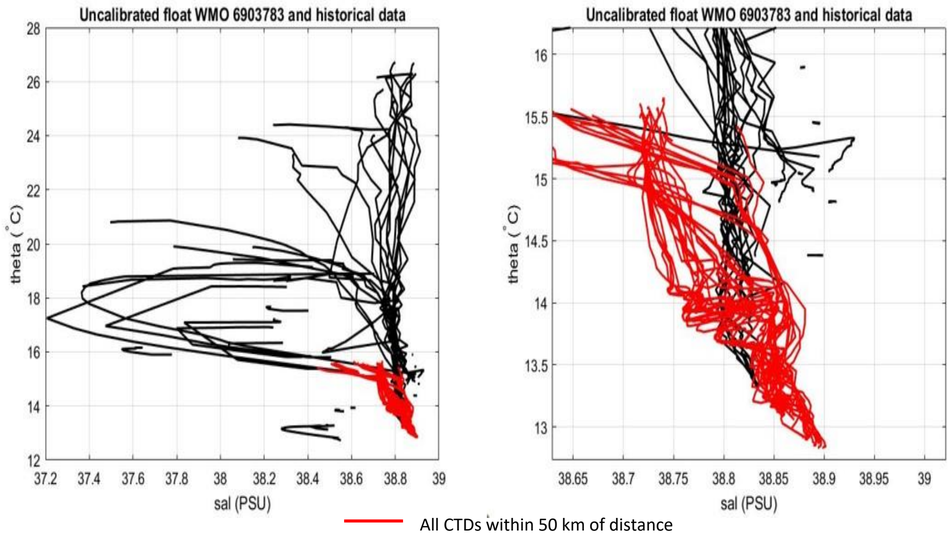
Fresh water (Po river, Atlantic water, other events)

Qualitative analysis results

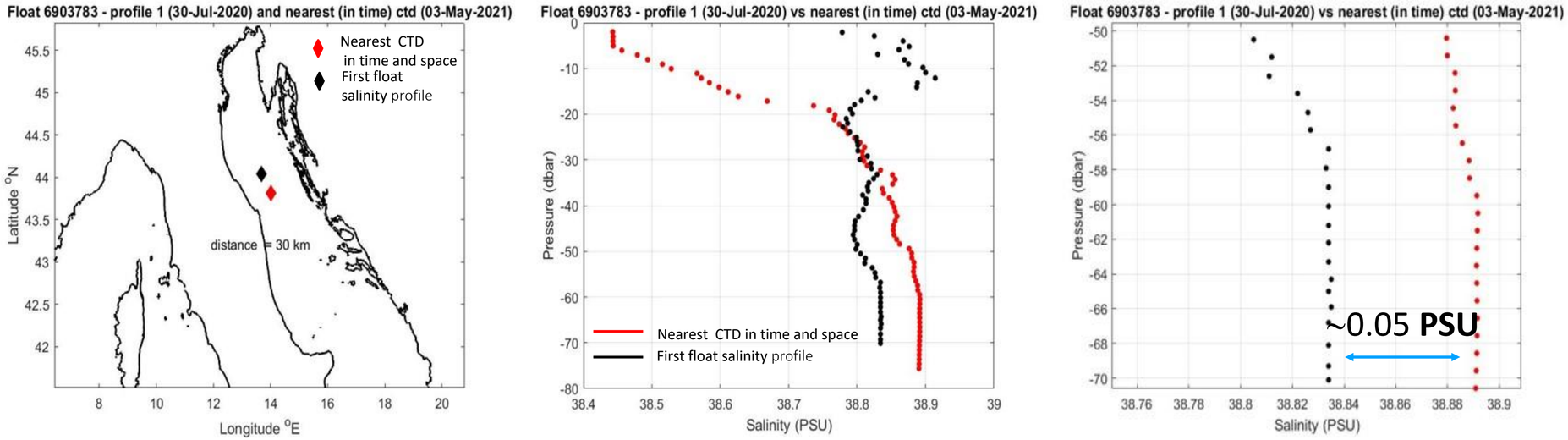
Locations of float profiles (red dots) and reference profiles within 50km of distance selected for statistical comparison (blue dots).



