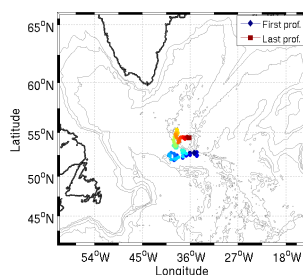

Delayed mode analysis of salinity data acquired by Argo floats

Float 6902811 (rrex 17)

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SO ARGO - LOPS report - Update May 6, 2021

Summary



WMO Number	DM Salinity Correction
6902811	OWC correction applied (salty drift ($\approx 0.012/\text{yr}$) starting cycle 1)

Table 1: Salinity Correction applied in delayed mode.

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1 Presentation

Delayed Mode analysis was performed float 6902811. First, salinity and temperature profiles were visually checked and compared to nearby reference profiles using `verif_flag` programs when necessary. Real time QC flags were verified and modified if necessary (see table 3). The OWC method was then run to estimate a salinity offset or/and a salinity drift, using, if possible, historical CTD or Argo profiles as reference databases. Finally, corrections were applied in the netcdf files when we thought it was necessary(see table 4).

WMO Number	Launch date	Centre	PI	Last cycle analysed (Active/NotActive)	Cycle Duration
6902811	09/08/2017	IF	V.Thierry	122(NA)	cy.1-122: 10 days

Table 2: Information on the floats analysed

Pressure sensor maker: KISTLER
Pressure sensor model: KISTLER_10153PSIA
Pressure sensor SN: 4750384

Conductivity sensor maker: SBE
Conductivity sensor model: SBE41CP_V7.2.5
Conductivity sensor SN: 8211

2 DMQC Summary

2.1 Verification of RT QC flags

Real Time QC flags were verified and modified if necessary. Table 3 gives the list of flags that have been modified during the delayed mode process.

WMO Number	Cycle	Param	Old flag	New flag	Levels	Date of modification
6902811	043A	PSAL	1	4	6.1 : 9.8	08/04/2021
		PSAL	1	4	35.7 : 35.7	08/04/2021
		PSAL	1	4	105.6 : 114.7	08/04/2021
		PSAL	1	4	145.4 : 155.6	08/04/2021
		PSAL	1	4	185.4 : 235.2	08/04/2021
		PSAL	1	4	285.3 : 395.3	08/04/2021
		PSAL	1	4	445.7 : 445.7	08/04/2021
		PSAL	1	4	485.6 : 485.6	08/04/2021
		PSAL	1	4	530.3 : 570.2	08/04/2021
		PSAL	1	4	630.5 : 950.4	08/04/2021
		TEMP	4	1	15.5 : 25.2	08/04/2021
		TEMP	4	1	75.2 : 95.3	08/04/2021
		TEMP	4	1	125.4 : 135.5	08/04/2021
		TEMP	4	1	166.3 : 175.4	08/04/2021
		TEMP	4	1	245.2 : 245.2	08/04/2021
		TEMP	4	1	265.6 : 275.3	08/04/2021
		TEMP	4	1	405.3 : 435.6	08/04/2021
		TEMP	4	1	455.6 : 475.4	08/04/2021
		TEMP	4	1	495.8 : 510.5	08/04/2021
		TEMP	4	1	590.3 : 610.6	08/04/2021
	057A	PSAL	4	1	263.2 : 263.2	08/04/2021
		TEMP	4	1	263.2 : 264.1	09/04/2021
	064A	TEMP	4	1	274.8 : 275.9	09/04/2021
		TEMP	4	1	279.2 : 280	09/04/2021
	067A	PSAL	4	1	163.6 : 163.6	08/04/2021
		TEMP	4	1	162.8 : 163.6	09/04/2021
	070A	TEMP	4	1	140 : 141	09/04/2021
		TEMP	4	1	143.9 : 144.9	09/04/2021
	077A	PSAL	1	4	260.1 : 260.1	08/04/2021
		TEMP	4	1	258 : 259.3	09/04/2021
	078A	PSAL	1	4	235 : 235	09/04/2021
		PSAL	1	4	237 : 237	09/04/2021
		PSAL	1	4	246.6 : 246.6	09/04/2021
		TEMP	4	1	238.2 : 239.2	09/04/2021
	082A	TEMP	4	1	71.2 : 71.8	09/04/2021
	092A	PSAL	1	4	66.2 : 70	09/04/2021
		PSAL	1	4	72.8 : 72.8	09/04/2021
		PSAL	1	4	75.9 : 78.1	09/04/2021
		PSAL	1	4	81.8 : 84.2	09/04/2021
		TEMP	4	1	71.1 : 72	09/04/2021
		TEMP	4	1	73.7 : 74.8	09/04/2021

WMO Number	Cycle	Param	Old flag	New flag	Levels	Date of modification
	107A	TEMP	4	1	79.3 : 80.6	09/04/2021
		PSAL	4	1	214.1 : 214.1	09/04/2021
		TEMP	4	1	214.1 : 214.8	09/04/2021
	108A	TEMP	4	1	47.1 : 47.9	09/04/2021
	115A	TEMP	4	1	44 : 44.8	09/04/2021
	116A	TEMP	4	1	34.8 : 35.5	09/04/2021
	117A	PSAL	4	1	65.9 : 65.9	09/04/2021
		TEMP	4	1	59 : 59.8	09/04/2021
		TEMP	4	1	65 : 65.9	09/04/2021

Table 3: Modified flags during DM analysis

For each float, we report here the list of cycles for which a density inversion was detected in real time (with a treshold value of 0.03). This sometimes reveals a problem with the conductivity sensor and it is necessary to particularly check these profiles in delayed time. Moreover, when density inversion are flagged in RT, it is often necessary to modified flags in DM: often, the temperature does not need to be flagged at 4 and not all the salinity measurements flagged in RT need a flag 4. We also report here some anomalies e.g. a float that did not dive for a given cycle or missing cycles.

- 6902811 - Density inversions are found cycles: 43, 57, 64, 67, 70, 77, 78, 82, 92, 107, 108, 115, 116, 117.

2.2 Salinity corrections applied

WMO Number	new CPcorr	Calibration (with new CPcorr value applied)		
		Comparison with the reference CTD cast	Correction from OWC method	Correction applied in the D files
6902811	-1.35e-07	-0.003	-0.0025 ± 0.008 (cycle 1) and linear drift ($\approx -0.012/\text{yr}$) (config. 39)	OWC correction ap- plied

Table 4: Salinity corrections for the floats proposed by the OWC method or by comparison with a shipboard CTD reference profile once the new Cpcorr value has been applied to the conductivity data. Uncertainties are the statistical uncertainties from the OWC method.

