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DELAYED MODE QUALITY CONTROL AND OXYGEN CORRECTION OF OVIDE ARGO DATA FLOAT WMO 5902297

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Reference : Internal Report **LOPS/17-04**

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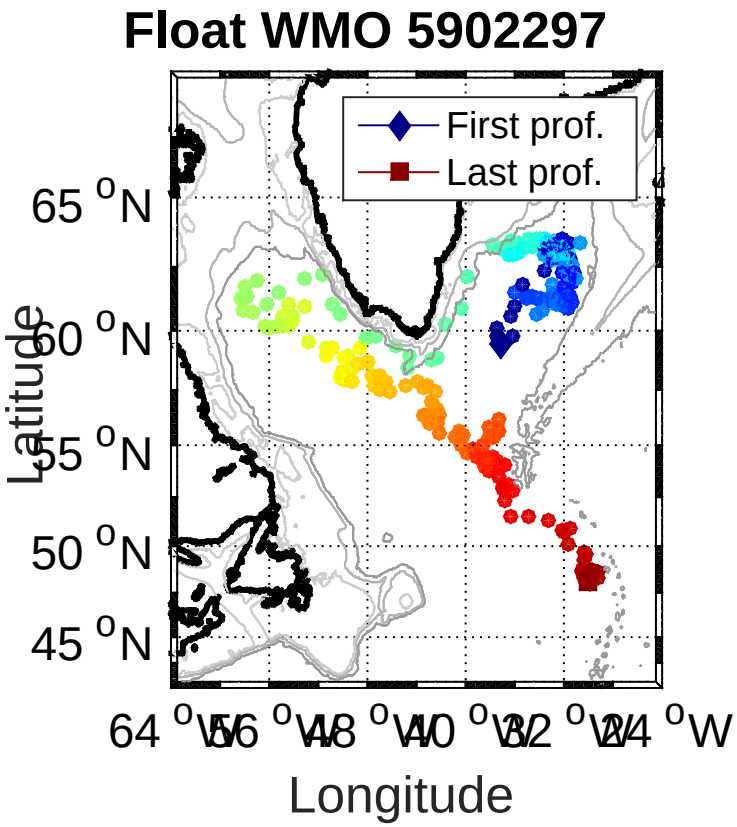
Internal Report LOPS 17-04

C. Lagadec - V. Thierry - C. Cabanes

June 28, 2017



1 Presentation and DMQC summary

Number	Deployment (cycle OD) cycle OD	Last cycle 228
Provor WMO 5902297	27/06/2010 23h11	
CTS3 DO 9	N 59.432 W 37.0478	

Date of control	Float status	Last cycle
Jan/April 2013	Active	102
Coriolis transmission		27/05/2013

Date of control	Float status	Last cycle
October 2015	Active	1/10/15
Coriolis transmission		15/10/2015

Date of control	Float status	Last cycle
May 2017	dead	25/09/16
Coriolis transmission		15/05/2017

Table 1: Status of the float

Warning : Note that all the figures are plotted with the latest QC flag values (the modifications mentionned table 2 are taken into account).

1.1 QC flag checks and interesting profiles

Warning : the resolution is equal to 10 dbar from the surface to 500 dbar, then 25 dbar from 500 to 2000 dbar. Salinity data between 0 and 5 dbar are suspicious because they are acquired when the pump of the CTD is turned off.

1.2 Salinity correction from the OW method

We cannot see any evidence of a drift or bias in the salinity measurement. We thus conclude that it is not necessary to correct the salinity data. Errors bars are maximum value between 0.01 and those determined from the OW method with parameters from the OW configuration 129.

2 Data

Cycle	Para-meter	Vertical level	Old flag	New flag	Comments	Coriolis transmission
26A	TEMP	1,2	4	1		07/01/13
41A	PSAL	0 to 539 dbar	1	4		07/01/13
53A	TEMP	1,2	4	1		07/01/13
54A	TEMP	1	4	1		07/01/13
68A	TEMP	1,2	4	1		07/01/13
72A	PSAL	1200m	3	1		07/01/13
all profiles (except 0D,0A,1A,2A)	DOXY	entire profile	1	4		24/04/13
110A	PSAL				interesting	oct 2015
203A	PSAL	60,61	4	1		may 2017
203A	TEMP	60,63	4	1		may 2017

Table 2: Float 5902297. Summary of the modifications of the real-time QC flags and of the interesting or suspicous data.

OW CONFIGURATION	129
CONFIG_MAX_CASTS	250
MAP_USE_PV	1
MAP_USE_PV_ELLIPSE	1
MAP_USE_FACTEUR	1
MAPSCALE_LONGITUDE_LARGE	3.2
MAPSCALE_LONGITUDE_SMALL	0.8
MAPSCALE_LATITUDE_LARGE	2
MAPSCALE_LATITUDE_SMALL	0.5
MAPSCALE_PHI_LARGE	0.1
MAPSCALE_PHI_SMALL	0.02
MAPSCALE_AGE	0.69
MAP_P_EXCLUDE	500
MAP_P_DELTA	250
Reference data base	CTD and ARGO

Table 3: Parameters of the OW method.

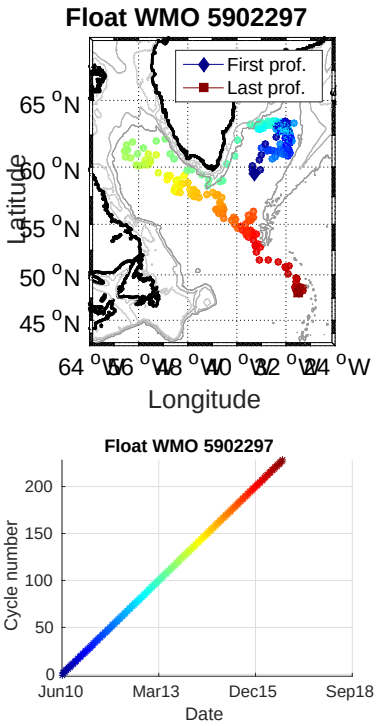


Figure 1: Profiles position and relationship between cycle number, date and color.

