Delayed Mode Quality Control of Argo float WMO 6903241

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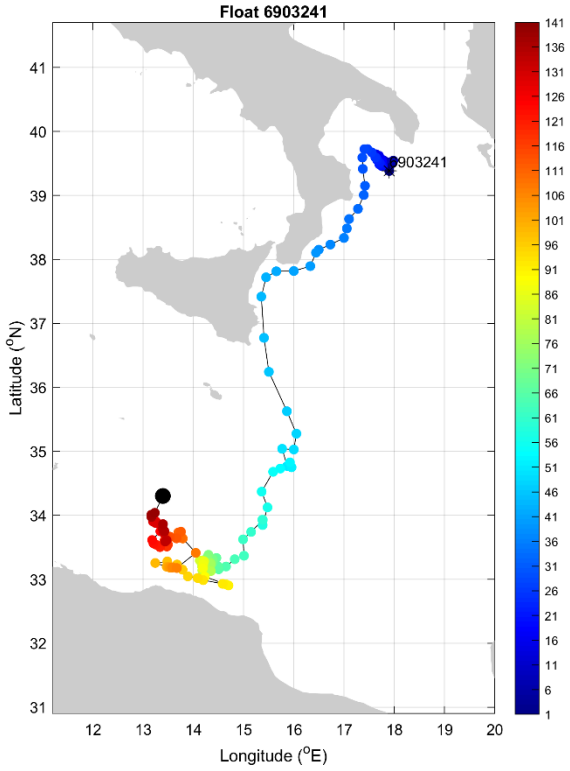

Contents

1 Introduction

This report includes the delayed mode analysis performed for float 6903241. It was deployed in Mediterranean Sea (Ionian sub-basin) in July 2017 and after performed 142 cycles died. Before the analysis, real-time QC flags were visually inspected. The list of flags applied is QC=1 for all cycles. Then, the satellite altimeter comparison plot between the sea surface height and dynamic height anomaly, constructed for this float by Ifremer, was analyzed. Plots of temperature and salinity time series and plots of temperature, salinity and density plotted against the nearby historical CTD profiles was generated. This visual analysis can help in detecting sensor salinity anomalies and spikes.
The reference dataset used is composed of the following CTD and Argo historical datasets:

CTD:

- CMEMS: INSITU_MED_TS_REP_OBSERVATIONS_013_041
- Coriolis: CTD_for_DMQC_2018V01
- Historical CTD profiles provided through personal contact

Argo:

- ARGO_for_DMQC_2018V01

Float 6903241 is the Arvor float where the pressure sensor is auto corrected and no adjustment is required. The OWC was run to estimate a salinity offset and a salinity drift (Cabanes et al., 2016).

2 Quality Check of Argo Float Data

2.1 Verification of Real-time Mode QC flags

The list of flags applied to the float in real-time mode is as follows.

Cycle number:
1-142 PSAL QC=1

2.2 Satellite Altimeter Report

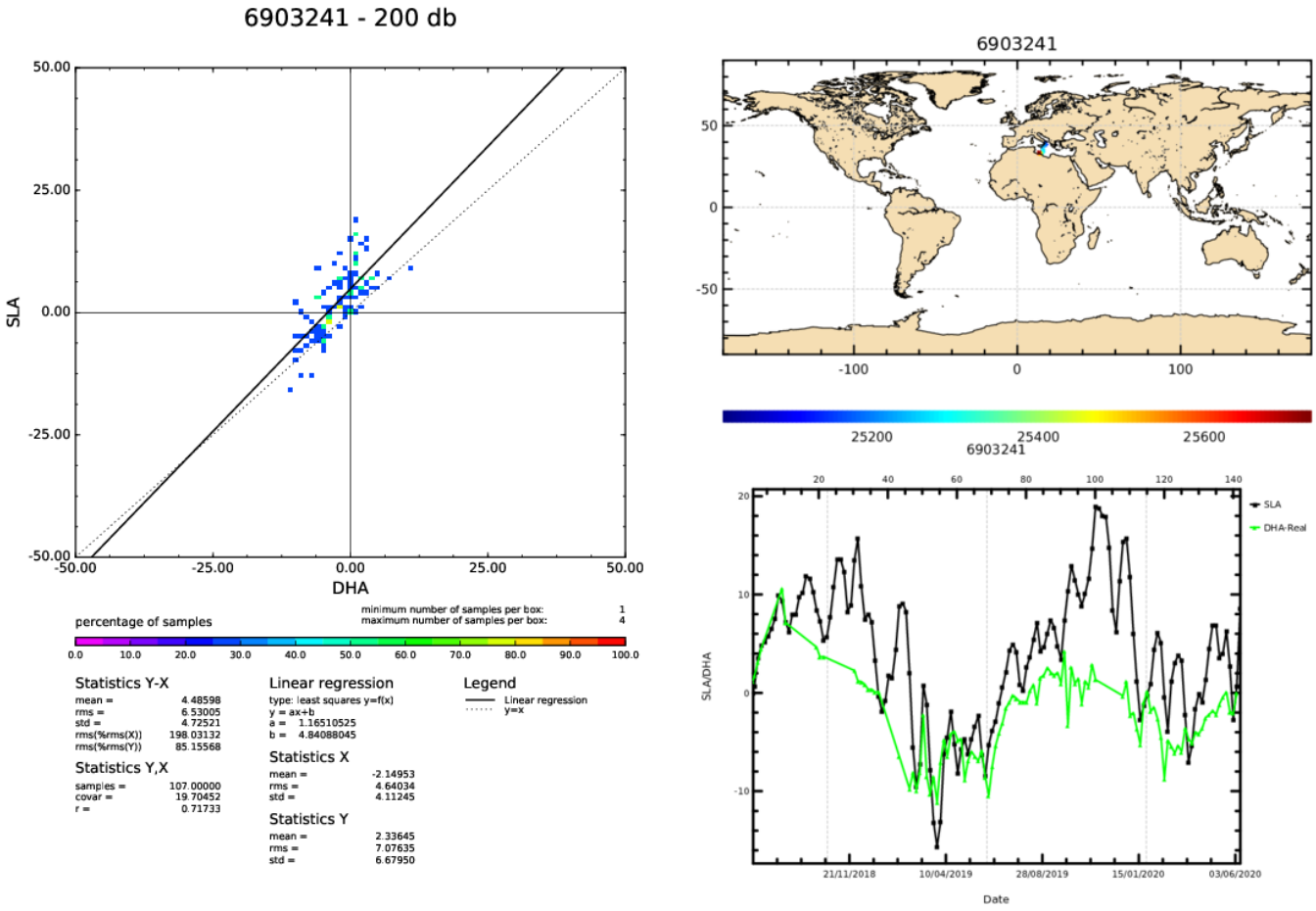

Figure 1: Float 6903241. The comparison between the sea surface height (SSH) from the satellite altimetry and dynamic height anomaly (DHA) extracted from the Argo float temperature and salinity. The figure is created by the CLS/Coriolis and distributed by Ifremer (ftp://ftp.ifremer.fr/ifremer/argo/etc/argo-ast9-item13-AltimeterComparison/figures/).

2.3 Time Series of Argo Float Temperature and Salinity

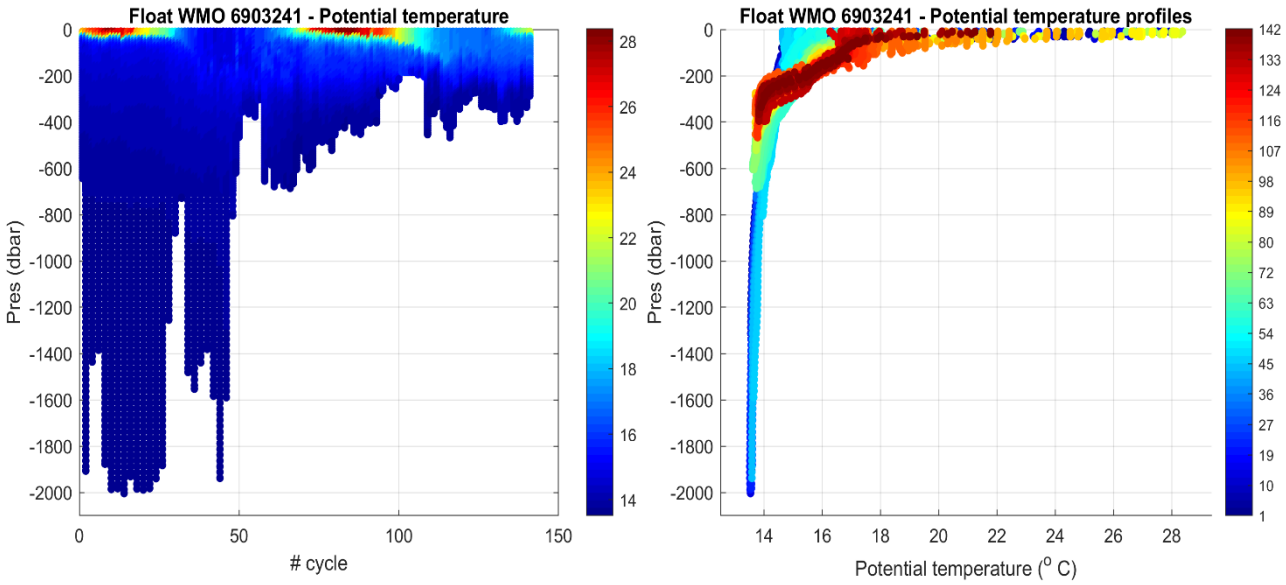

Figure 2: Float 6903241. Time series of Argo float potential temperature (°C) on the left, and potential temperature profiles color-coded per cycle number on the right.