3 Float 6902811

3.1 Trajectory

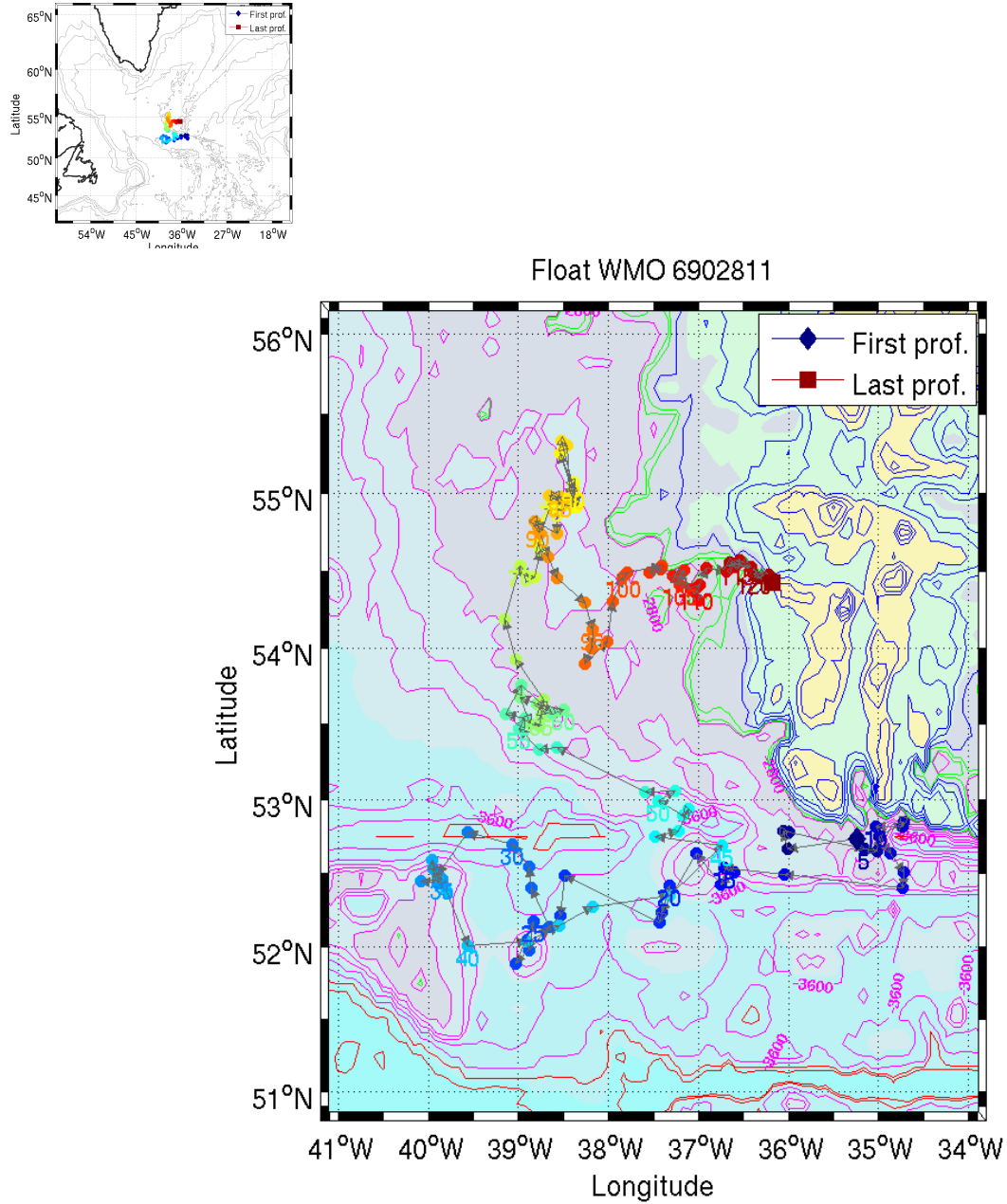


Figure 1: Float 6902811. Trajectory of the float and bathymetry. Parking depth is: 2750m and profile depth is: 4000m. Bathymetric contours at float's parking depth ± 30 m are plotted in green, bathymetric contours at float's profile depth ± 30 m are plotted in red, bathymetric contours between profile depth and parking depth are plotted every 200m in magenta and bathymetric contours between parking depth and surface are plotted every 200m in blue.