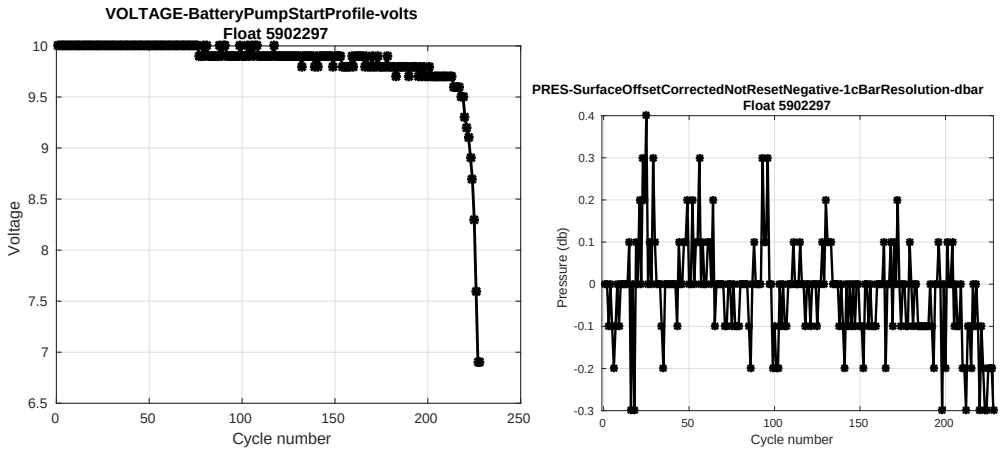


Figure 2: Battery Voltage and Surface Pressure

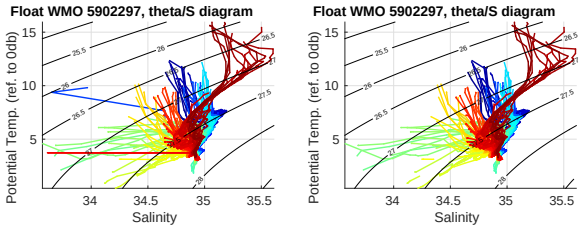


Figure 3: θ/S diagrams. (Left panel) Flags are not taken into account. (Right panel) Quality flags are taken into account.

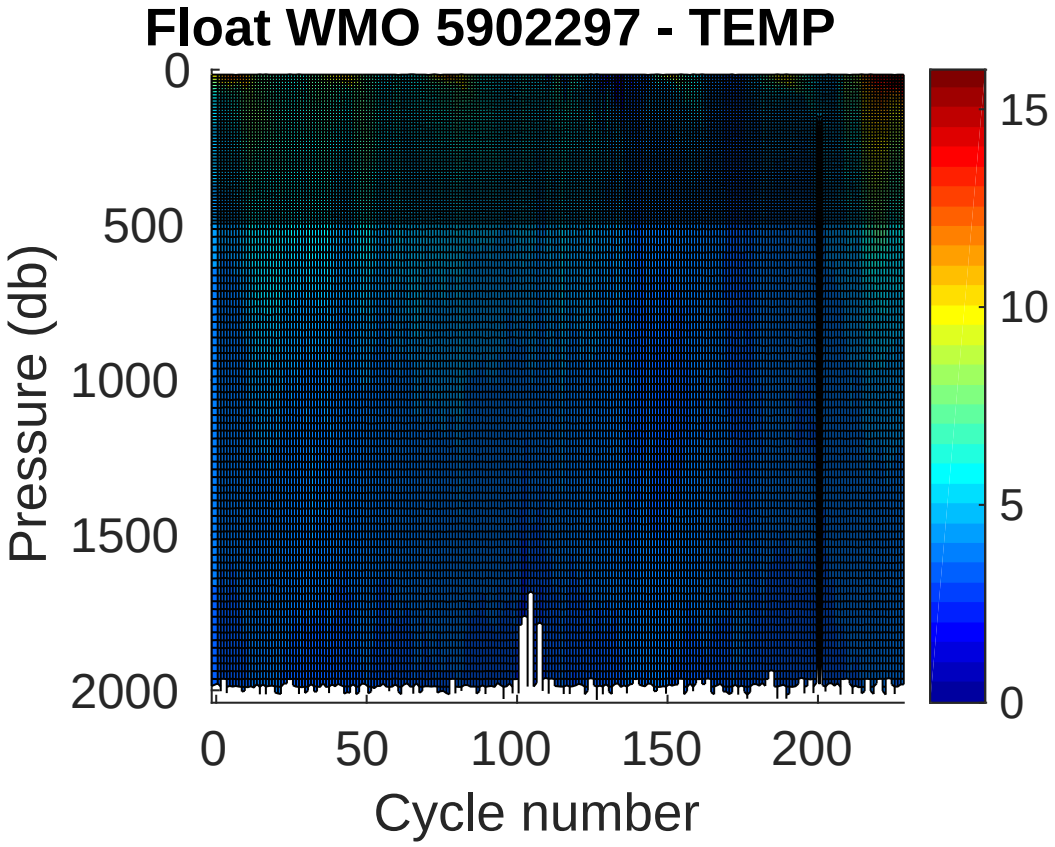


Figure 4: Temperature section along the float trajectory. Quality flags are not taken into account.

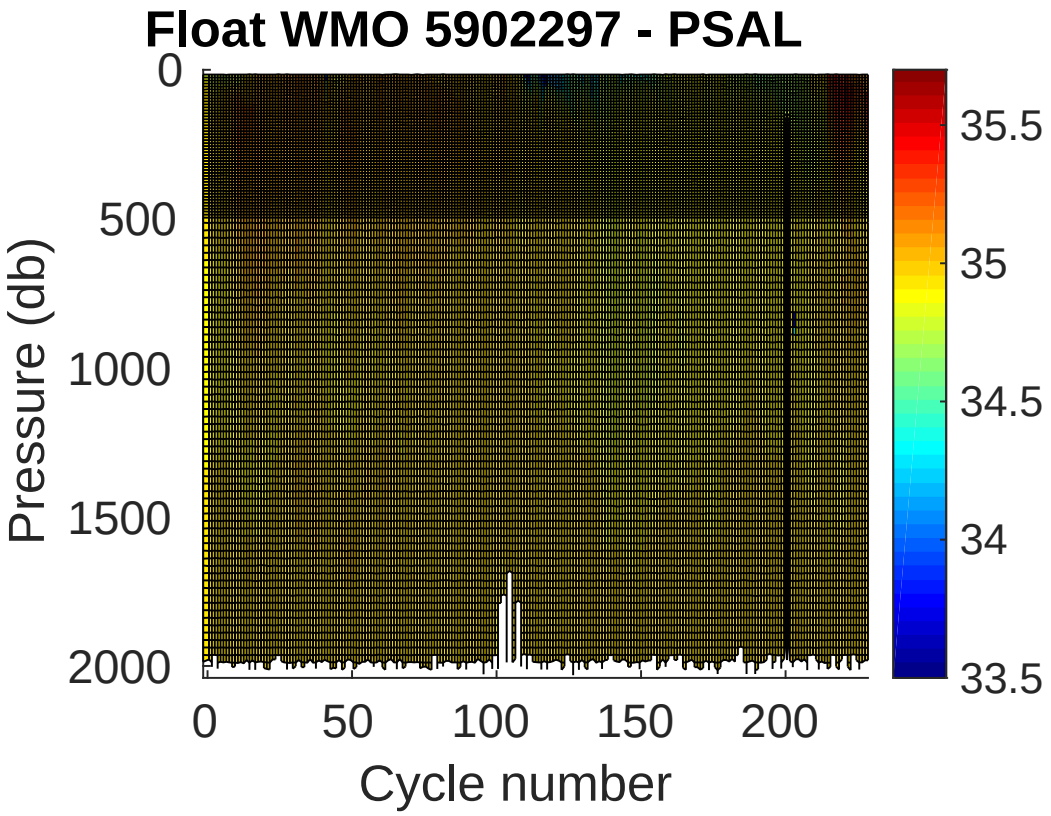


Figure 5: Salinity section along the float trajectory. Quality flags are not taken into account.