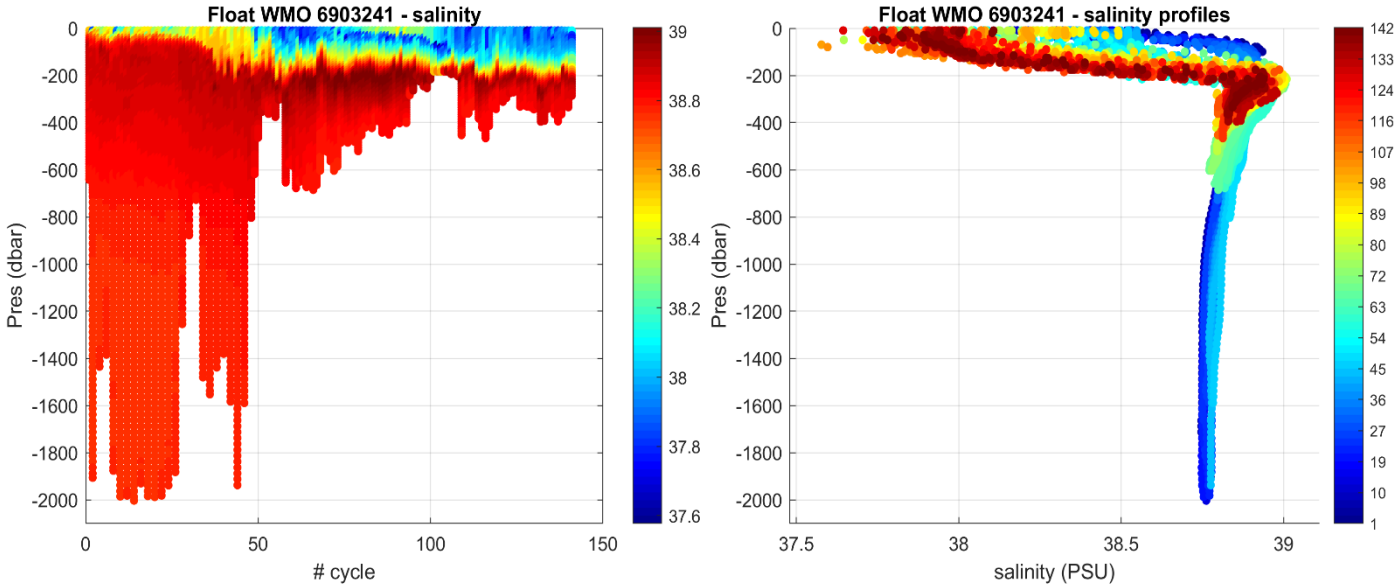

Figure 3: Float 6903241. Time series of Argo float potential salinity (PSS-78) on the left, and salinity profiles color-coded per cycle number on the right.

Before running the Owens and Wong method, referred to as OW hereafter, the theta-salinity (θ-S) diagram of the float is analyzed (Figure 4) and in particular the area where the θ-S relationship is the tightest (Figure 5). A potential salinity drift is observed.

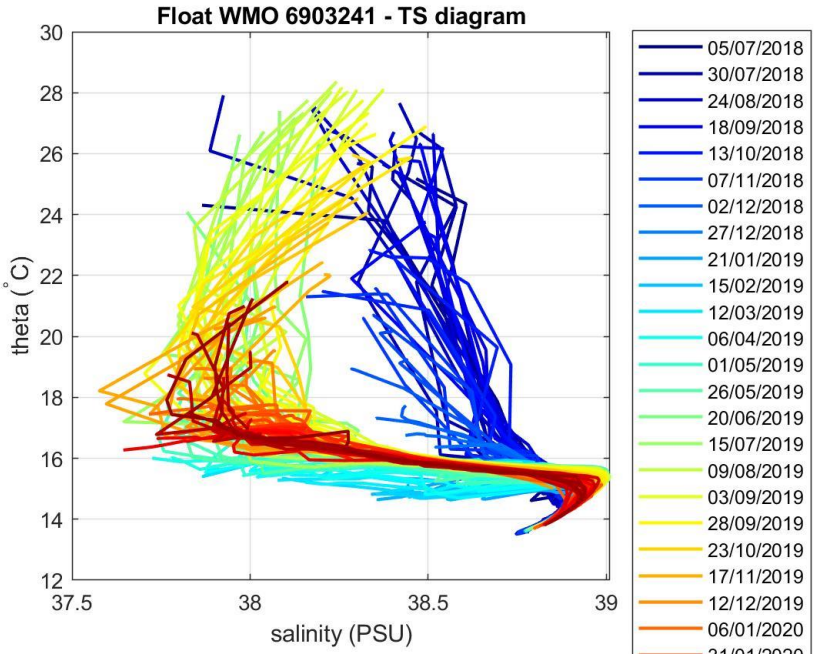

Figure 4: Float 6903241. θ-S diagram color-coded per cycle number.

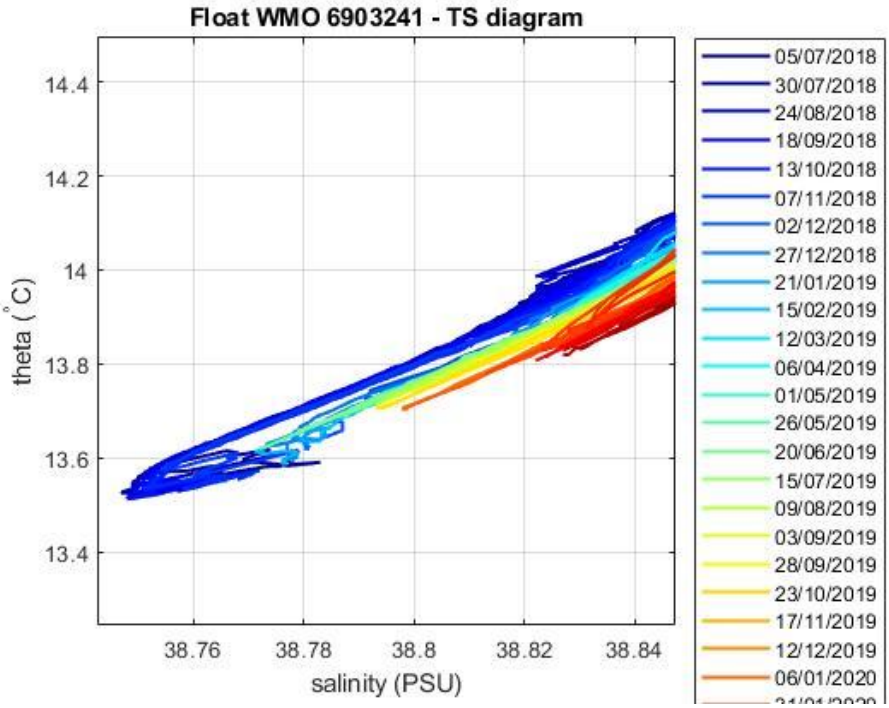

Figure 5: Float 6903241. Area of the θ-S diagram (color-coded per cycle number) where the θ-S relationship is more uniform.

2.4 Comparison Between Argo Float and Climatology

Three salinity float profiles are selected to perform a comparison (in time and space) with the historical data. In figure 6, 7 and 8 each selected profile is compared with all reference data used in this analysis. The salinity float profile is depicted in black while other colors represent the salinity reference profiles. The red color means that the historical data are more recent with respect to the float ones, while magenta states that the float data are more recent than the historical ones (the maximal difference is 9 years). A time difference between 3 and 6, 6 and 9 and larger than 9 years is depicted in green, cyan and blue, respectively.

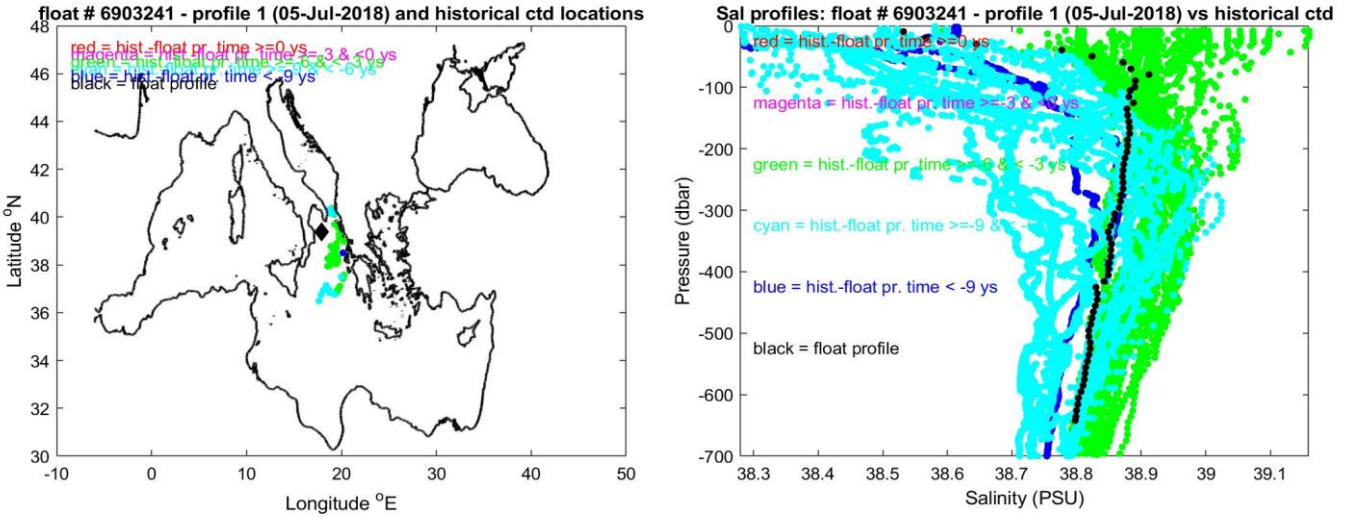

Figure 6: Float 6903241. Locations of the salinity float profile number 1 and historical CTD data (right panel) and the respective salinity profiles (left panel).