3.2 Sections along the float trajectory - raw data

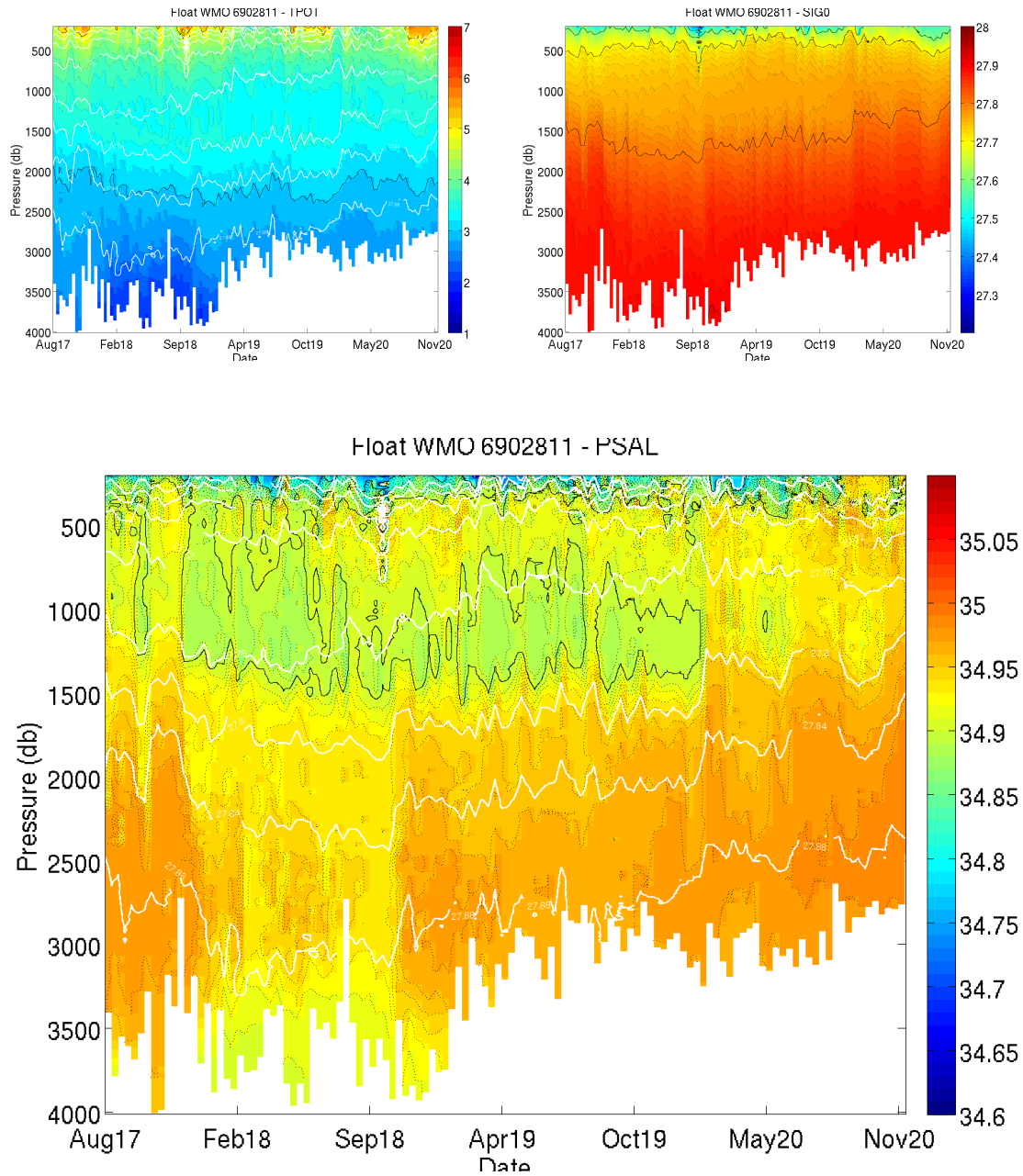


Figure 2: Float 6902811. Potential temperature, Sig0 and salinity sections along the float trajectory (raw data, flags not used)

3.3 Theta/S diagrams - raw data

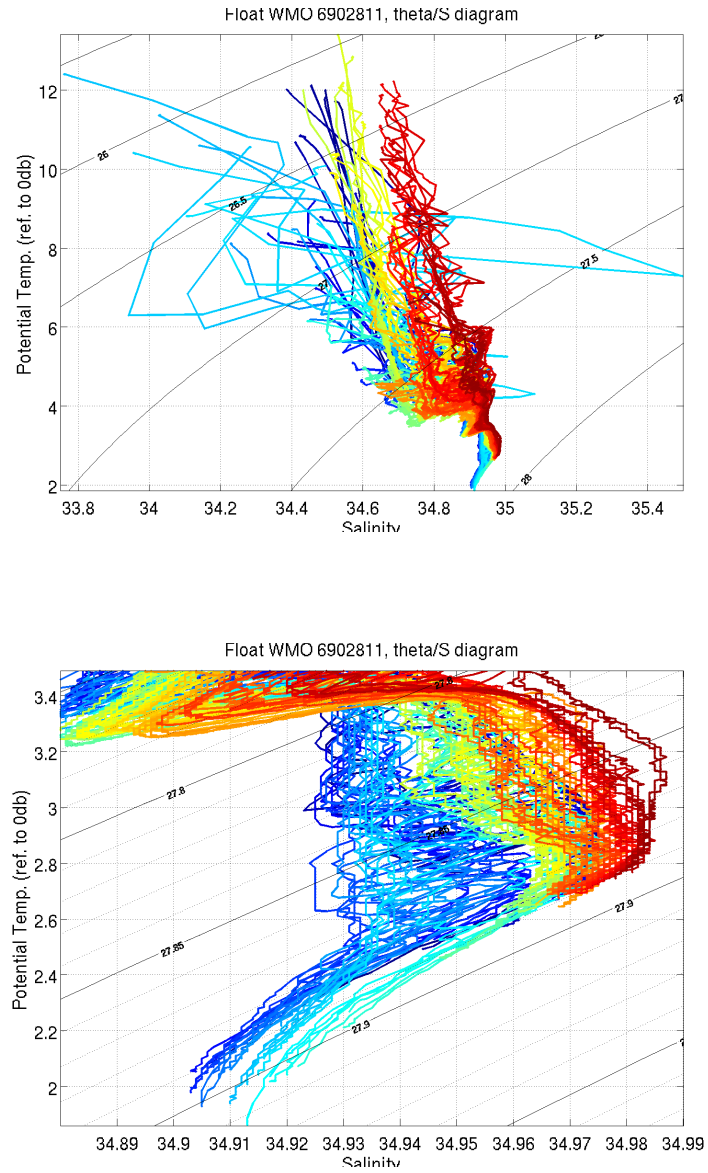


Figure 3: Float 6902811. Theta/S diagrams of the raw data, with the potential temperature referenced to 0db. Full profiles (upper panel) and zoom below 1500m (lower panel). Flags are not used