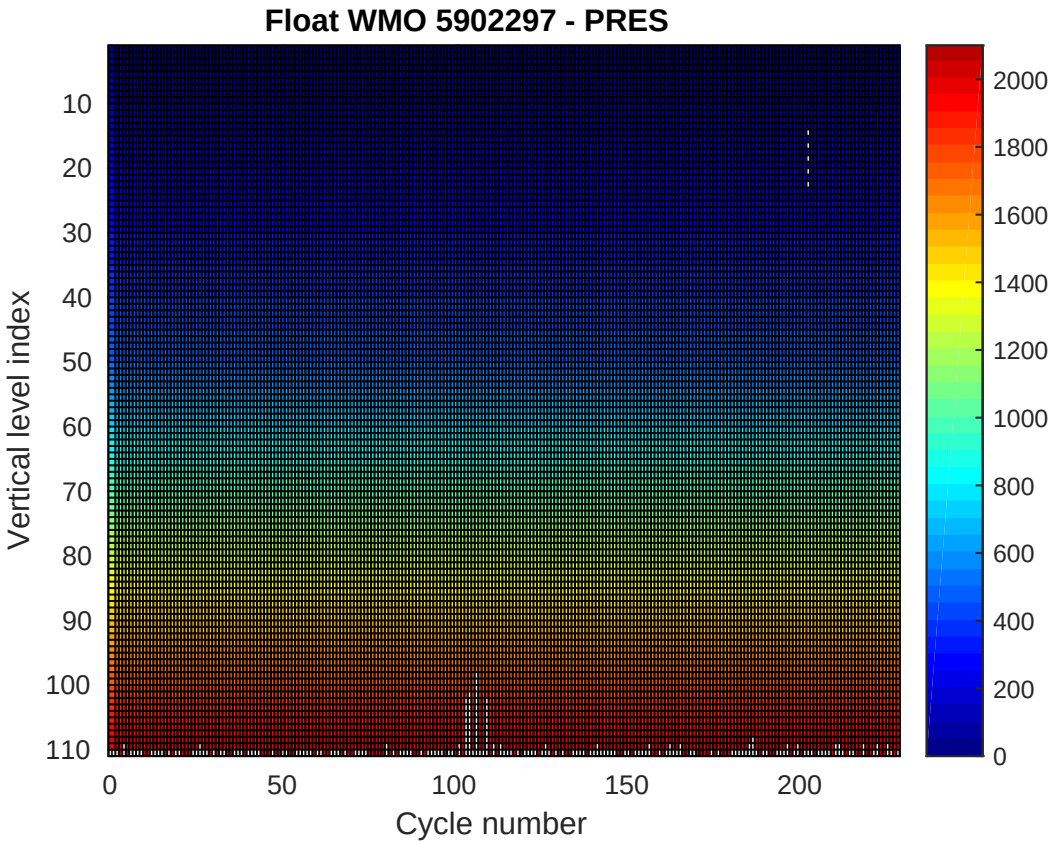


Figure 6: Pression as fonction of cycle number and vertical level index along the float trajectory. Quality flags are taken into account.

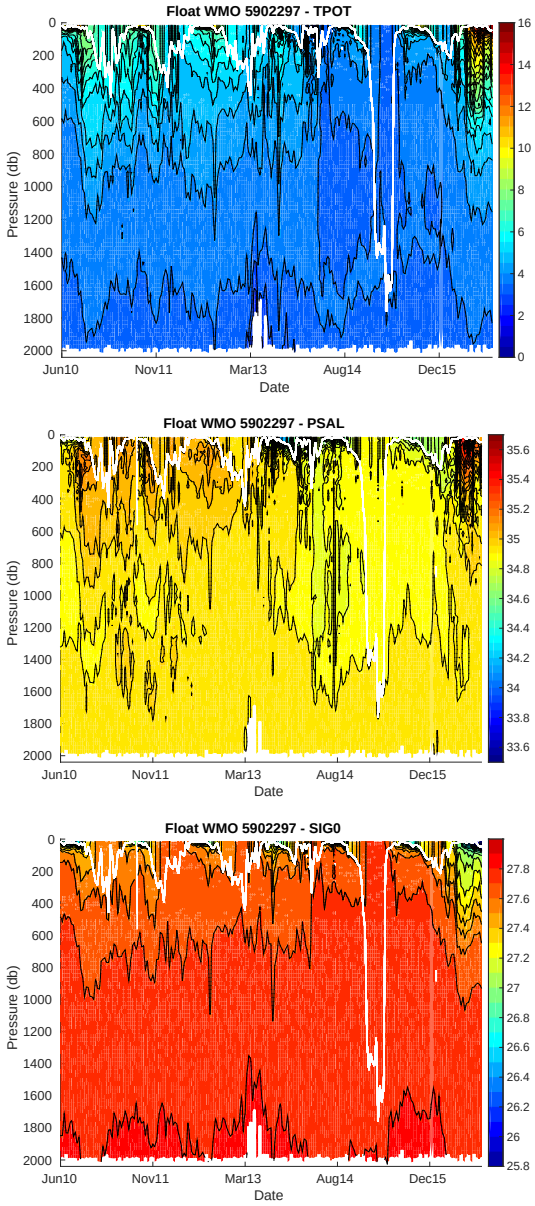


Figure 7: Potential temperature, salinity and potential density sections along the float trajectory (interpolated on standard levels). Quality flags are taken into account.