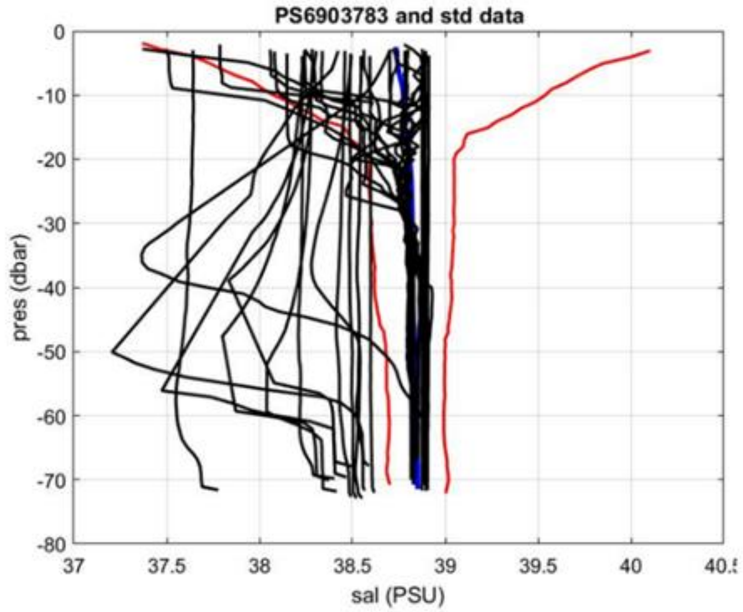
Comparison of float profiles (2020-2021) with the nearest CTDs