3.4 Technical data : surface pressure - battery - pump or valve actions

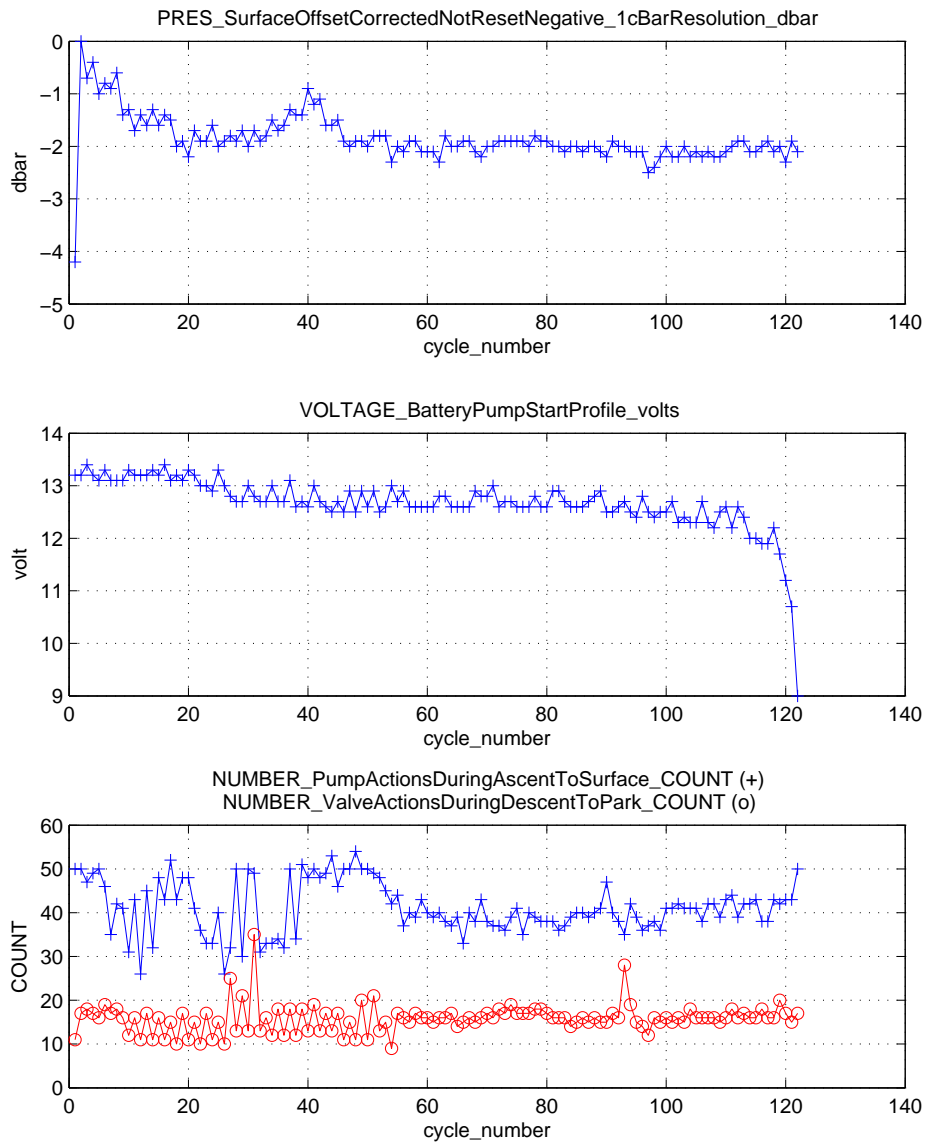


Figure 4: Float 6902811: Some technical data as read in the technical file

3.5 Cpcor Analyse

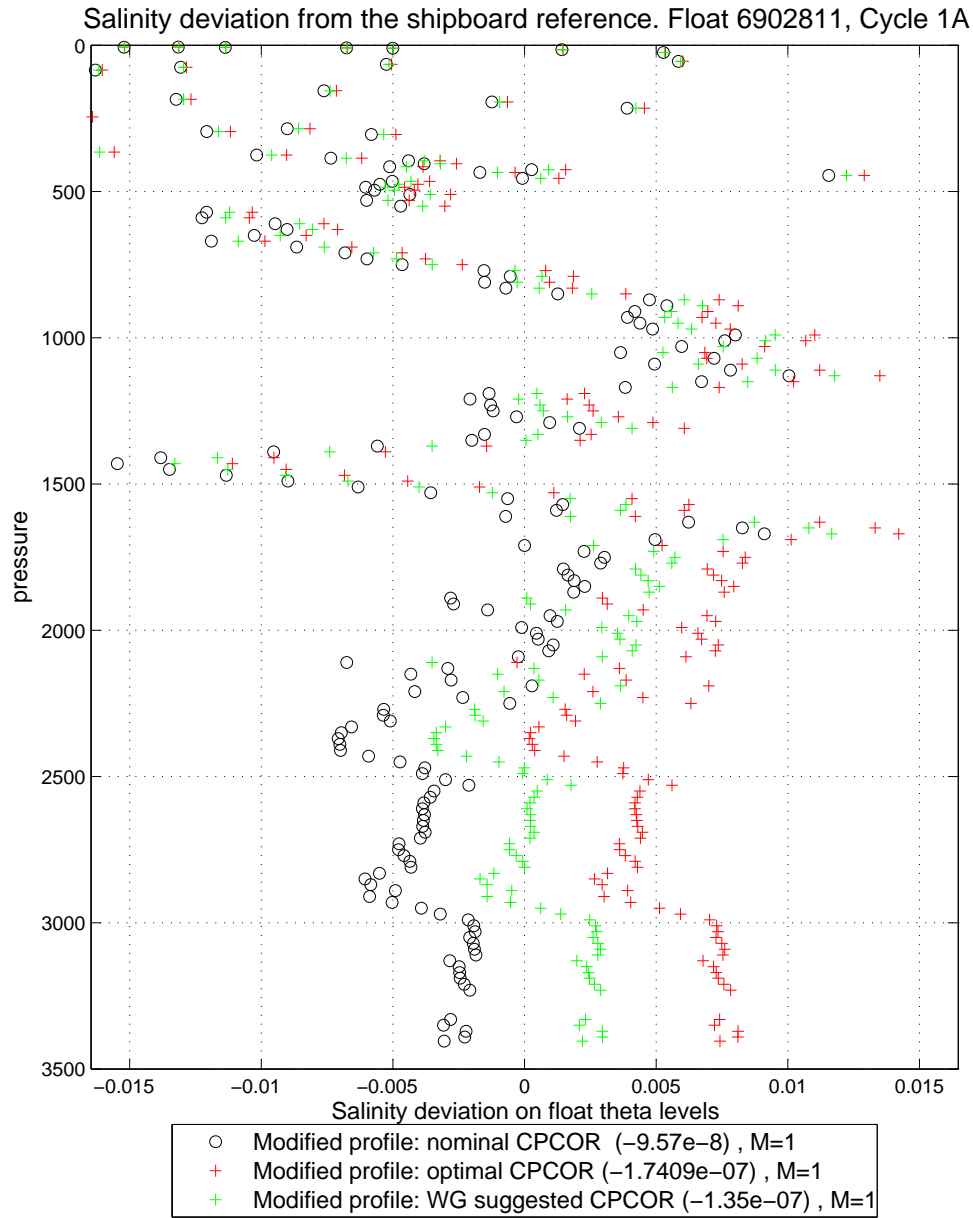


Figure 5: Float 6902811. Estimation of the optimal Cpcor (<1000m). Comparison with the Working Group (WG) suggested value for Cpcor.

In what follows, the salinity has been adjusted using the Working Group (WG) suggested value for Cpcor. No offset has been applied yet.