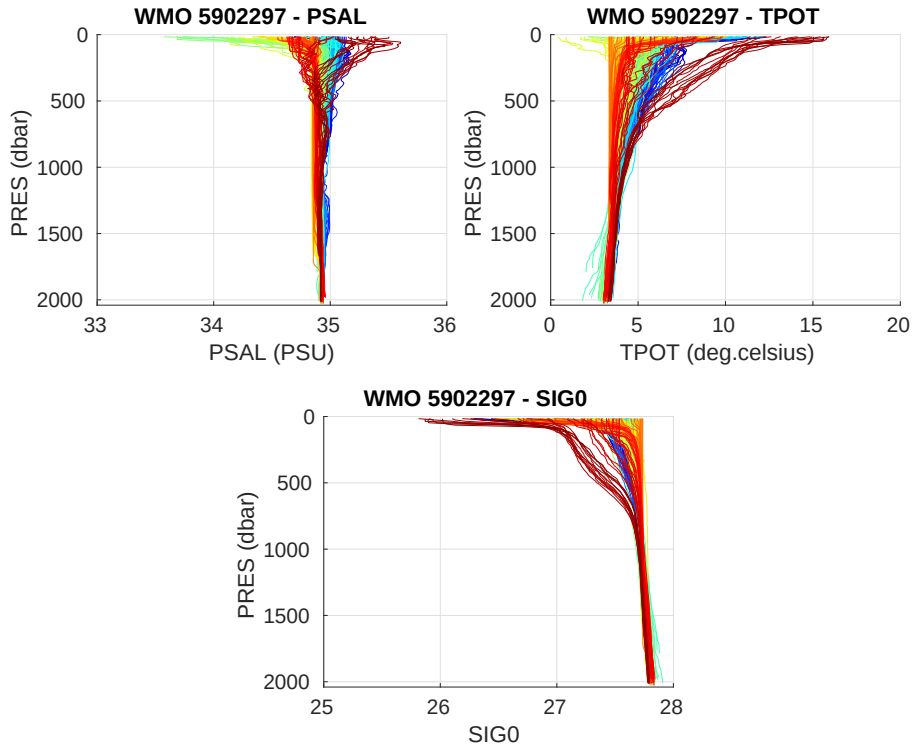


Figure 8: Salinity, Potential Temperature and Potential Density profiles. Quality flags are taken into account.

3 Comparison to the OVIDE 2010 nearest CTD profile

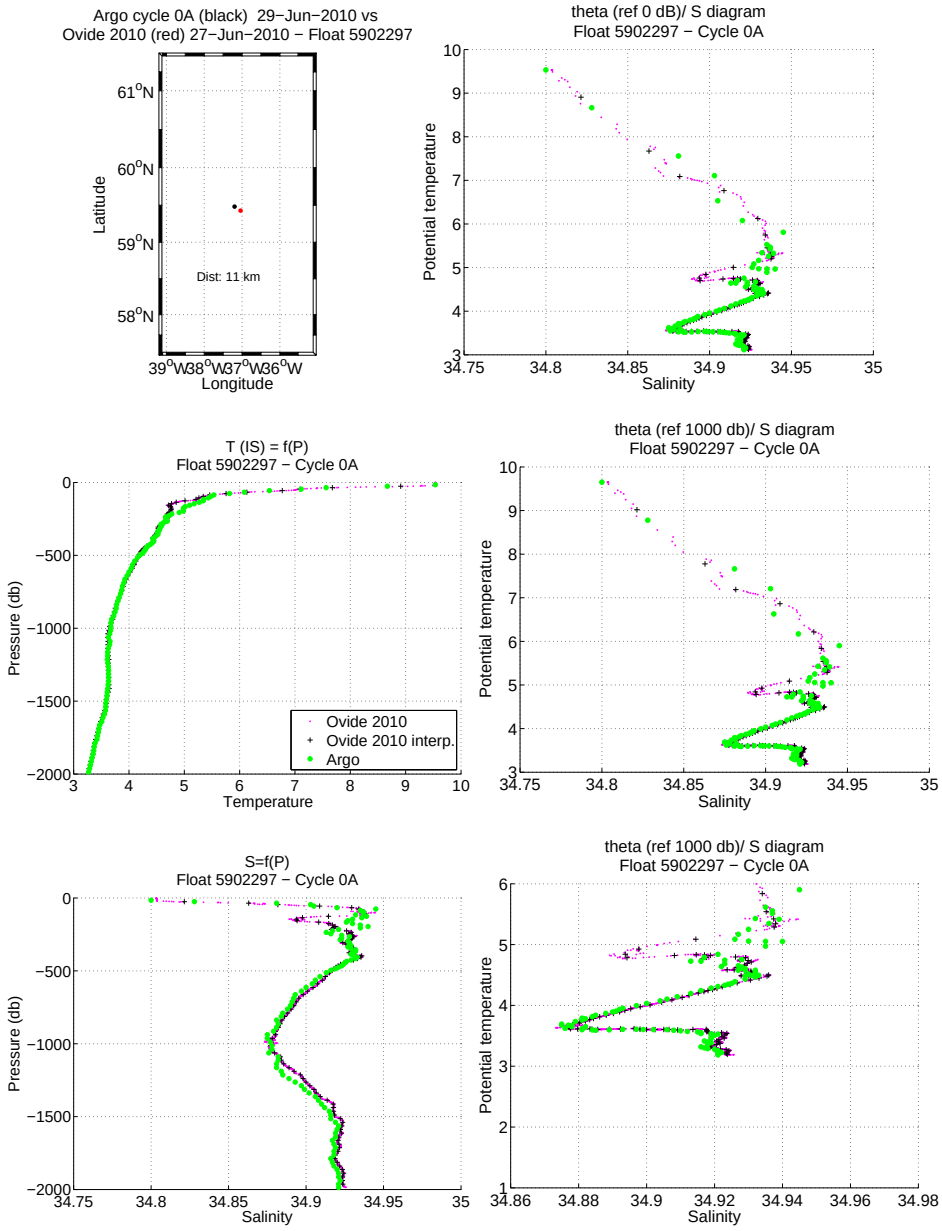


Figure 9: Comparison of the cycle 0A with the nearest CTD profile done after the float deployment.