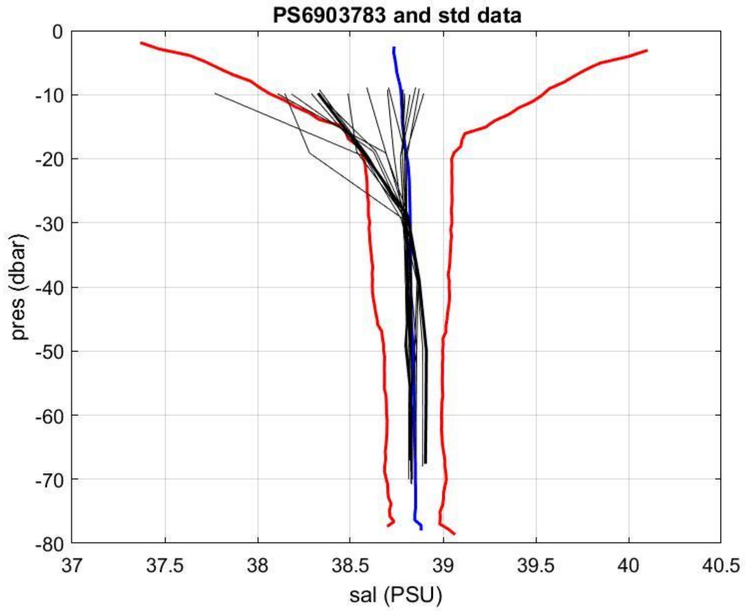


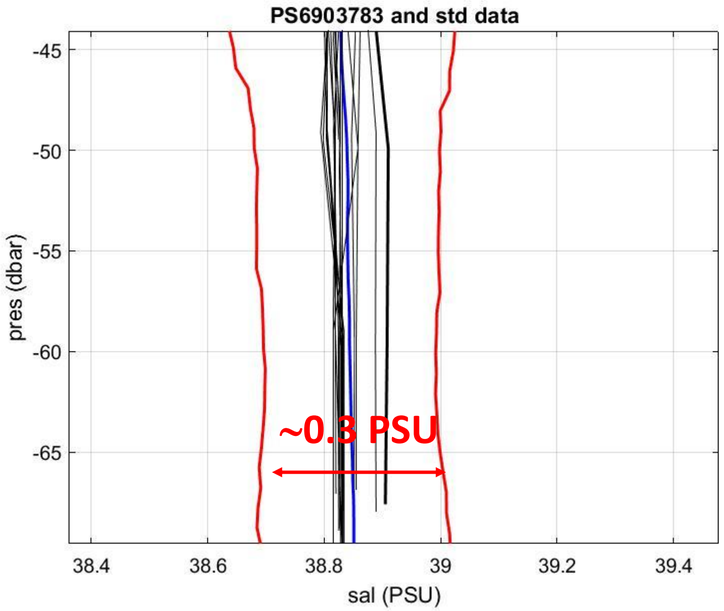
Comparison of first float profile with nearest CTD



Qualitative analysis results







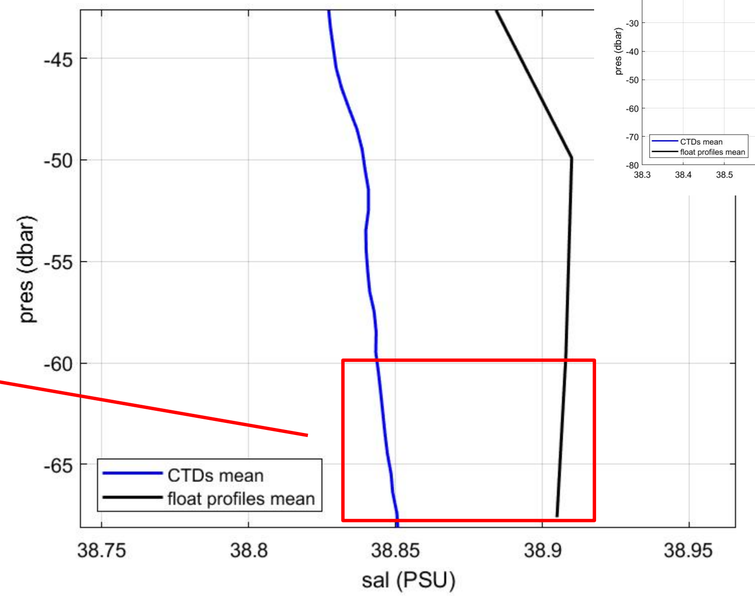
mean of the most recent CTD data

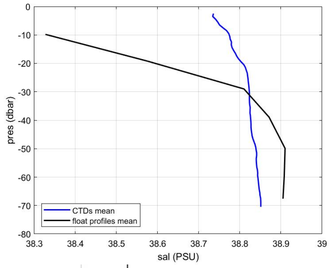
standard deviation calculated with all CTDs

Comparison between the mean of salinity float profiles (black lines) and nearest CTDs (blue line)

Mean salinity (60-70m)