3.6 Comparison with the reference CTD cast

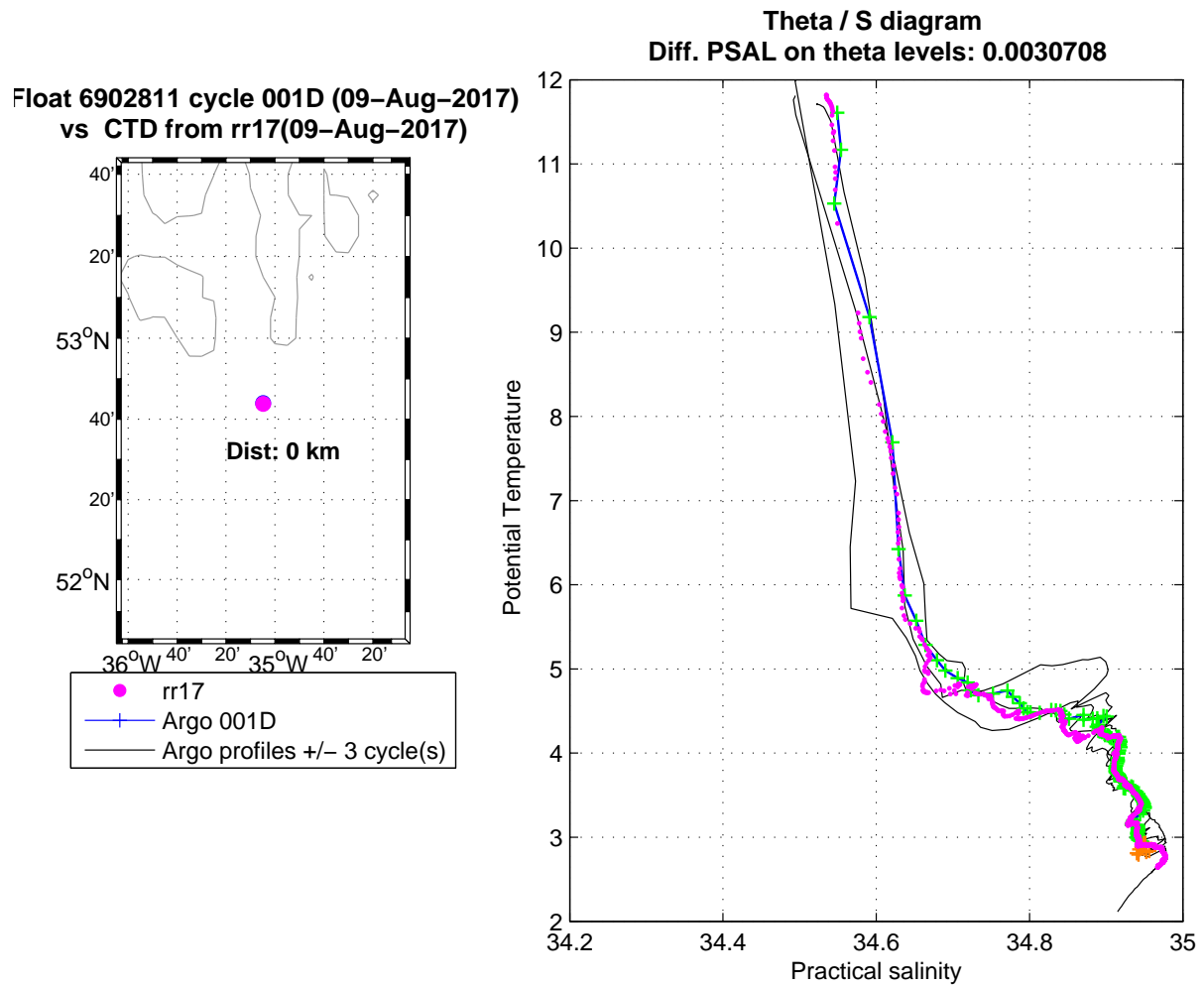


Figure 6: Float 6902811. Comparaision of the first descending (or ascending) argo profile with the CTD made at float deployment. Difference is $PSAL(argo) - PSAL(ref\ cast)$.

3.7 Results of the OWC method

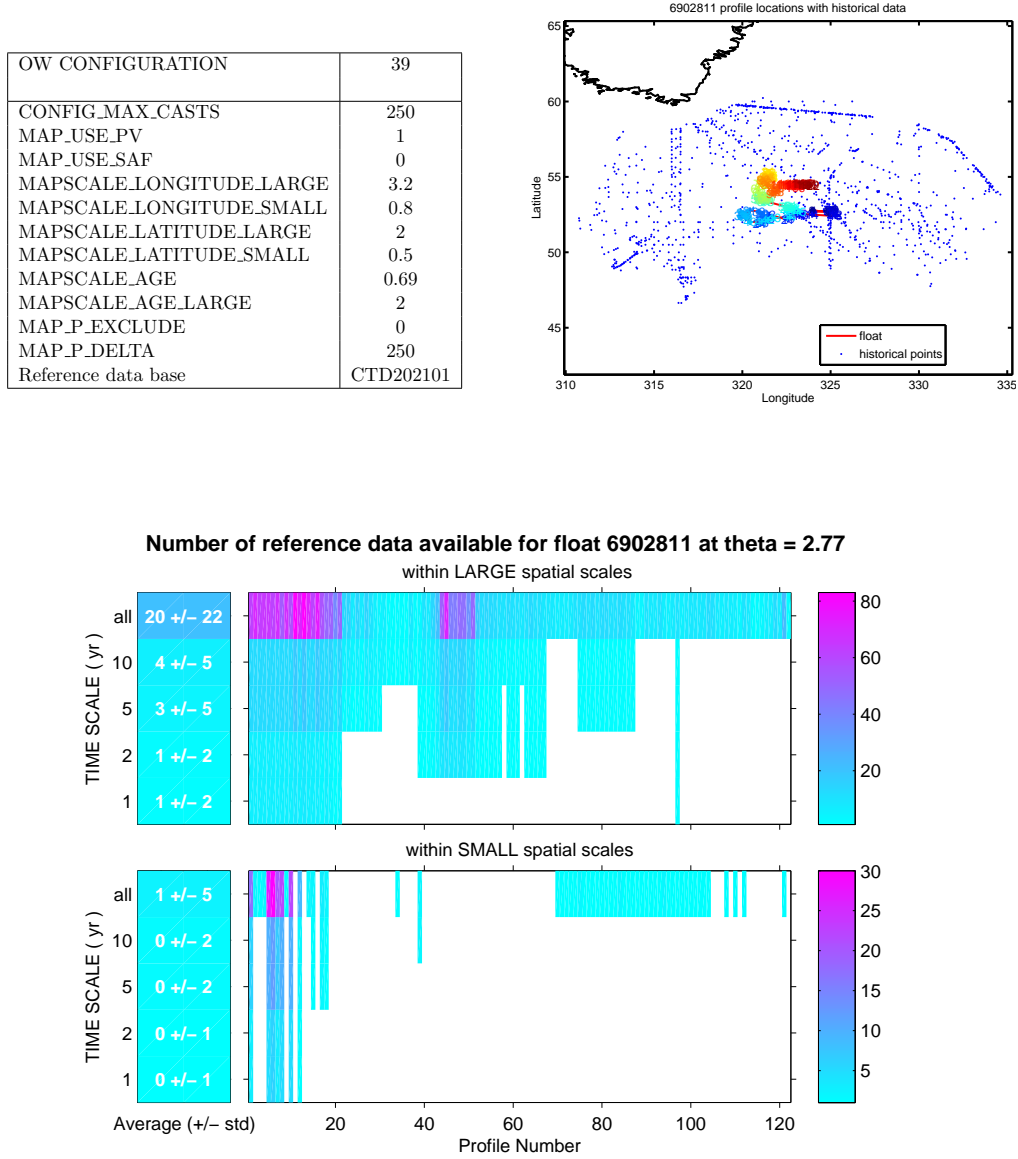


Figure 7: Float 6902811. Upper (left): Configuration parameters used for OWC method. Upper (right) : Reference profiles used for the mapping (grey dots) are shown on the map along with the float trajectory. Lower: Number of reference profile available within the defined spatial and temporal scales.

set_calseries.m	
breaks	[]
max_breaks	4
use_theta_lt	[]
use_theta_gt	[]
use_pres_lt	[]
use_pres_gt	[]
use_percent_gt	0.5