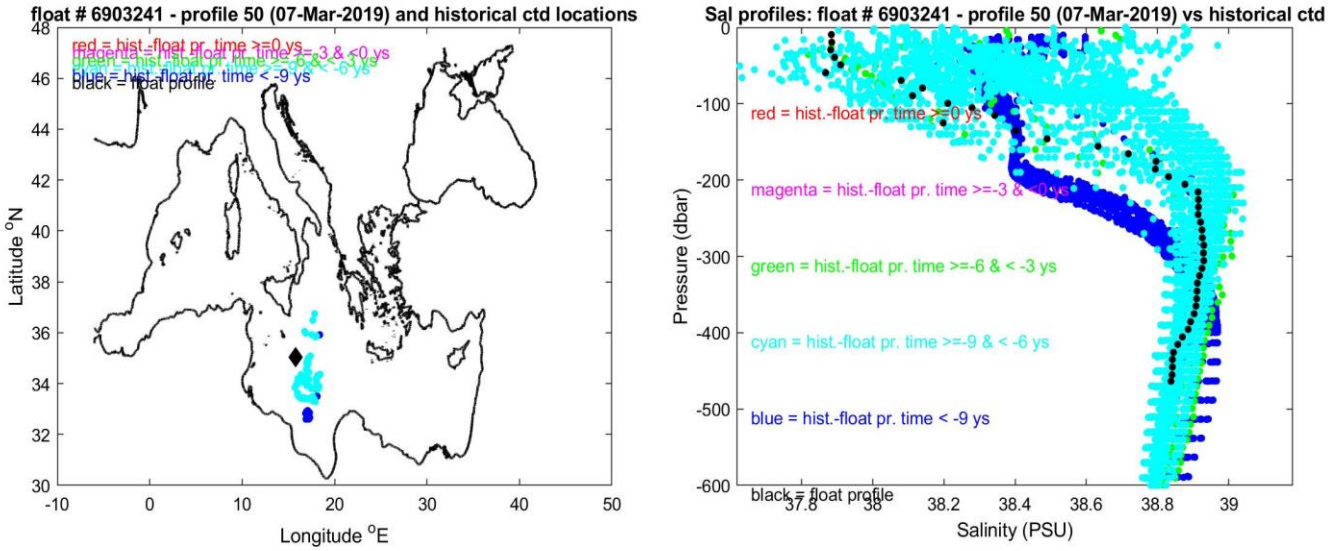

Figure 7: Float 6903241. Locations of the salinity float profile number 50 and historical CTD data (right panel) and the respective salinity profiles (left panel).

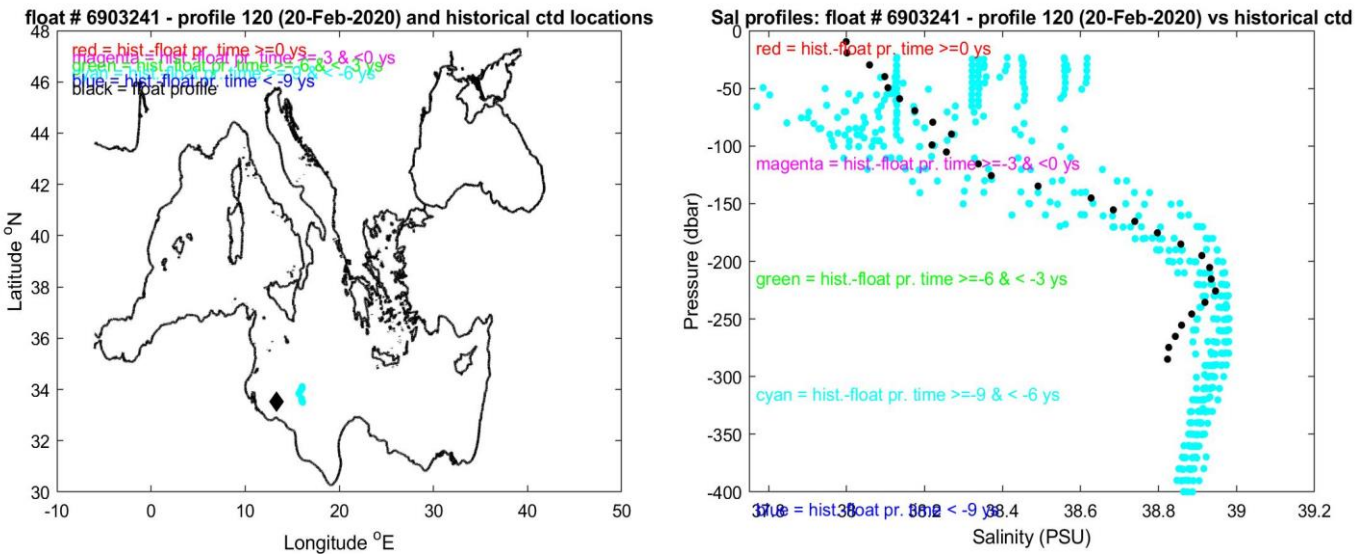

Figure 8: Float 6903241. Locations of the salinity float profile number 50 and historical CTD data (right panel) and the respective salinity profiles (left panel).

The comparison of these 3 selected salinity float profiles with the closest (in space and time) salinity reference profile in shown in Figures from 9 to 11. The agreement between the selected float salinity profiles and the historical salinity profiles seems quite good in the intermediate and deep layers. The float sample the shallow layers and the reference dataset is old.

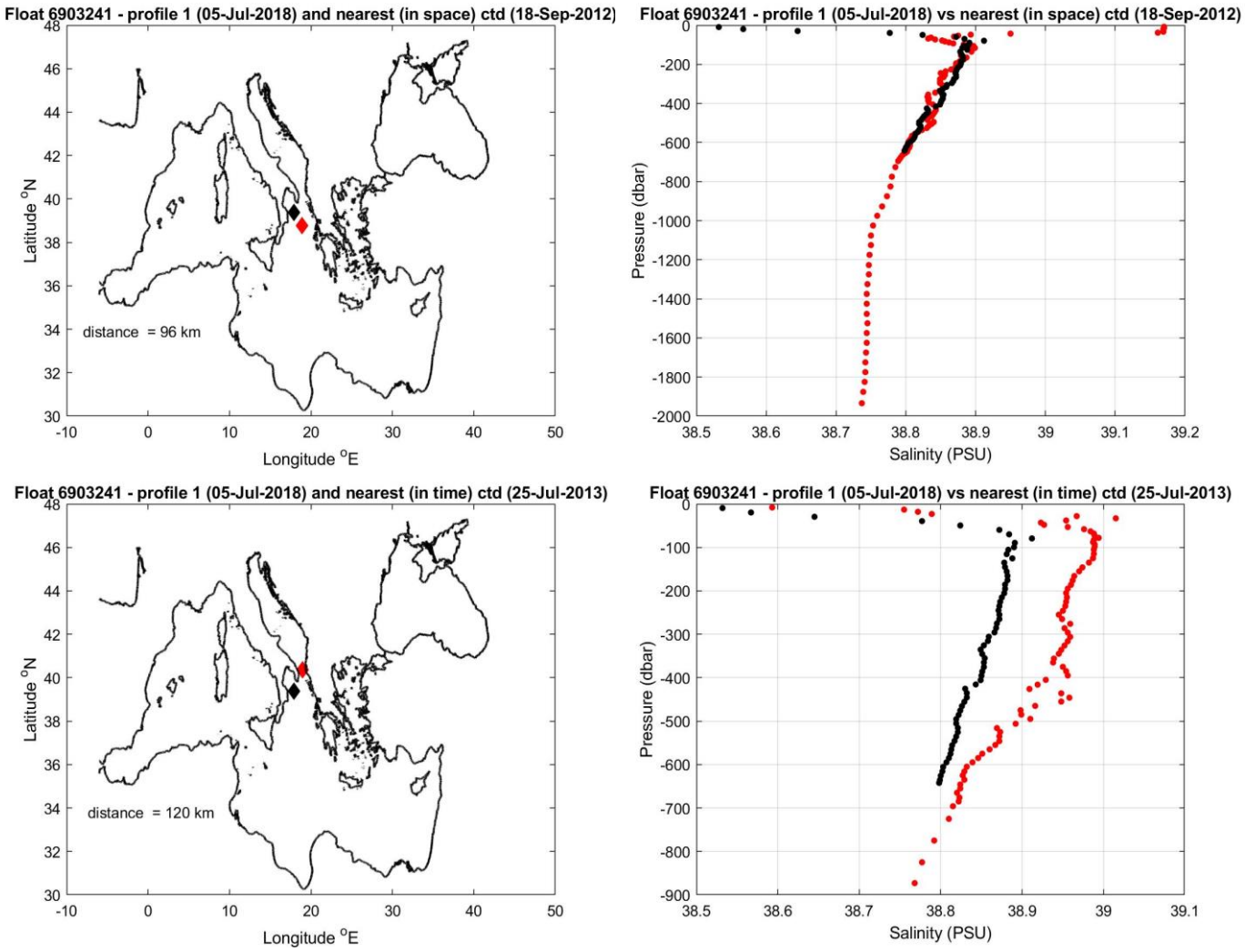

Figure 9: Float 6903241. The salinity float profile number 1 (black dots) are compared to the nearest in space (top) and in time (bottom) reference profile (red dots). The locations of the two profiles and their distance is given in the left panel.