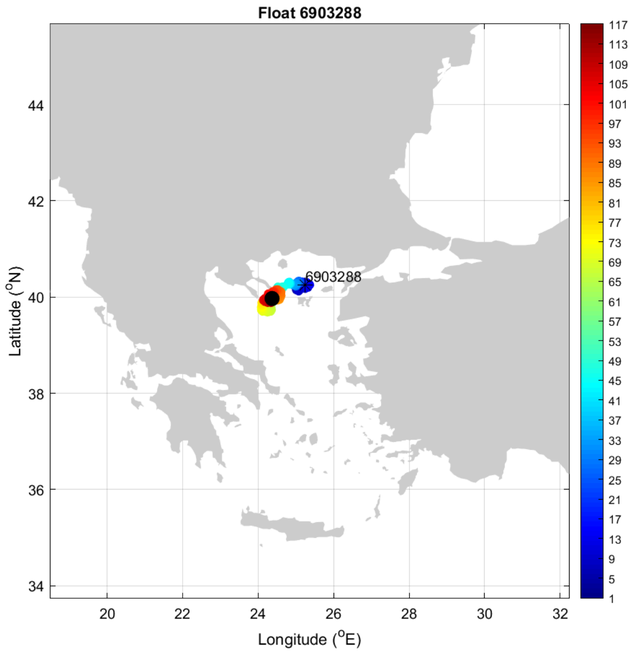
~0.06 PSU

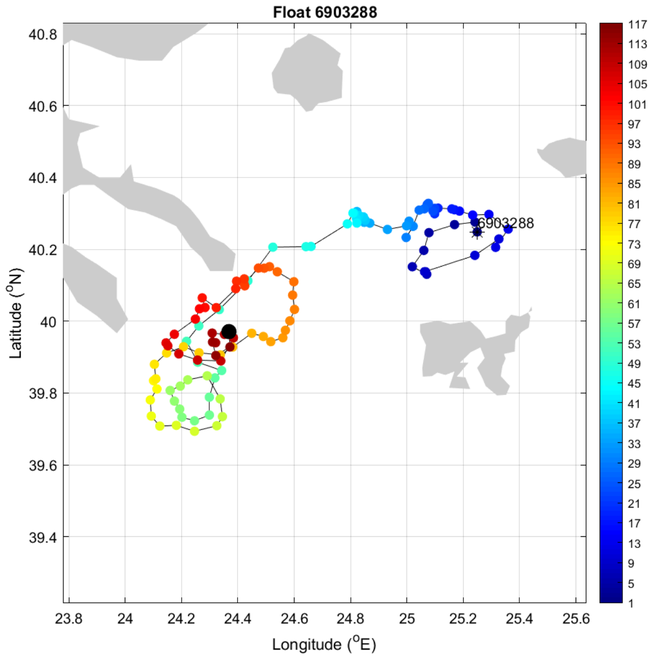




Example Aegean sea – WMO 6903288

Float type	WMO	Deployment date	Last station date	Cycle
Apex	6903288	9 February 2020	5 October 2020	120