4 Cycle 41 - Comparison to the nearest historical CTD profiles

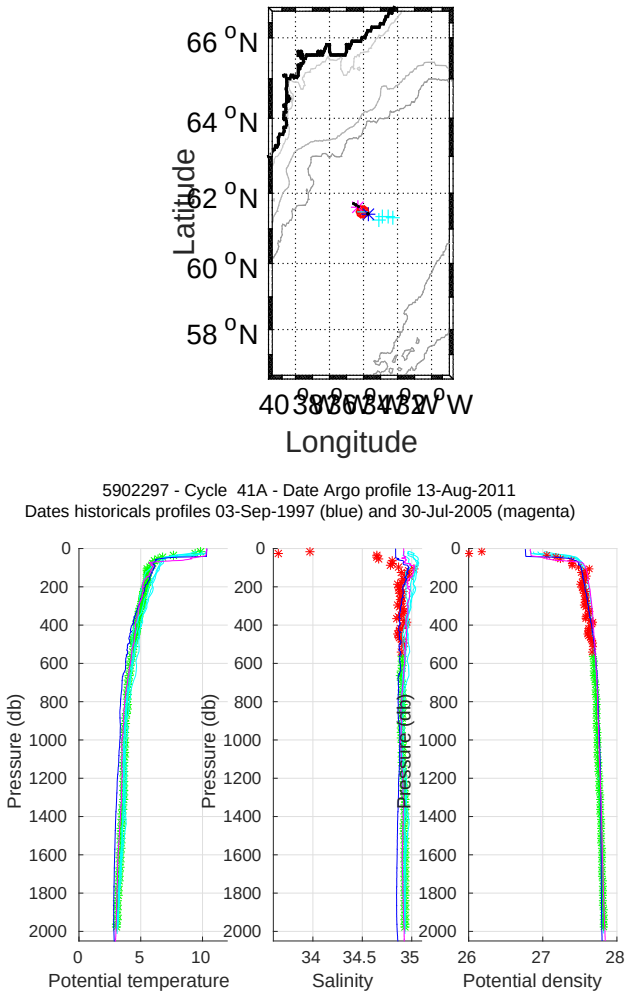


Figure 10: Flotteur 5902297, cycle 41. Upper panel: Position of the analysed CTD profile (red) and of the nearest CTD profiles (black). The nearest CTD profile in time is in magenta while the nearest CTD profile in space is in blue. Lower panels: Temperature, salinity and potential density as function of pressure for the analysed CTD profile (stars) and for the nearest CTD profile in time (magenta line) and for the nearest CTD profile in space (blue line). The color of the analysed CTD profile represents the QC flag (green for a QC=1; blue for a QC=2; orange for a QC=3 and red for a QC=4).

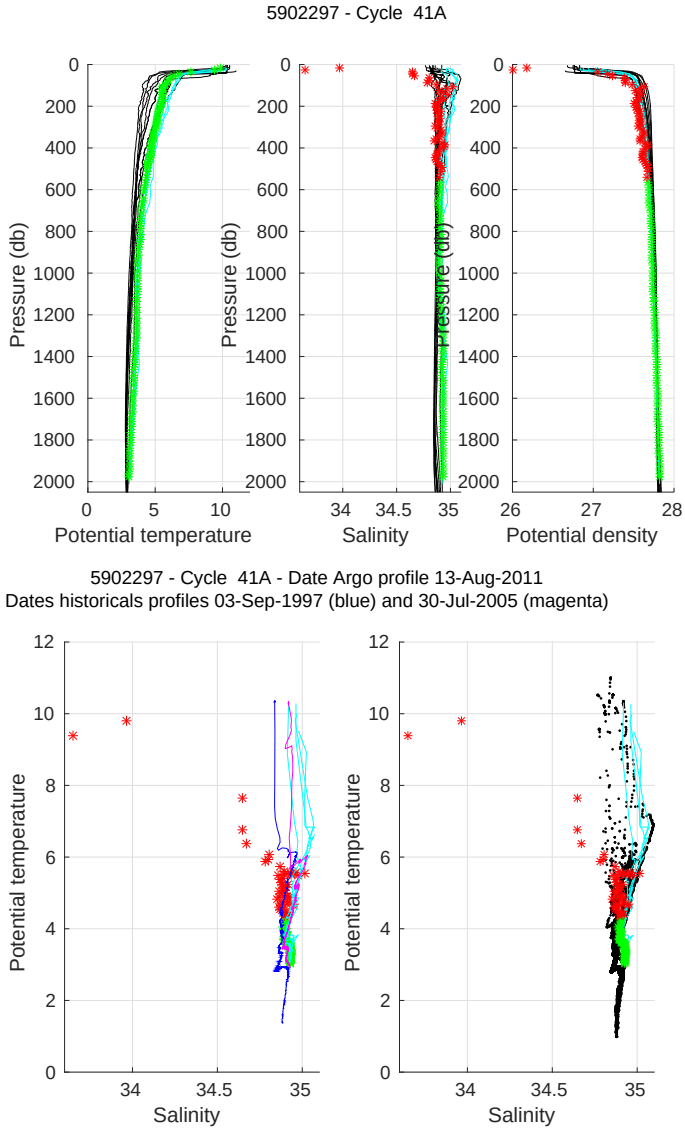


Figure 11: Float 5902297, cycle 41. The analysed CTD profile (stars) is compared to the nearest CTD profiles (black line) and to two specific profiles: the nearest CTD profile in time (magenta) and the nearest CTD profile in space (blue). The color of the analysed CTD profile represents the QC flag (green for a QC=1; blue for a QC=2; orange for a QC=3 and red for a QC=4). (Upper panels) Temperature (left panel), salinity (middle panel) and potential density (right panel) as function of pressure. (Lower panels) θ/S diagrams.

5 Cycle 41A - Comparison to the nearest ARGO profiles

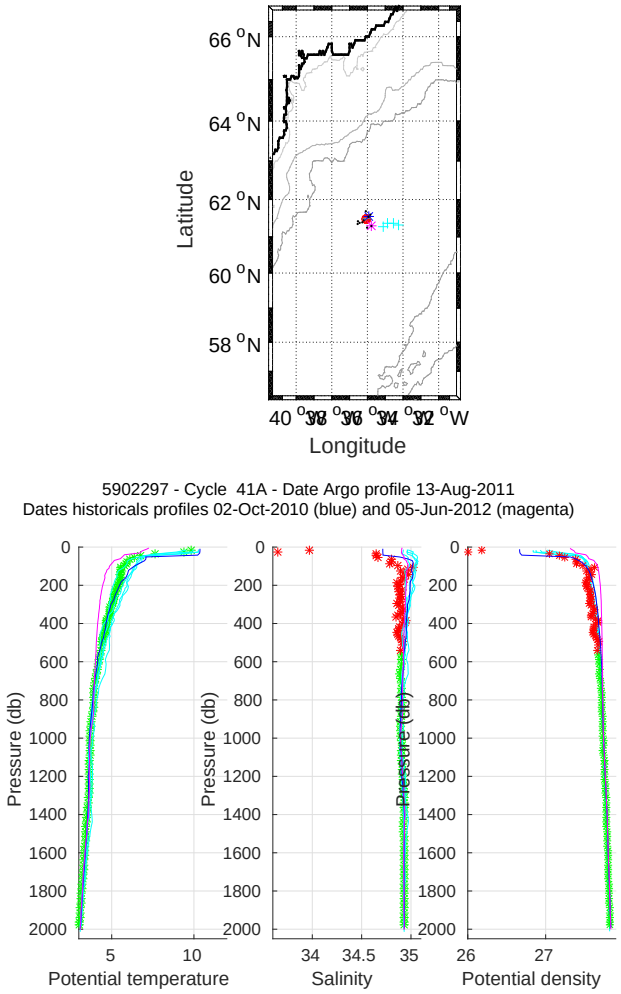


Figure 12: Flotteur 5902297, cycle 41A. Upper panel: Position of the analysed Argo profile (red) and of the nearest Argo profiles (black). The nearest Argo profile in time is in magenta while the nearest CTD profile in space is in blue. Lower panels: Temperature, salinity and potential density as function of pressure for the analysed Argo profile (stars) and for the nearest Argo profile in time (magenta line) and for the nearest Argo profile in space (blue line). The color of the analysed Argo profile represents the QC flag (green for a QC=1; blue for a QC=2; orange for a QC=3 and red for a QC=4).