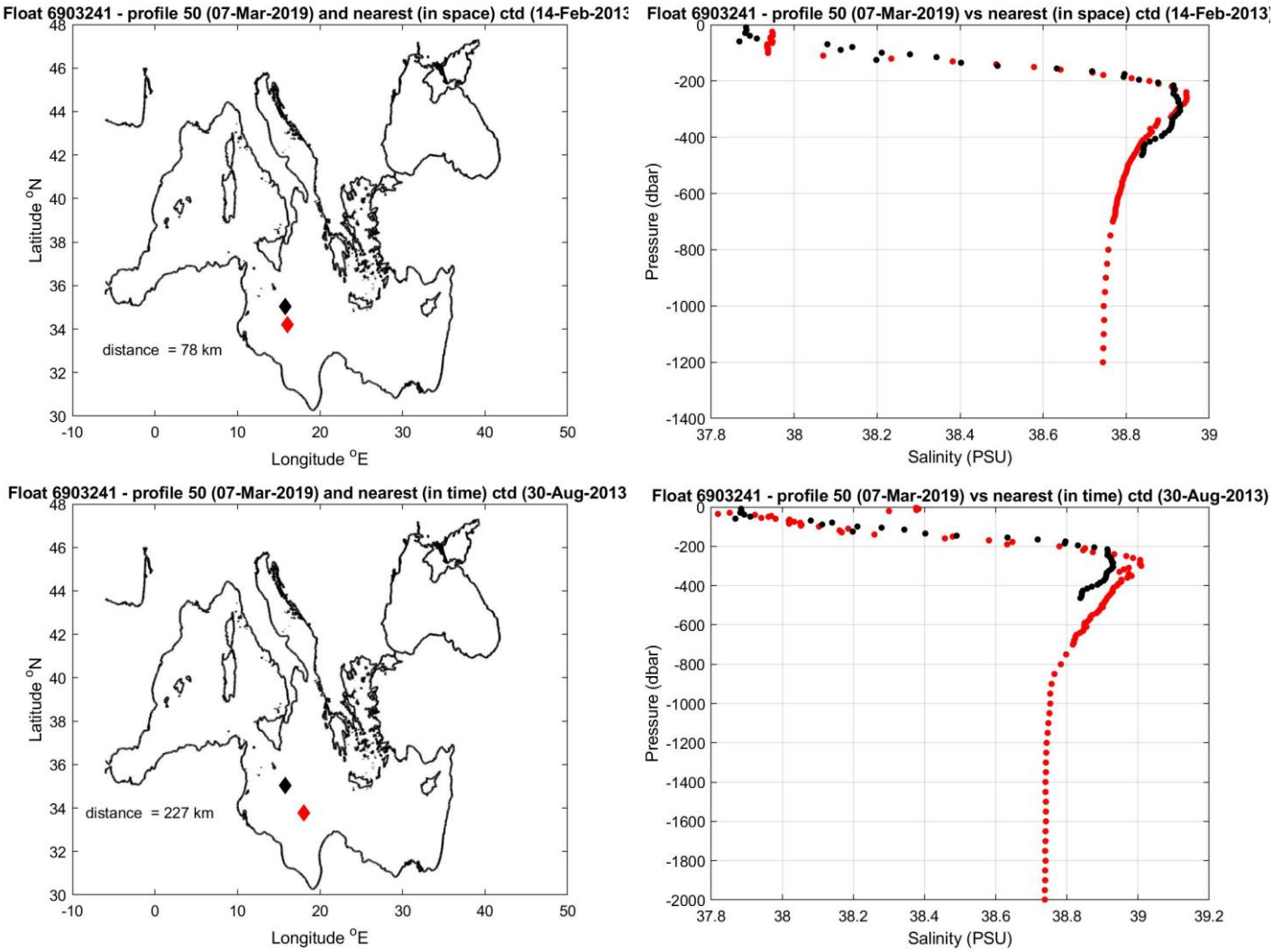

Figure 10: Float 6903241. The salinity float profile number 50 (black dots) are compared to the nearest in space (top) and in time (bottom) reference profile (red dots). The locations of the two profiles and their distance is given in the left panel.

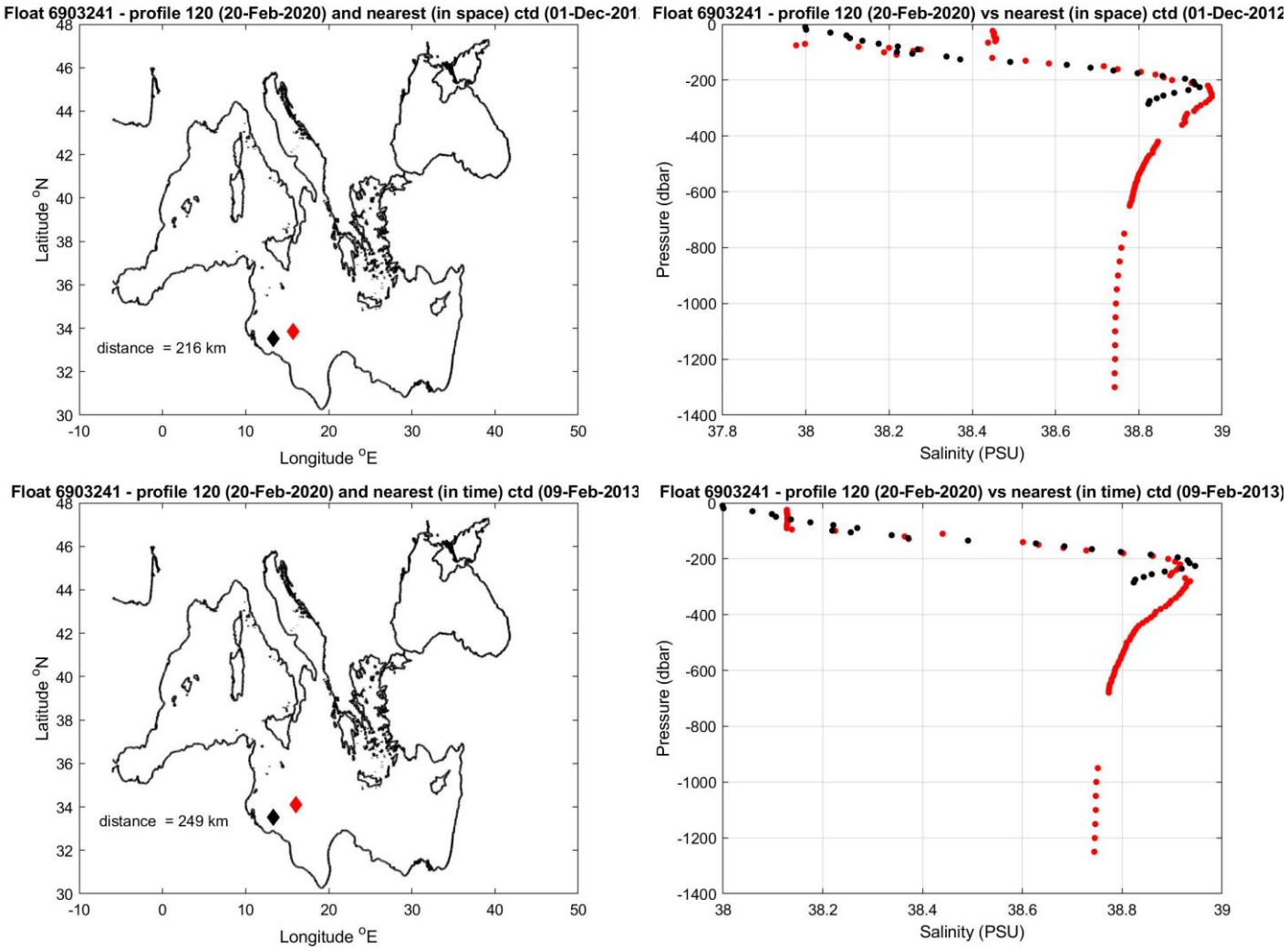

Figure 11: Float 6903241. The salinity float profile number 120 (black dots) are compared to the nearest in space (top) and in time (botton) reference profile (red dots). The locations of the two profiles and their distance is given in the left panel.

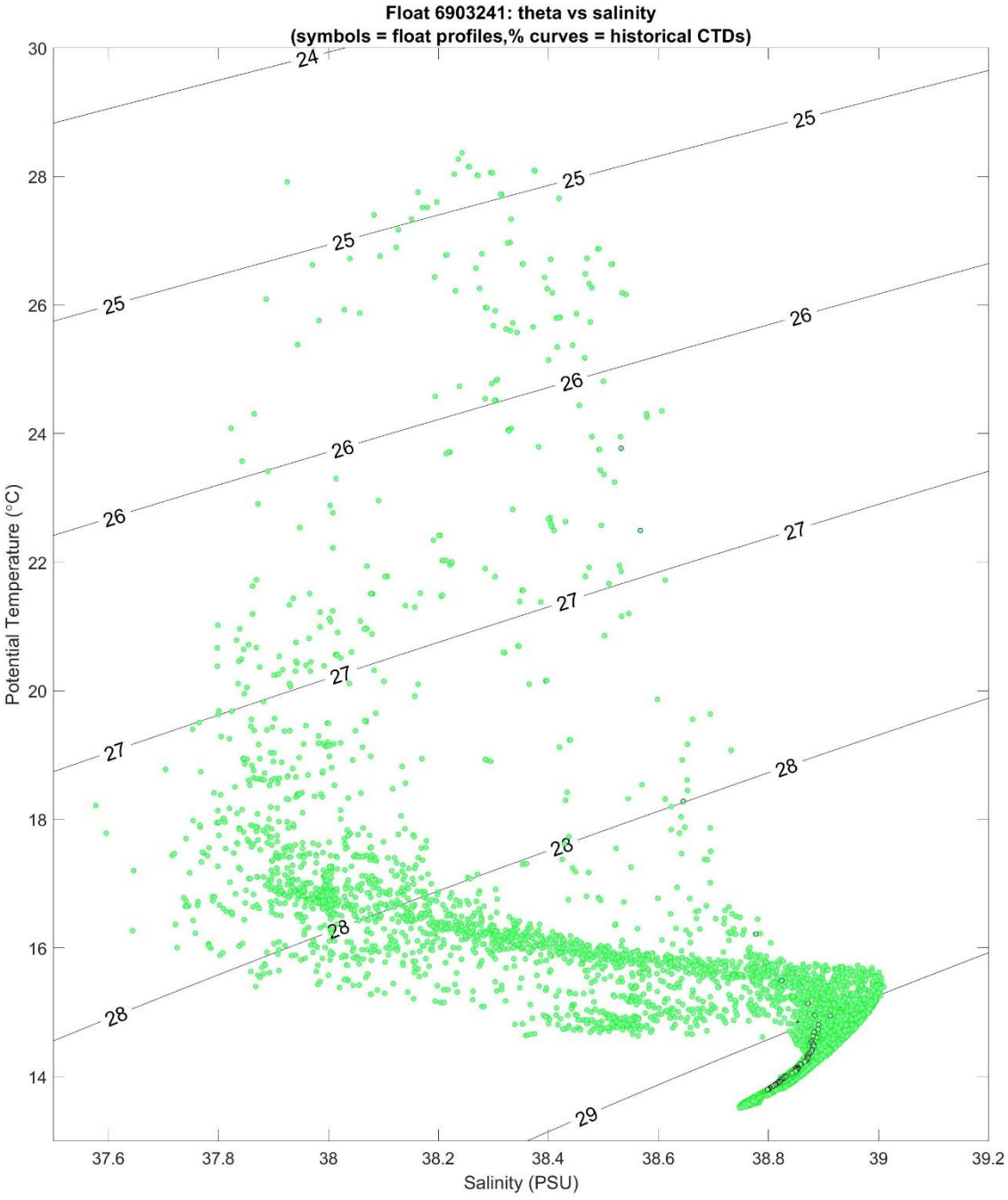

Figure 12: Float 6903241. T/S diagram plotted with and data from WMO boxes of CTD reference data +/- 10°of latitude and longitude. The black and blue cycles indicate the first and the last Argo profile, respectively. Green symbols represent other Argo profiles from this float. The thin colours lines indicate the reference data.