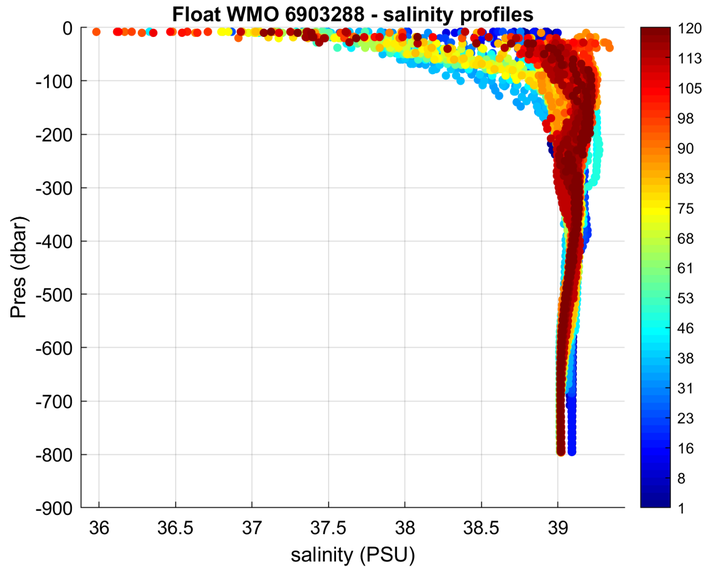


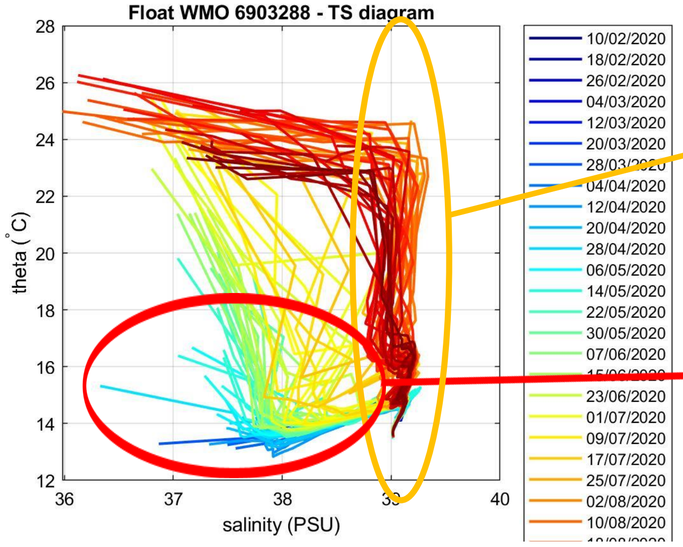


Flags applied are QC=1 to all cycles

The drifting and profiling depth of the float were both set to 800 m

The cycle time was set quite short (2 days)