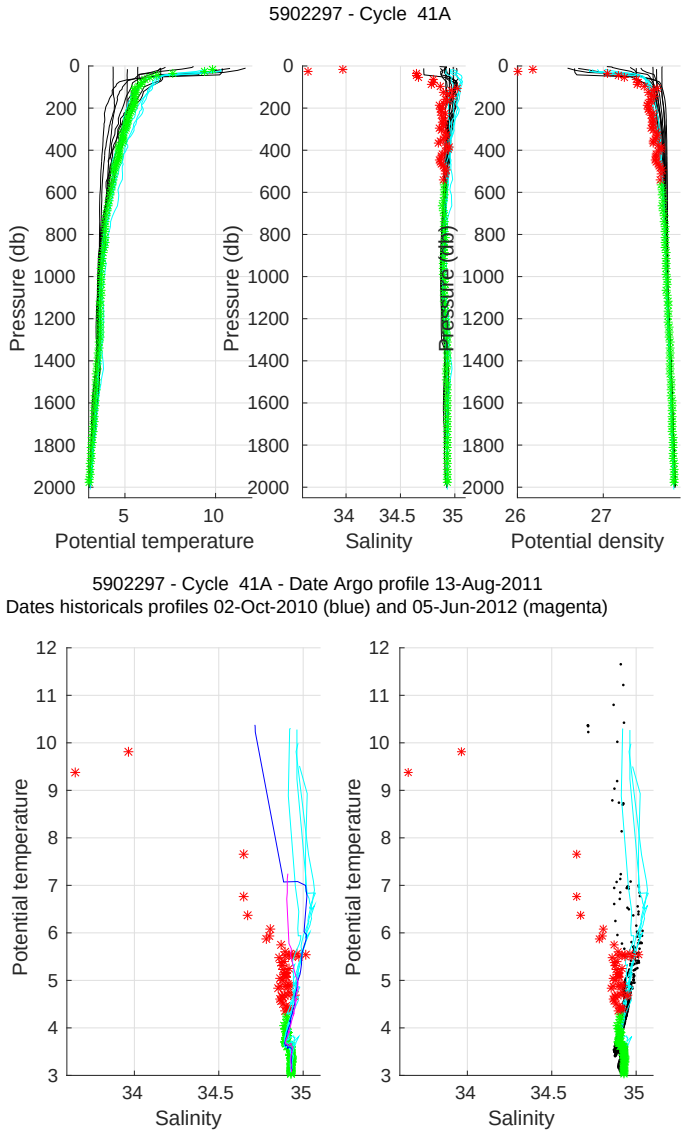


Figure 13: Float 5902297, cycle 41A. The analysed Argo profile (stars) is compared to the nearest Argo profiles (black line) and to two specific profiles: the nearest Argo profile in time (magenta) and the nearest Argo profile in space (blue). The color of the analysed Argo profile represents the QC flag (green for a QC=1; blue for a QC=2; orange for a QC=3 and red for a QC=4). (Upper panels) Temperature (left panel), salinity (middle panel) and potential density (right panel) as function of pressure. (Lower panels) θ/S diagrams.

6 Cycle 110 - Comparison to the nearest historical CTD profiles

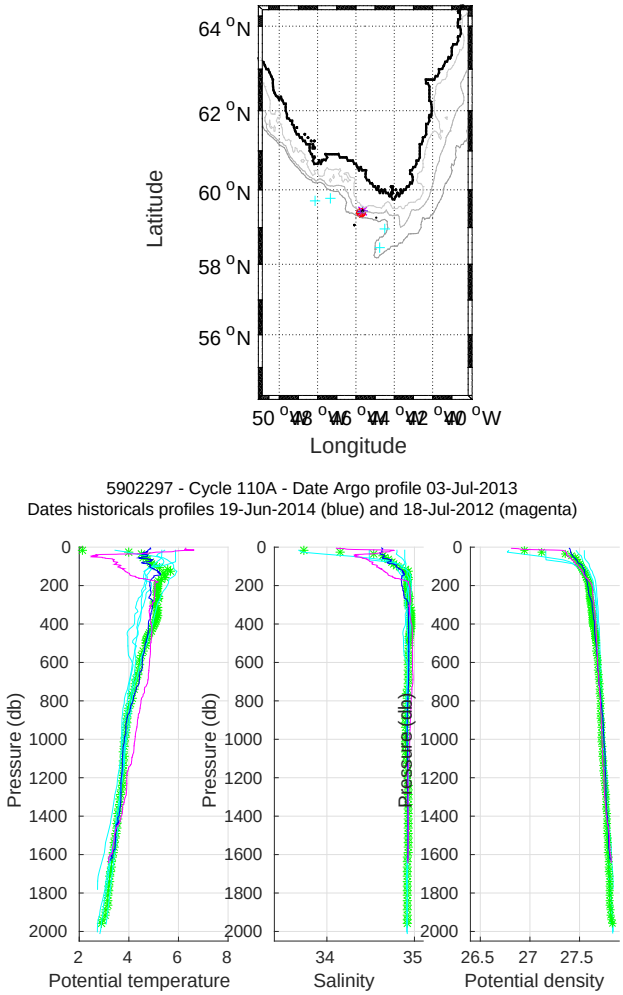


Figure 14: Flotteur 5902297, cycle 110. Upper panel: Position of the analysed CTD profile (red) and of the nearest CTD profiles (black). The nearest CTD profile in time is in magenta while the nearest CTD profile in space is in blue. Lower panels: Temperature, salinity and potential density as function of pressure for the analysed CTD profile (stars) and for the nearest CTD profile in time (magenta line) and for the nearest CTD profile in space (blue line). The color of the analysed CTD profile represents the QC flag (green for a QC=1; blue for a QC=2; orange for a QC=3 and red for a QC=4).