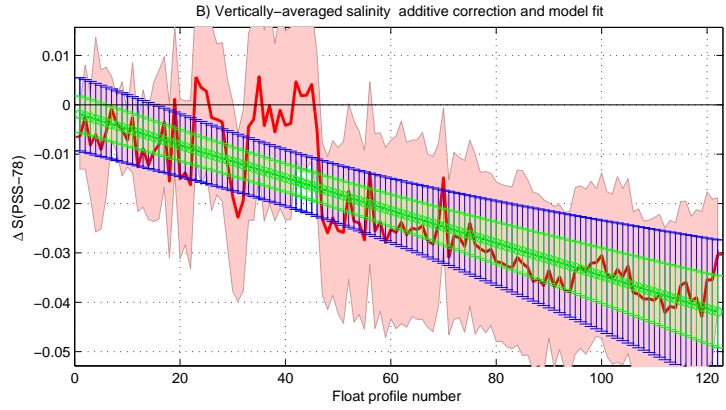
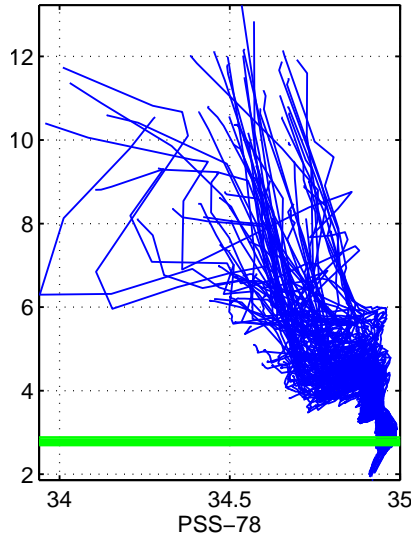
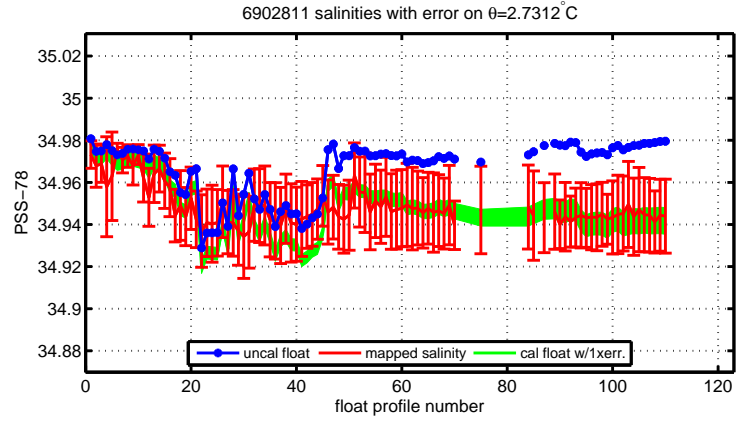


Figure 8: Float 6902811. Results of the OWC method (configuration 39). Upper panel (right): float salinities at one θ level (blue dots) compared to mapped salinities with errors (red). Lower panel (left): The 10 θ levels (green lines) with less salinity variance along the float path that are used for computing the conductivity correction. Lower panel (right): vertically-averaged mapped salinities minus float salinities on the 10 θ levels (red) and the computed offset (green).

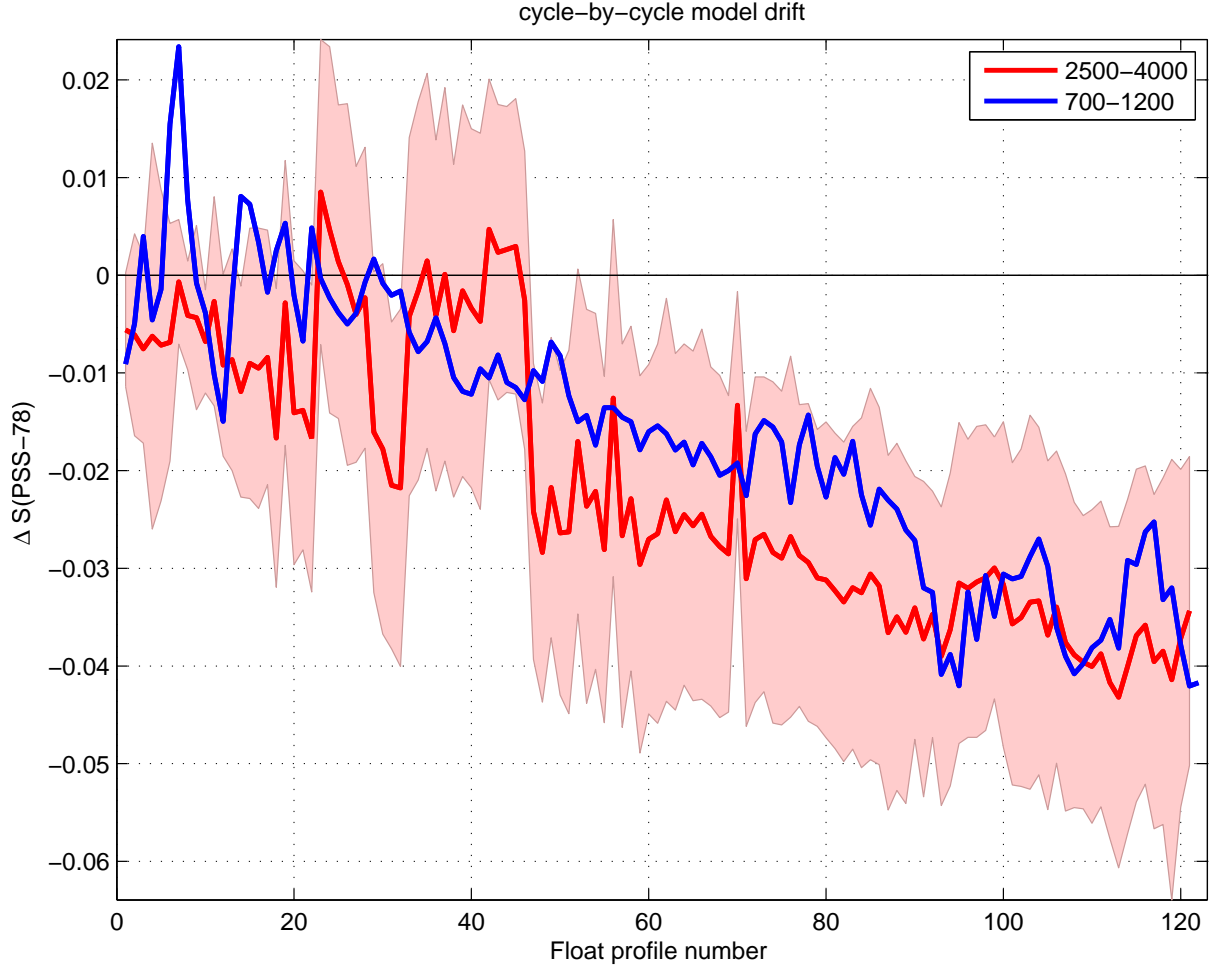


Figure 9: Float 6902811. Results of the OWC method (configuration 39) using different depths to compute calibration curve.