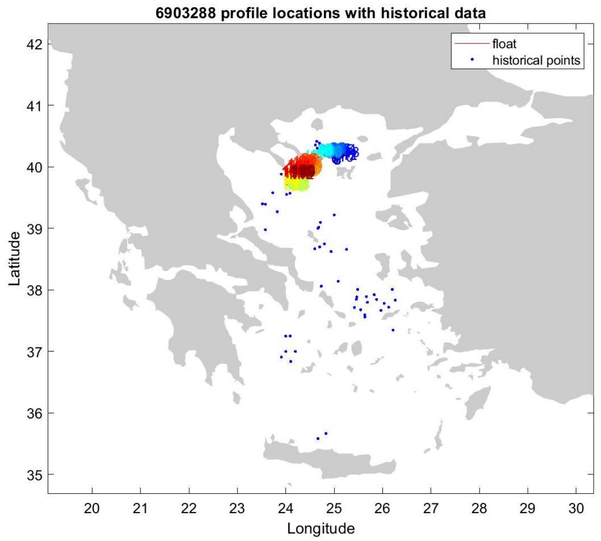




Levantin water

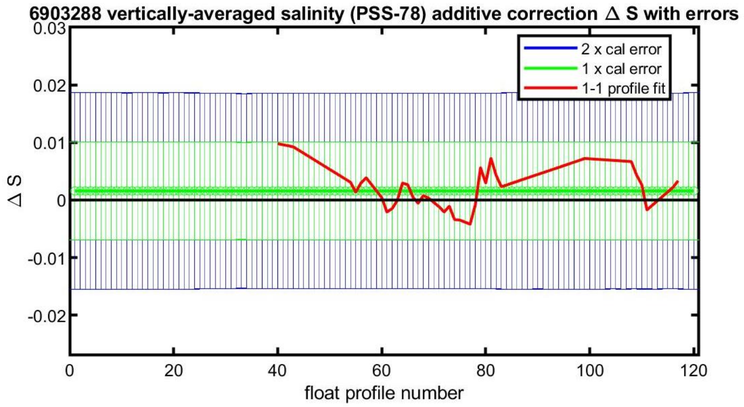
Black Sea water

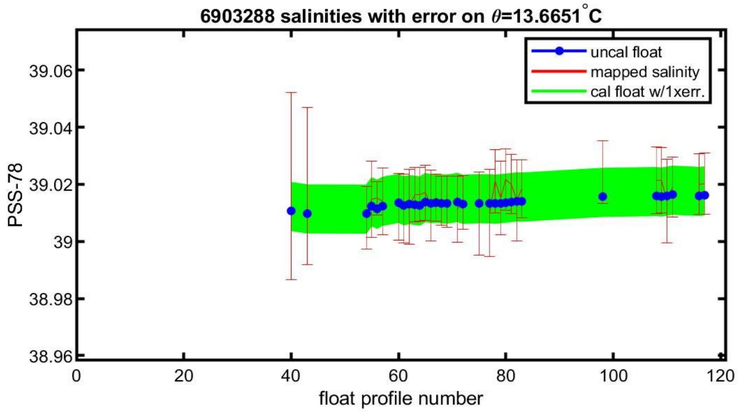
OWC results



A time-varying potential conductivity correction

Correction proposed < 0.01 PSU

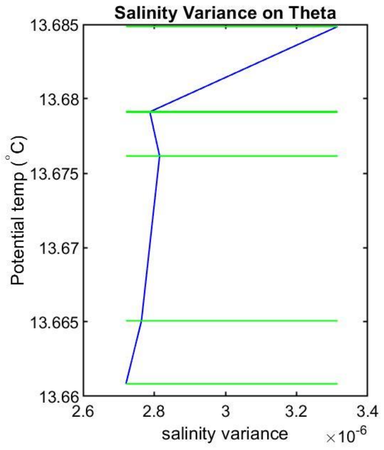


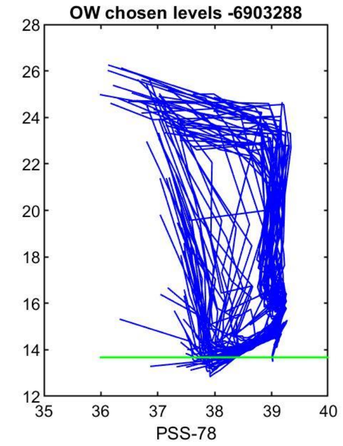


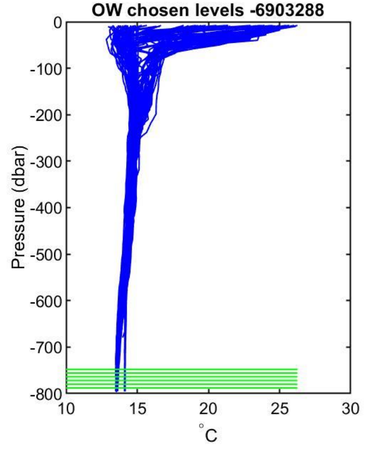
The evolution of salinity in time along selected theta levels with the minimum salinity variance.

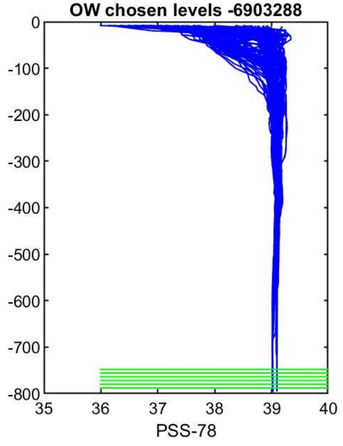
The red line indicates high variability of the area and no good comparison with the scarce reference dataset

Less reliable fit, with large uncertainties, due to both the scarce reference dataset and the shallow areas characterized by different water masses









The ten most stable θ levels that have the minimum salinity variance chosen to compare float and reference salinity data