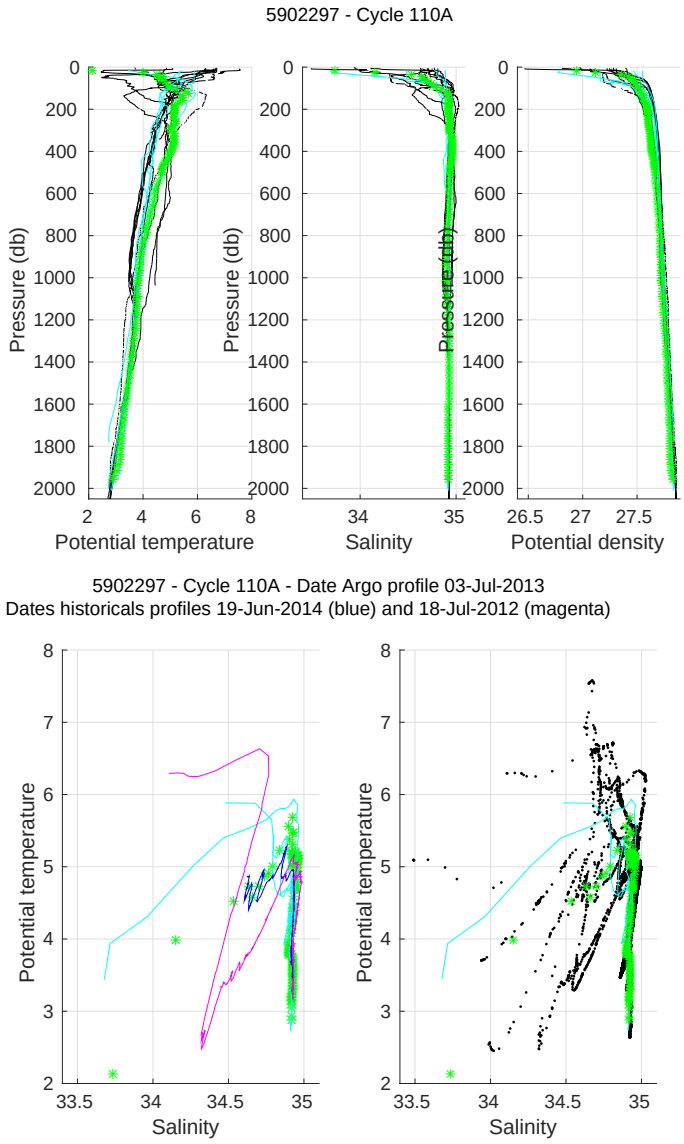


Figure 15: Float 5902297, cycle 110. The analysed CTD profile (stars) is compared to the nearest CTD profiles (black line) and to two specific profiles: the nearest CTD profile in time (magenta) and the nearest CTD profile in space (blue). The color of the analysed CTD profile represents the QC flag (green for a QC=1; blue for a QC=2; orange for a QC=3 and red for a QC=4). (Upper panels) Temperature (left panel), salinity (middle panel) and potential density (right panel) as function of pressure. (Lower panels) θ/S diagrams.

7 Cycle 110A - Comparison to the nearest ARGO profiles

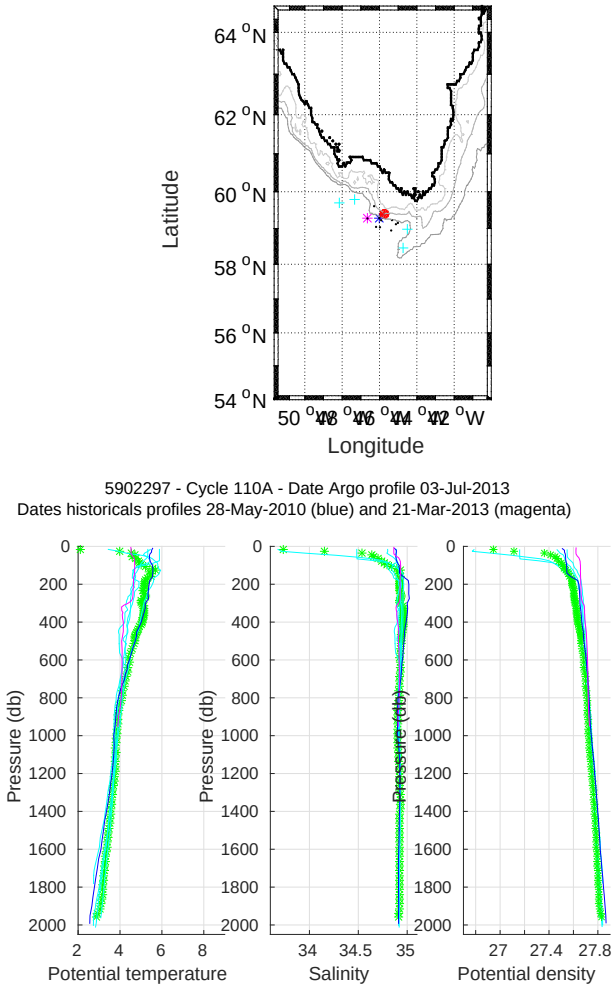


Figure 16: Flotteur 5902297, cycle 110A. Upper panel: Position of the analysed Argo profile (red) and of the nearest Argo profiles (black). The nearest Argo profile in time is in magenta while the nearest CTD profile in space is in blue. Lower panels: Temperature, salinity and potential density as function of pressure for the analysed Argo profile (stars) and for the nearest Argo profile in time (magenta line) and for the nearest Argo profile in space (blue line). The color of the analysed Argo profile represents the QC flag (green for a QC=1; blue for a QC=2; orange for a QC=3 and red for a QC=4).

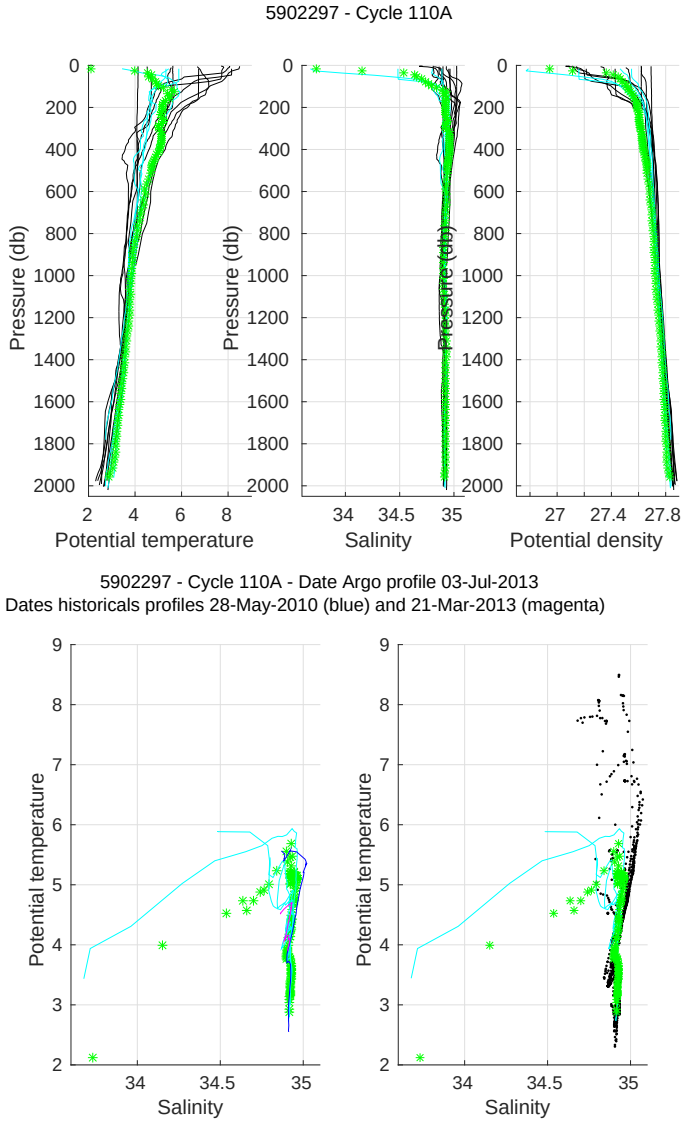


Figure 17: Float 5902297, cycle 110A. The analysed Argo profile (stars) is compared to the nearest Argo profiles (black line) and to two specific profiles: the nearest Argo profile in time (magenta) and the nearest Argo profile in space (blue). The color of the analysed Argo profile represents the QC flag (green for a QC=1; blue for a QC=2; orange for a QC=3 and red for a QC=4). (Upper panels) Temperature (left panel), salinity (middle panel) and potential density (right panel) as function of pressure. (Lower panels) θ/S diagrams.