Conclusion

The OWC run correction shows a salty drift ($\approx 0.012/\text{yr}$). We wondered if the jump in vertically averaged salinity anomalies seen at cycle 45 (red curve in Figure 8) was the result of a sensor malfunction. However, this jump does not appear at all depths (see Figure 2) and may instead result from the trajectory of the float as it moves back near the Reykjanes ridge after cycle 45 and encounters saltier water. Once corrected 6902811 cycle 3 compares

well with colocated profile from 6902812 (see [here](#)).

3.8 Adjusted data

3.8.1 Salinity flags and correction in D files

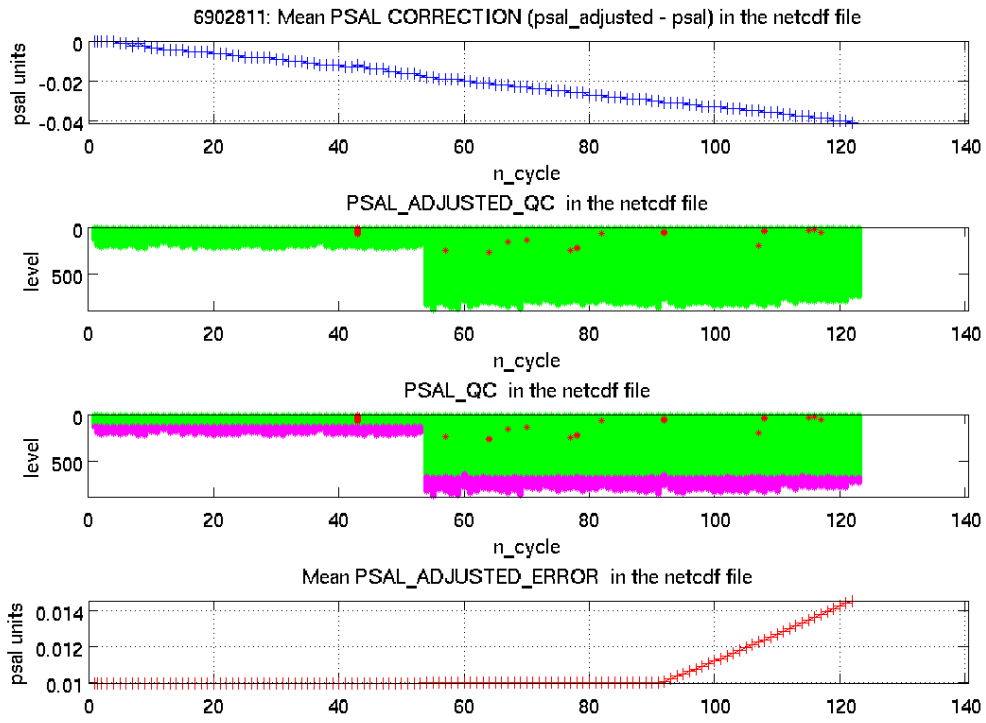


Figure 10: Salinity correction and flags in D files (Flag 0: blue, Flag 1: green, Flag 2: yellow, Flag 3: magenta, Flag 4: red)

3.8.2 Sections along the float trajectory

Salinity Correction applied in DM: OWC correction applied (salty drift ($\approx 0.012/\text{yr}$) starting cycle 1)

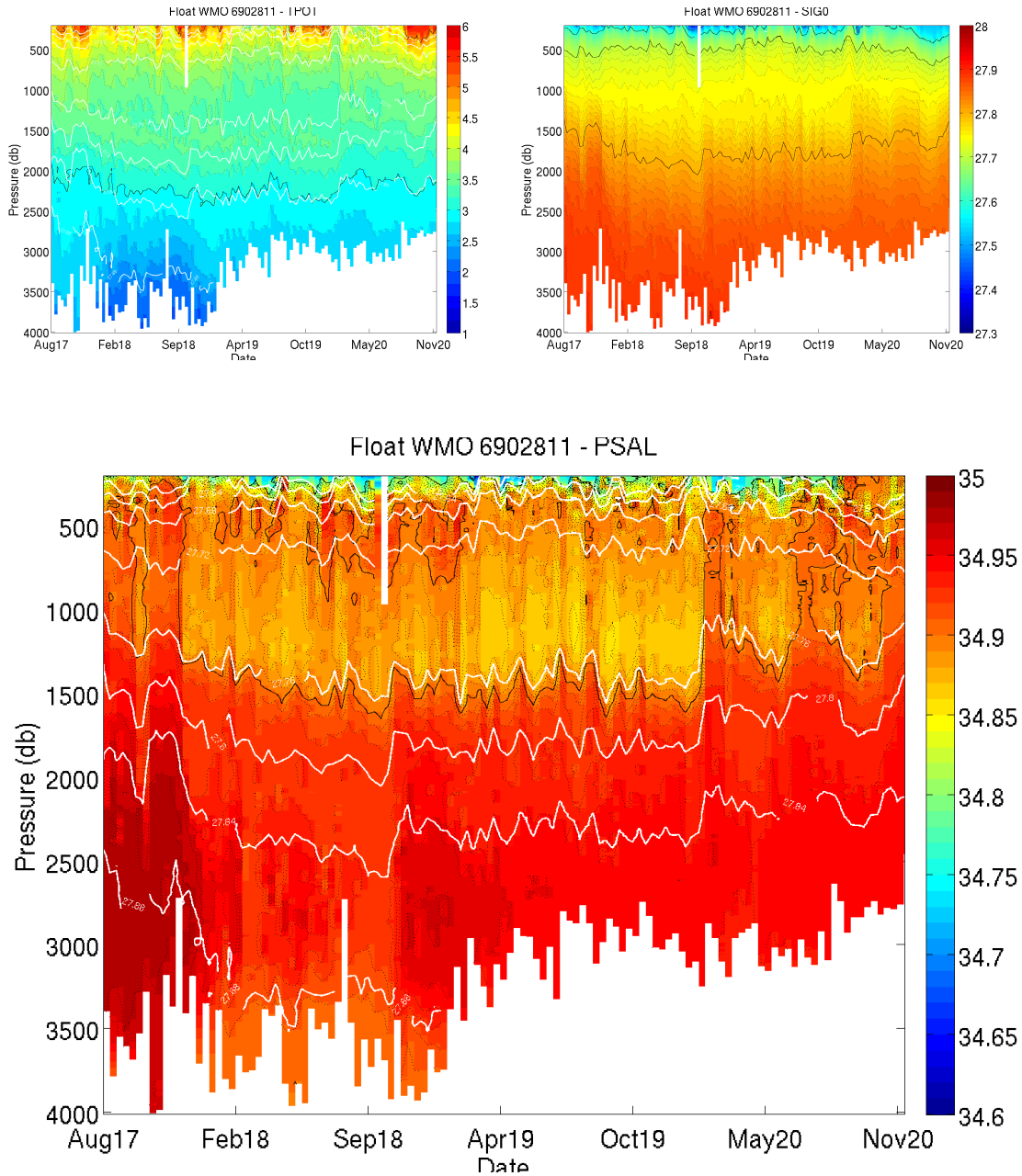


Figure 11: Float 6902811. Potential temperature, Sig0 and salinity sections along the float trajectory (raw data, flags not used)