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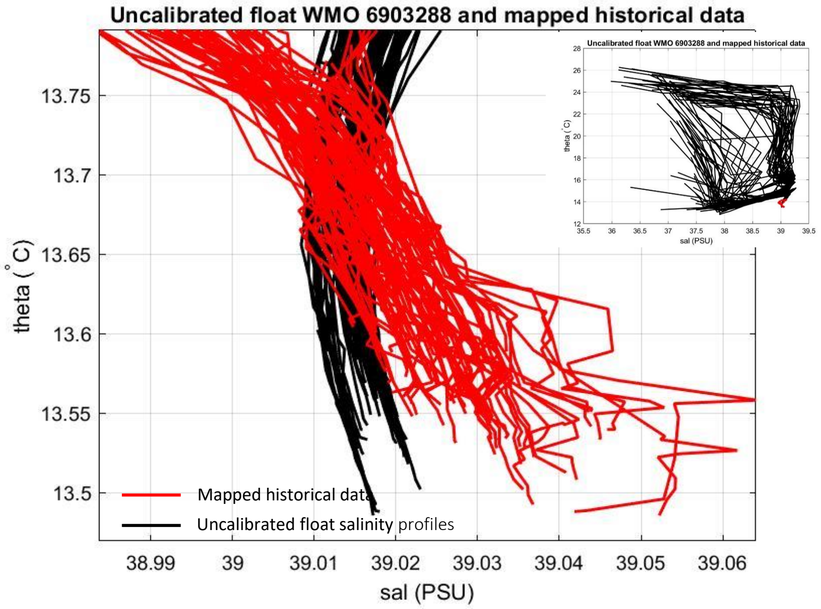
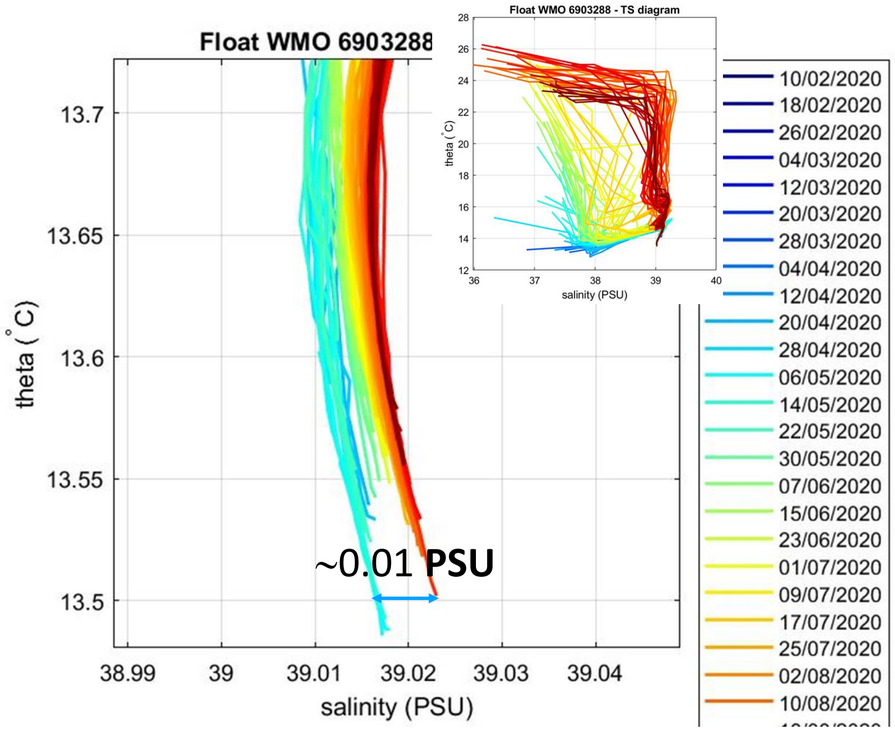
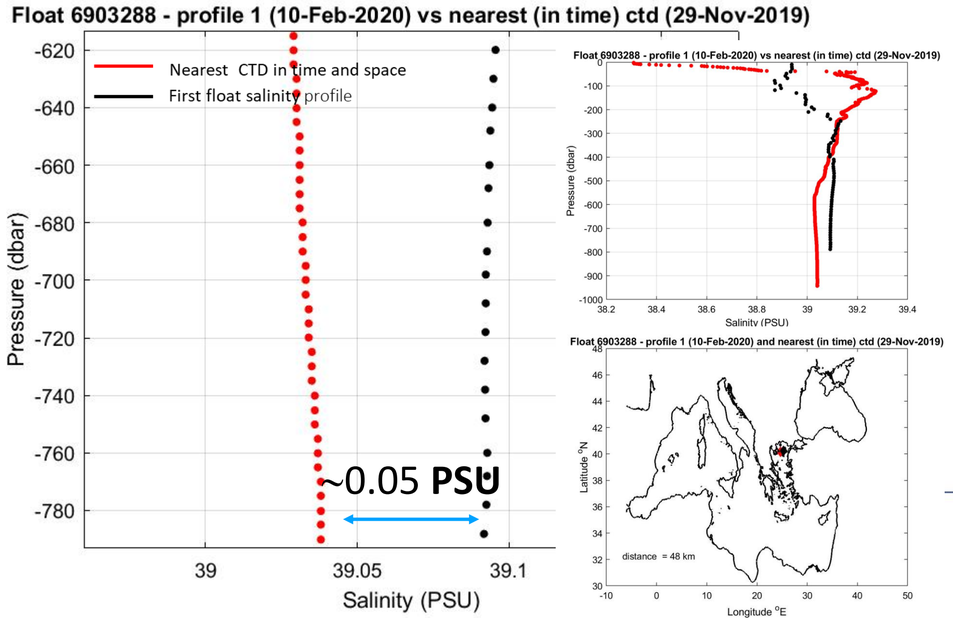
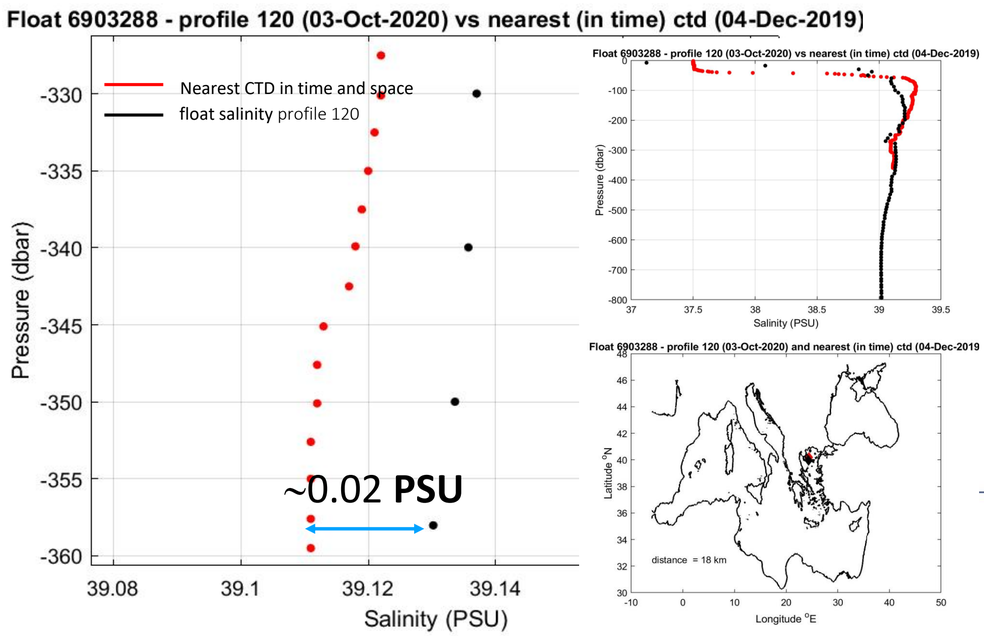
Qualitative analysis results









Conclusions

✓Argo floats were tested under targeted missions in near-shore and shallow waters of the Mediterranean sea within the framework of the Euro-Argo RISE project

✓The reference dataset plays a fundamental role in the DMQC activity. It is important to have high quality CTD ship based data, preferably collected close in time and space to the float mission

✓For the WMO 6903783 float:
- quite good agreement between salinity float profiles and most recent reference salinity profiles
- the mean salinity difference between CTD and Argo profiles in the deepest layers is about 0.06 PSU

✓For the WMO 6903288 float:
- the correction proposed by OW is quite small and below the Argo requested accuracy (0.01)
- the comparison between selected Argo float and reference salinity profiles shows a difference in the range of 0.02- 0.05

✓The investigation of float profiles acquired in shallow coastal waters is complicated and work is still in progress. The analysis led us to conclude that the expected accuracy for the Argo salinity could be in the range of 0.05- 0.1.

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Thank you for your attention!

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