3 Correction of Salinity Data

3.1 Comparison between Argo Float and CTD Climatology

3.1.1 Configurations

Parameters	Value
CONFIG_MAX_CASTS	300
MAP_USE_PV	1
MAP_USE_SAF	0
MAPSCALE_LONGITUDE_LARGE	4
MAPSCALE_LONGITUDE_SMALL	1.33
MAPSCALE_LATITUDE_LARGE	4
MAPSCALE_LATITUDE_SMALL	1.33
MAPSCALE_PHI_LARGE	0.5
MAPSCALE_PHI_SMALL	0.1
MAPSCALE_AGE	10
MAP_P_EXCLUDE	700
MAP_P_DELTA	250

3.1.2 Results

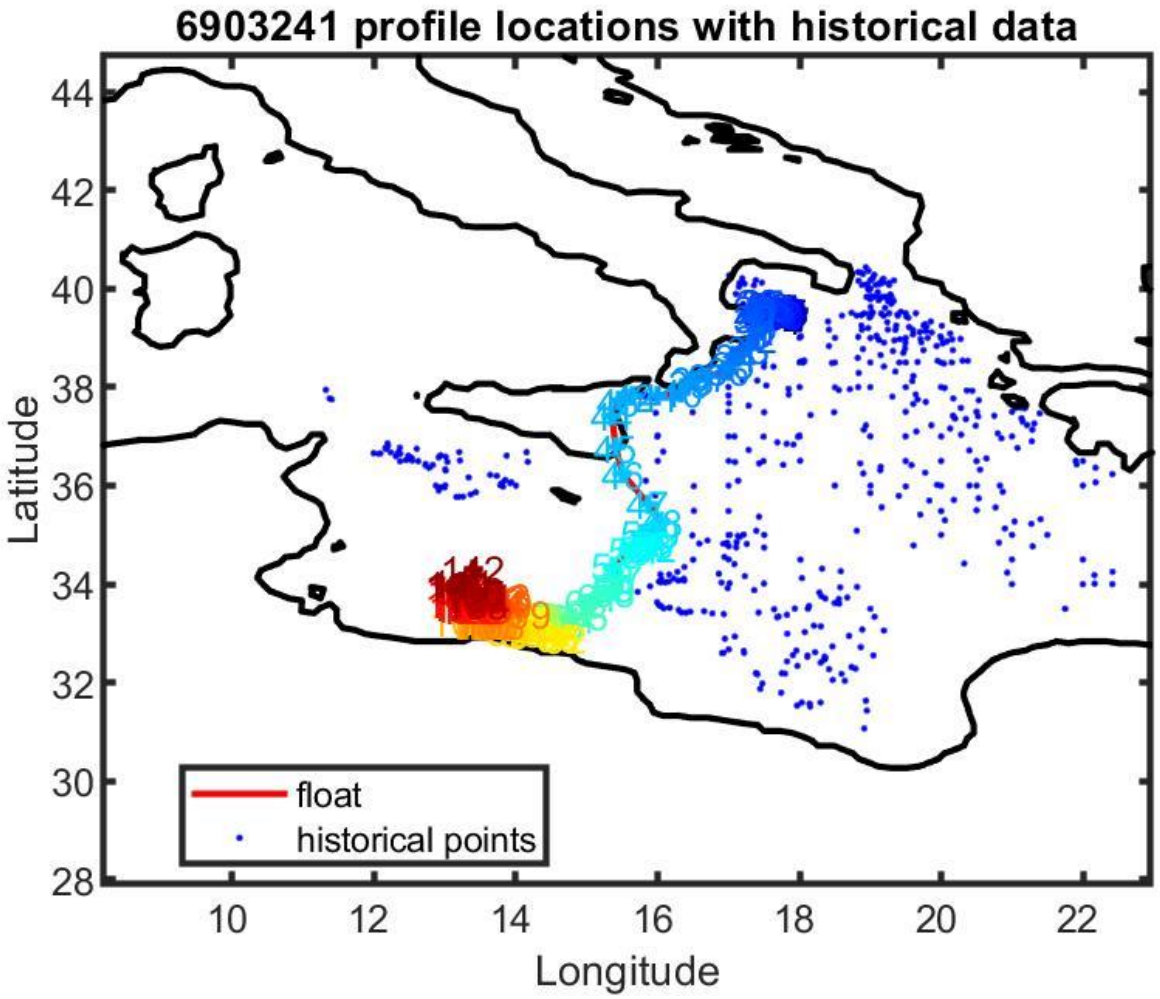

Figure 13: Float 6903241. Location of the float profiles (red line with colored numbers) and the reference data selected for mapping (blue dots).

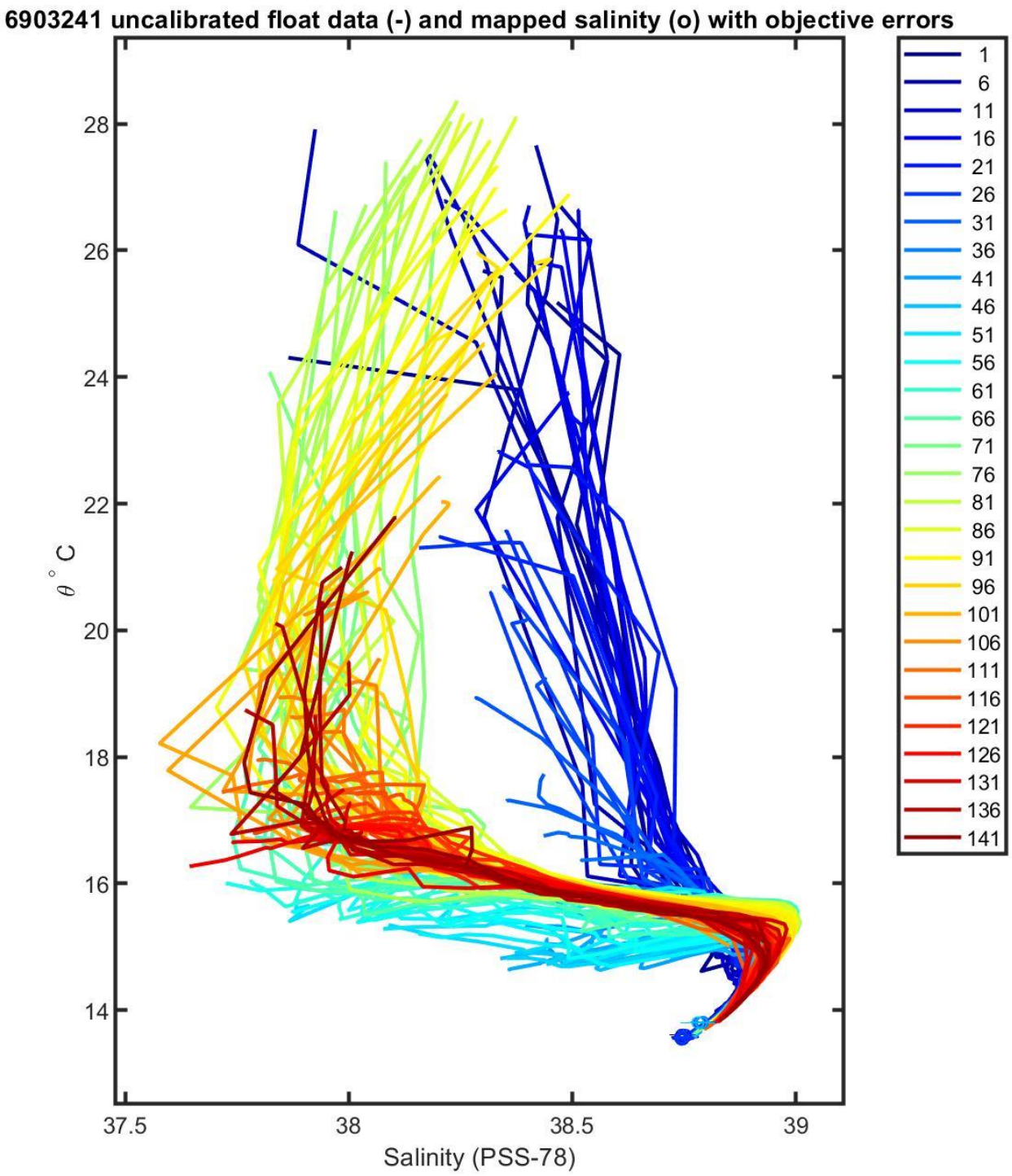

Figure 14: Float 6903241. Plot the original float salinity and the objectively estimated reference salinity at the 10 float theta levels that are used in calibration.