3.8.3 Theta/S diagrams

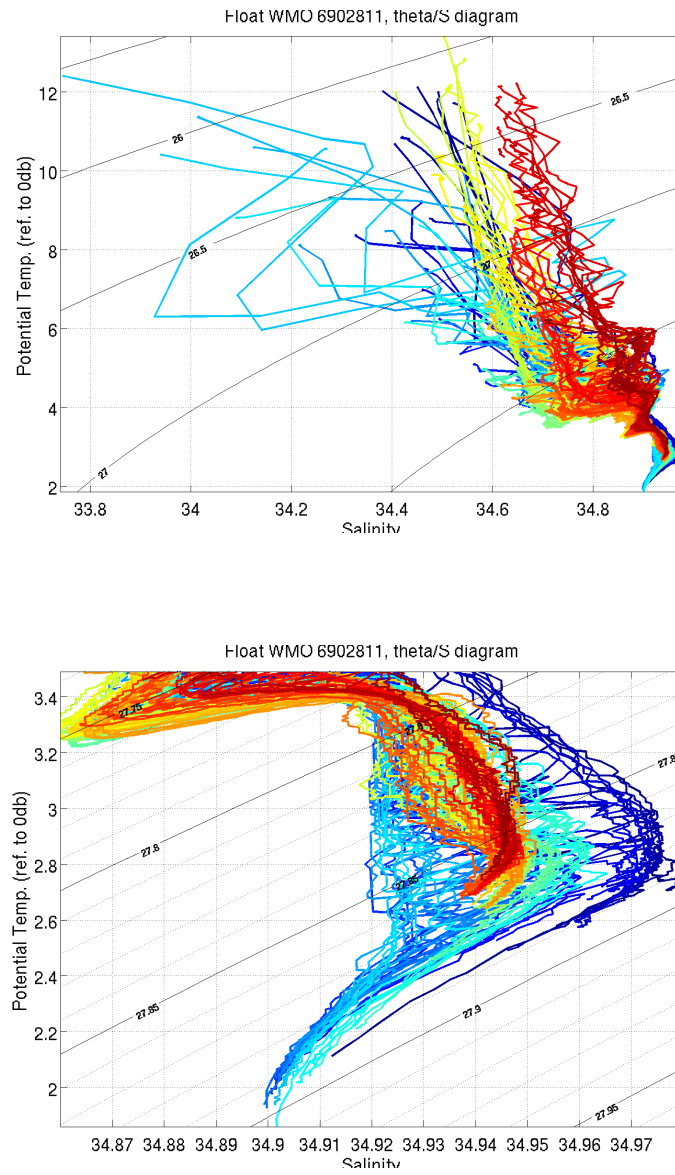
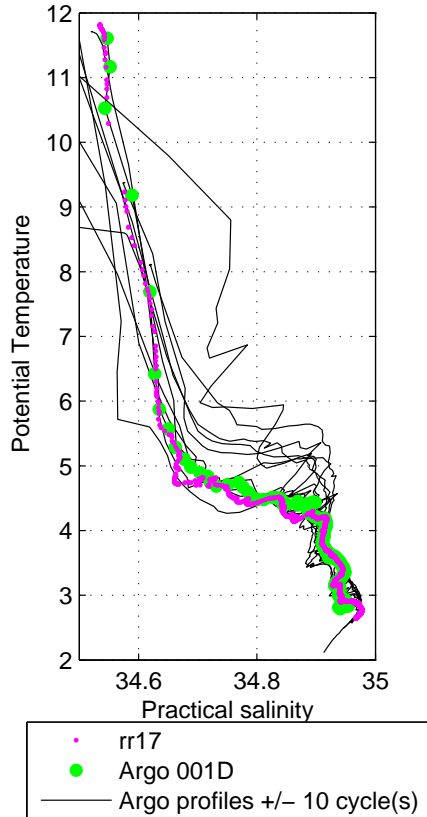


Figure 12: Float 6902811. Theta/S diagrams of the adjusted data, with the potential temperature referenced to 0db. Full profiles (upper panel) and zoom below 1500m (lower panel). Flags are used

3.8.4 Comparison with the reference CTD cast, adjusted profiles

Float 6902811 cycle 001D (09-Aug-2017)
vs CTD from rr17(09-Aug-2017)



Zoom on depths deeper than 1000m
Diff. PSAL on theta levels: 0.001152

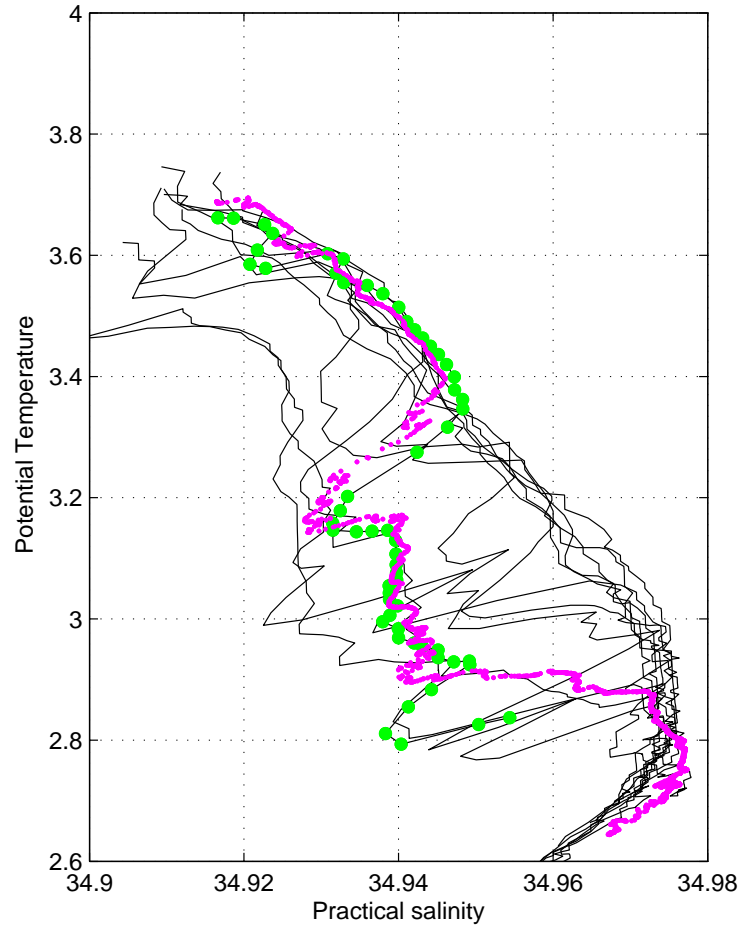


Figure 13: Float 6902811. Comparison of the first descending (or ascending) argo profile with the CTD made at float deployment. Difference is $PSAL_ADJUSTED(argo) - PSAL(ref\ cast)$.