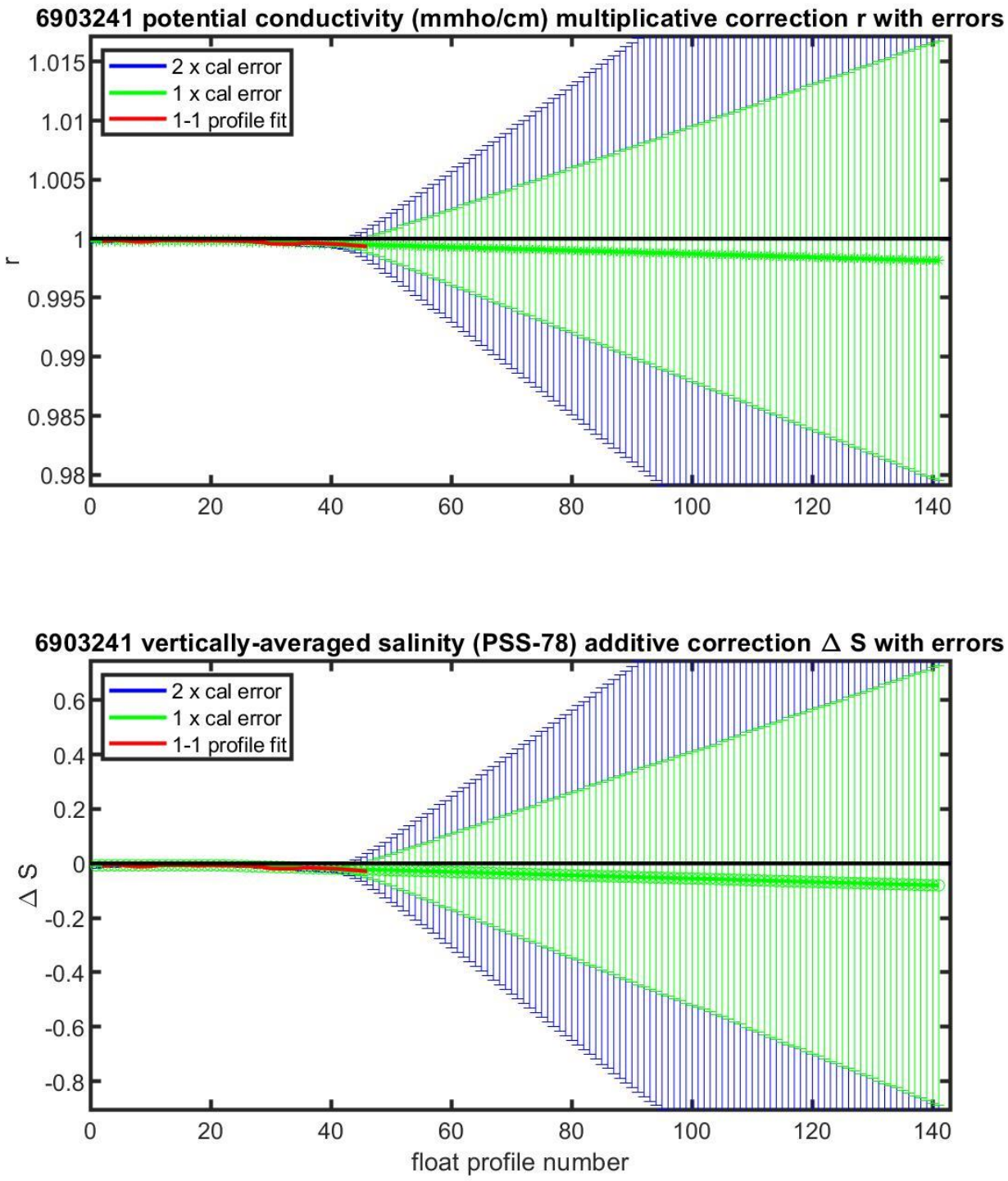

Figure 15: Float 6903241. Evolution of the suggested adjustment with time. The top panel plots the potential conductivity multiplicative adjustment. The bottom panel plots the equivalent salinity additive adjustment. The red line denotes one-to-one profile fit that uses the vertically weighted mean of each profile. The red line can be used to check for anomalous profiles relative to the optimal fit.

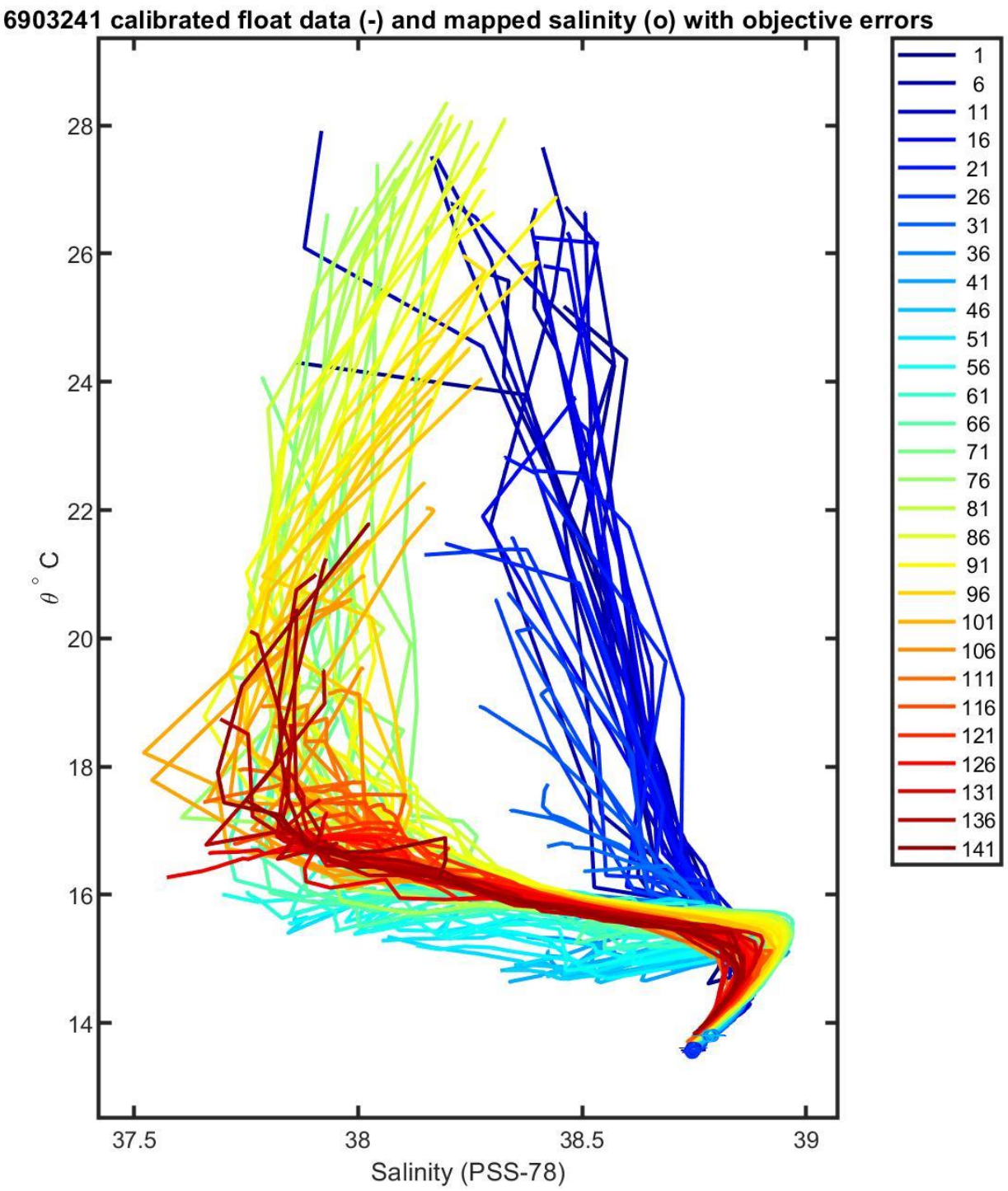

Figure 16: Float 6903241. The plot of calibrated float salinity and the objectively estimated reference salinity at the 10 float theta levels that are used in calibration.

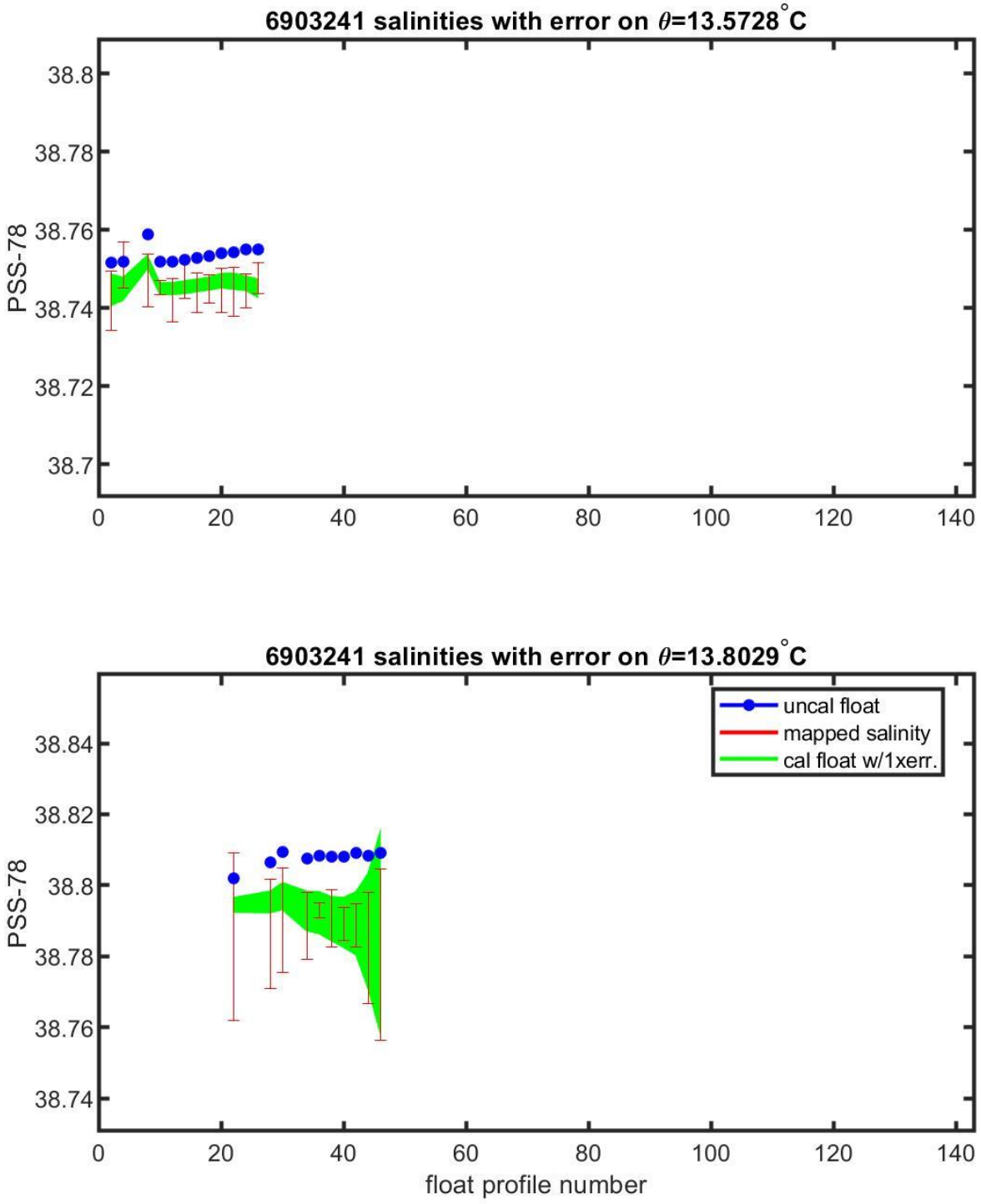

Figure 17: Float 6903241. Plots of the evolution of salinity with time along with selected theta levels with minimum salinity variance.

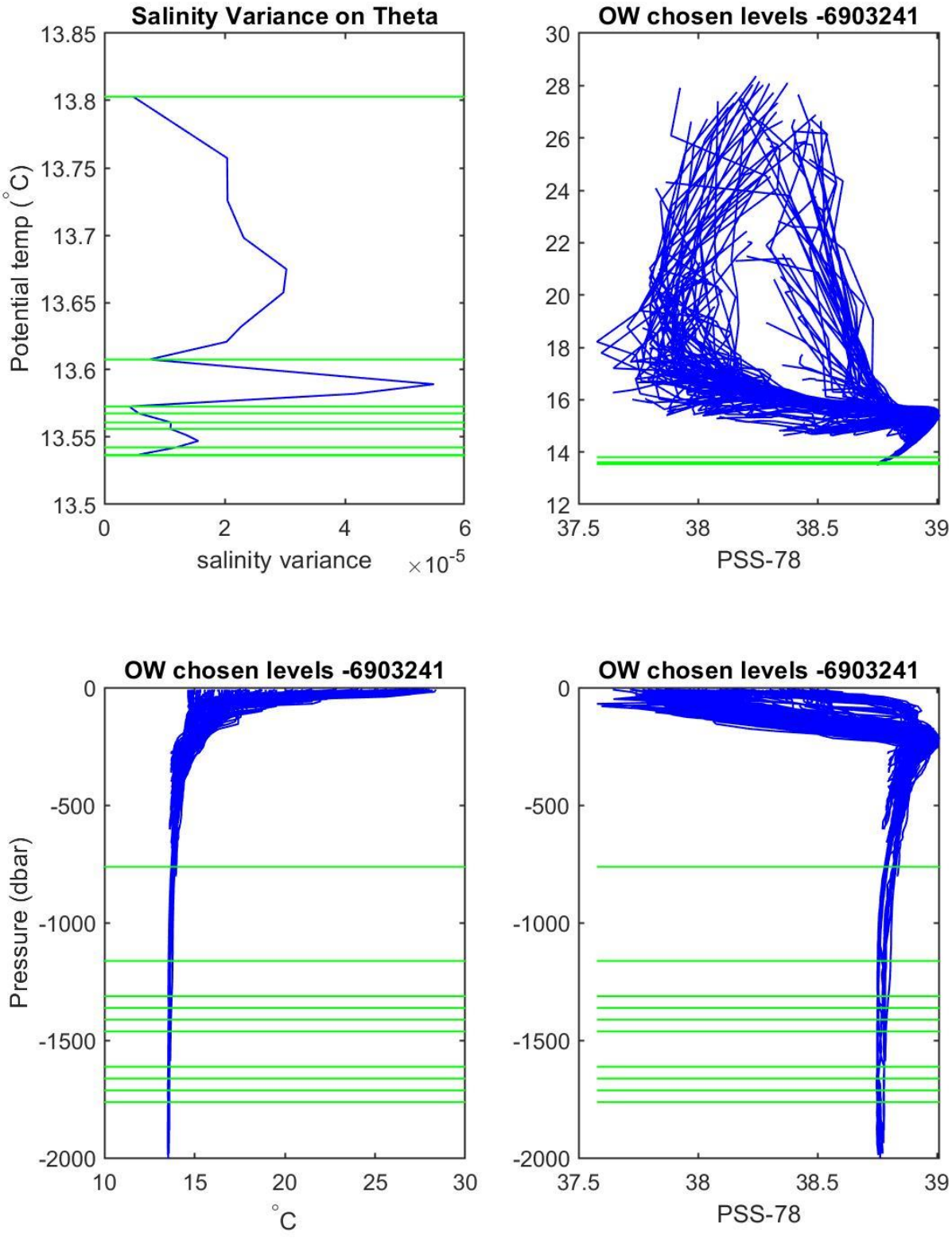

Figure 18: Float 6903241. Plots include the theta levels chosen for calibration: Top left: Salinity variance at theta levels. Top right: T/S diagram of all profiles of Argo float. Bottom left: potential temperature plotted against pressure. Bottom right: salinity plotted against pressure.

The analysis of the θ-S diagram of profile segments (Figure 19) shows that the OW method was run where the θ-S relationship is the tightest.

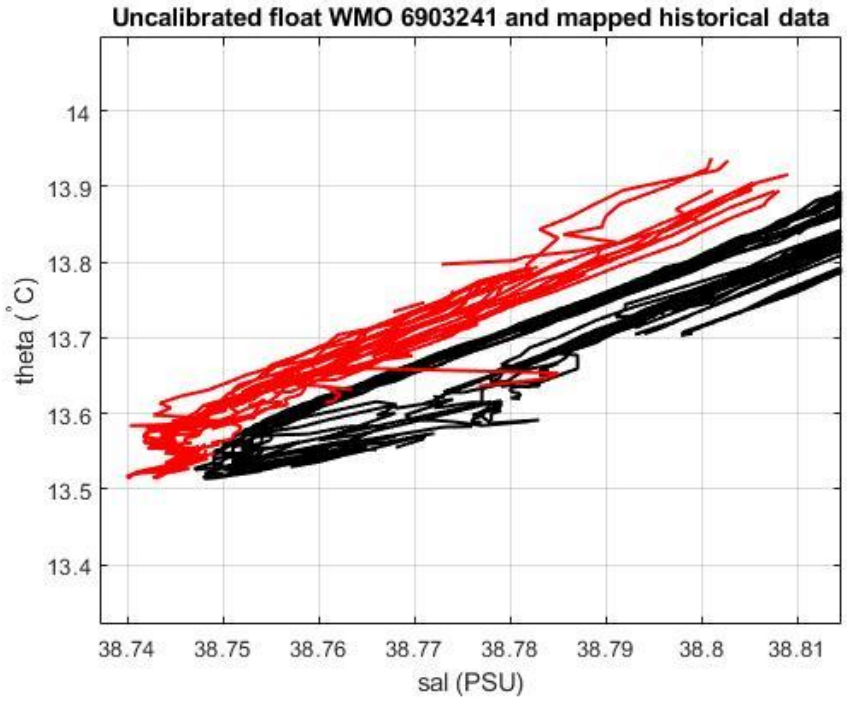

Figure 19: Float 6903241. Uncalibrated float salinity profile (black lines) and mapped historical data (red lines), in the most uniform part of the θ-S curve.

4 Comparison between Argo float under study and other Argo float in the same area

Two floats, WMO 6903242 and WMO 6903023 (Figure 20), are selected to perform a comparison with the float under study when it was in the Sicily channel, to obtain additional qualitative analysis.

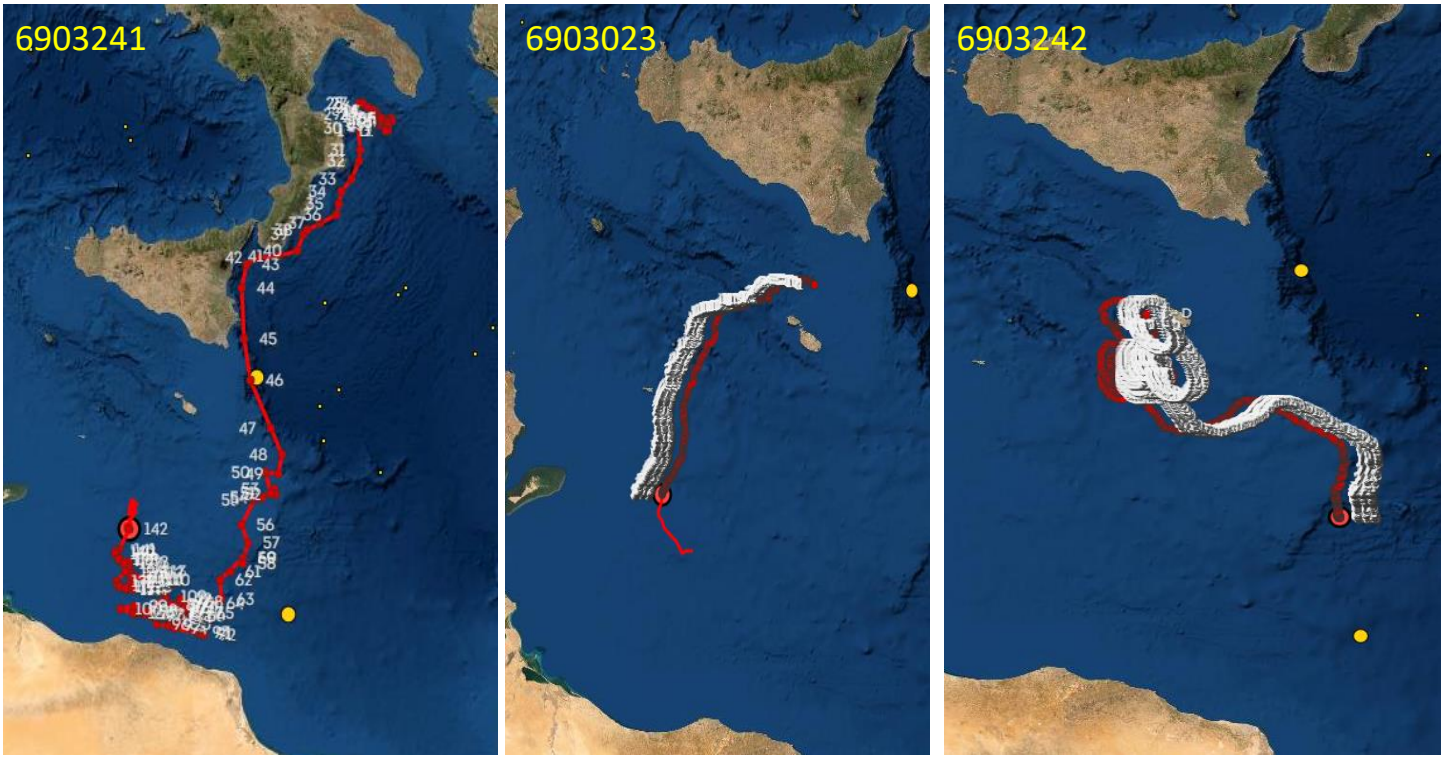

Figure 20: Float 6903241. Trajectory of the floats used for the comparison.

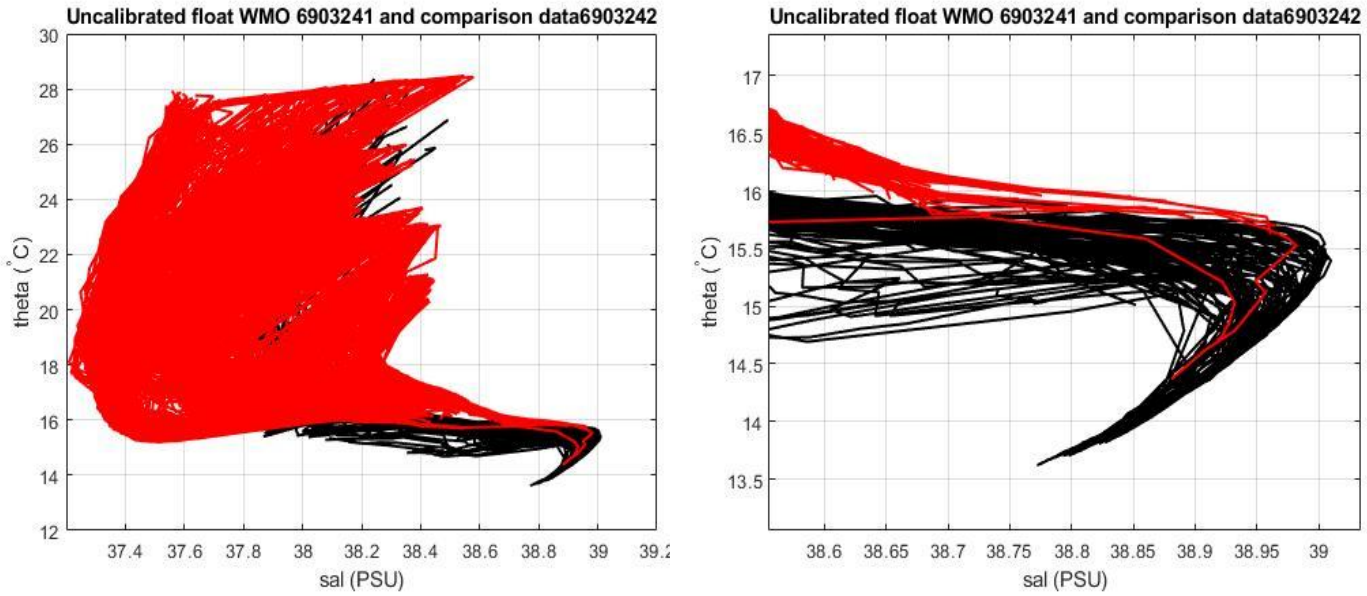

Figure 21: Float 6903241. Comparison between float 6903241 (black line) and float 6903242 (red line), on the left. On the right zoom in the most uniform part of the θ-S curve

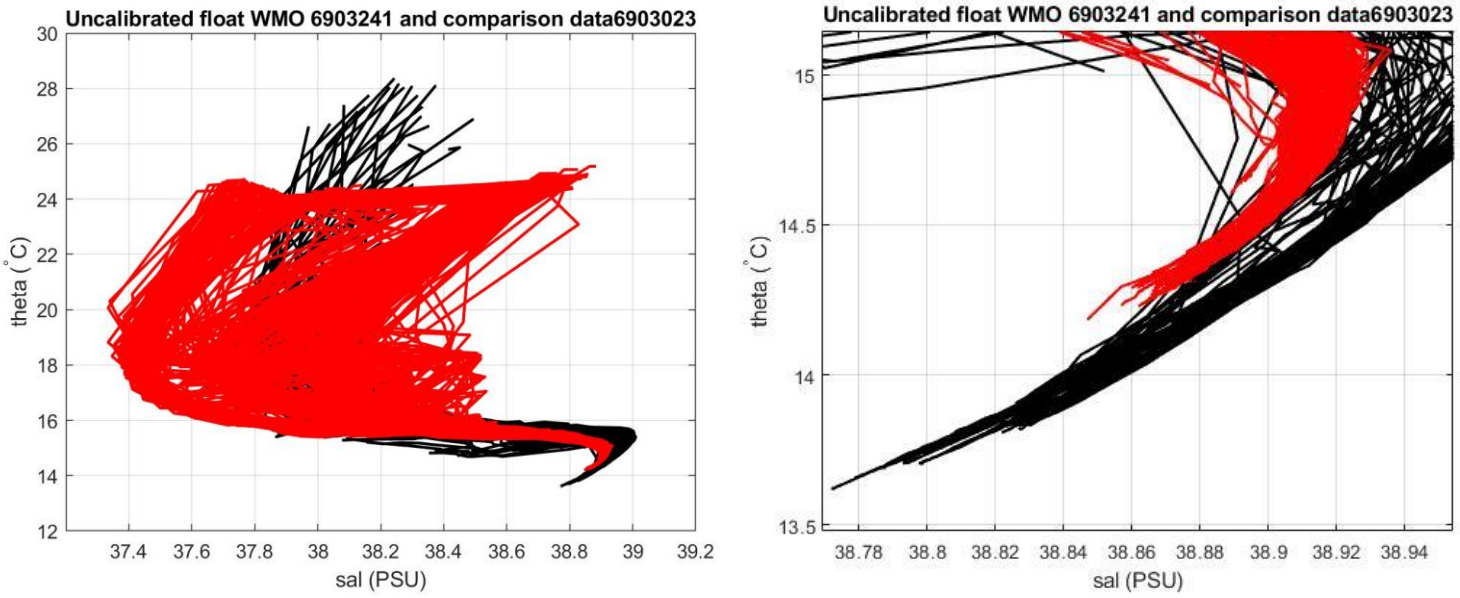

Figure 22: Float 6903242. Comparison between float 6903241 (black line) and float 6903023 (red line), on the left. On the right zoom in the most uniform part of the θ-S curve

5 Summary

Float was deployed in the Ionian sub-basin, in the Mediterranean Sea. During its life, it reaches the Sicily channel. The TS diagram highlight the two water masses. The most favorable water masses, which are useful for comparison with climatology is relatively stable intermediate and deep waters from around 700 m. The initial comparison between Argo float and reference data shows that the float sample shallow depth. Figure 3 shows that the float reaches 700 m of depth only in the first part of its life. A potential drift is showed. This float was not DMQC-ed before.

The OWC analysis didn't produce results with a reliable statistic due to the depth reached by the float and the old reference dataset. However, figure 17 shows a possible drift. A comparison with two floats in the Sicily channel area, where the float is superficial, is performed to better delayed mode check data.

After several analyses, the last decision is that the salinity data of float WMO 6903242 need a delayed mode correction, but the correction proposed by OWC is not reliable. For this reason, no correction is applied. QC=2 is applied for different reasons. The depth reached by the float when was in the Sicily channel, is not enough to reached the intermediate layer where water mass is useful for analysis. Furthermore, the reference dataset is old enough to obtain a good mapped reference salinity.

PSAL_ADJUSTED= PSAL from cycle 1 to 142

The quality flags applied are the following:

PSAL_ADJUSTED_QC='2' from cycle 1 to 142

The delayed-mode files (Dfiles) have been created accordingly and sent to the Coriolis GDAC.

5 References

Cabanes, C., Thierry, V., & Lagadec, C. (2016). Improvement of bias detection in Argo float conductivity sensors and its application in the North Atlantic. Deep-Sea Research Part I: Oceanographic Research Papers, 114, 128–136. https://doi.org/10.1016/j.dsr.2016.05.007