8 Cycle 203 - Comparison to the nearest historical CTD profiles

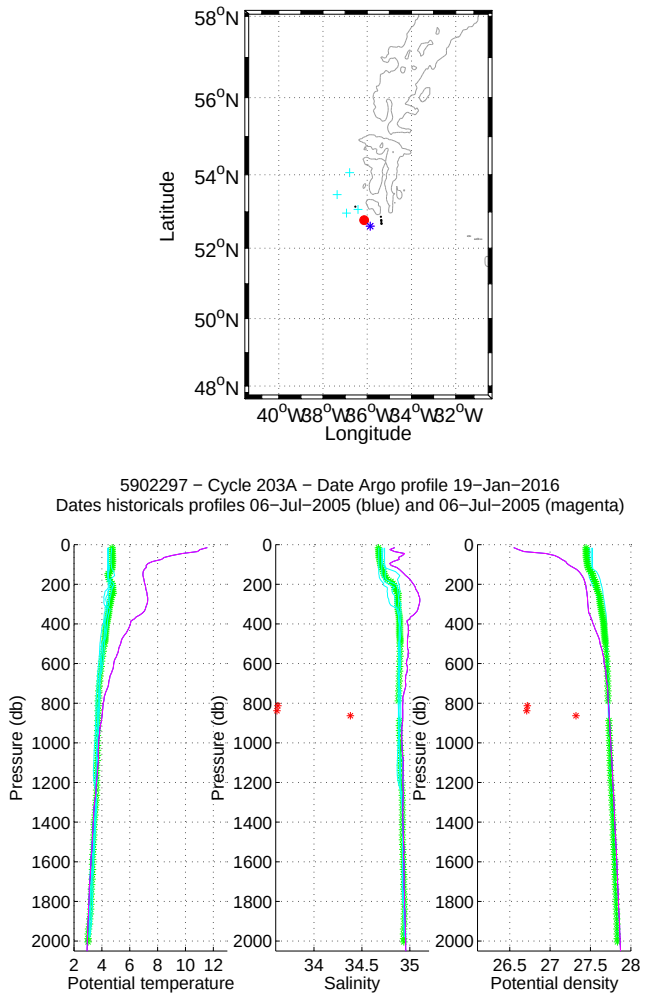


Figure 18: Flotteur 5902297, cycle 203. Upper panel: Position of the analysed CTD profile (red) and of the nearest CTD profiles (black). The nearest CTD profile in time is in magenta while the nearest CTD profile in space is in blue. Lower panels: Temperature, salinity and potential density as function of pressure for the analysed CTD profile (stars) and for the nearest CTD profile in time (magenta line) and for the nearest CTD profile in space (blue line). The color of the analysed CTD profile represents the QC flag (green for a QC=1; blue for a QC=2; orange for a QC=3 and red for a QC=4).

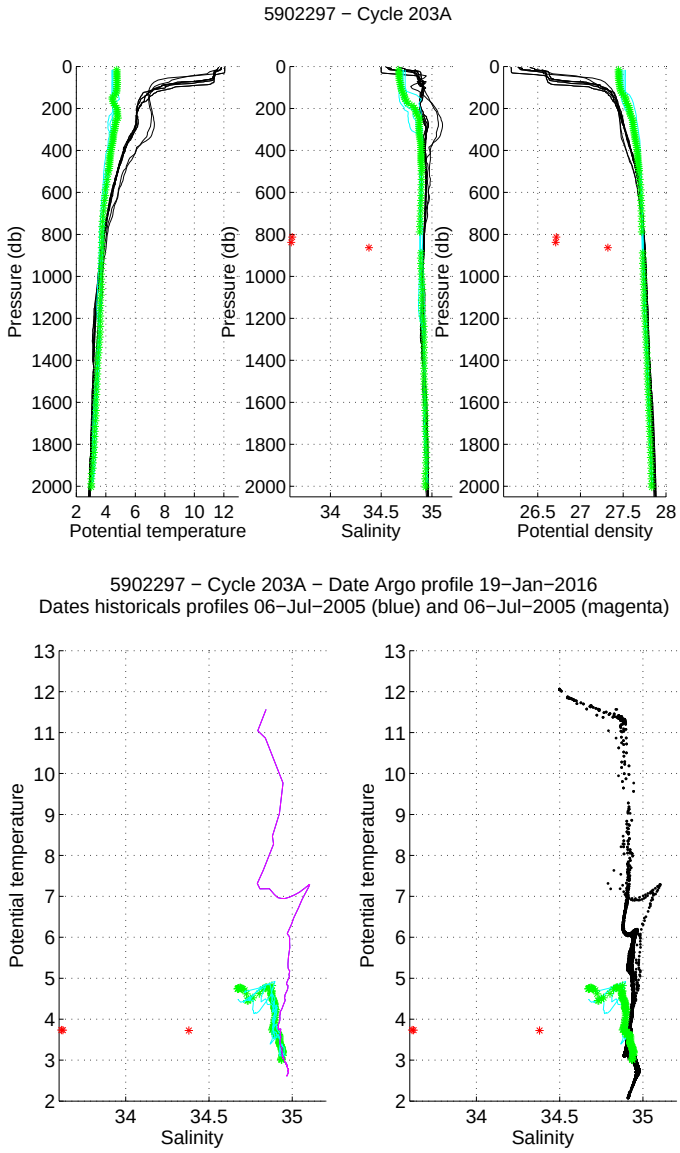


Figure 19: Float 5902297, cycle 203. The analysed CTD profile (stars) is compared to the nearest CTD profiles (black line) and to two specific profiles: the nearest CTD profile in time (magenta) and the nearest CTD profile in space (blue). The color of the analysed CTD profile represents the QC flag (green for a QC=1; blue for a QC=2; orange for a QC=3 and red for a QC=4). (Upper panels) Temperature (left panel), salinity (middle panel) and potential density (right panel) as function of pressure. (Lower panels) θ/S diagrams.

9 Cycle 203A - Comparison to the nearest ARGO profiles

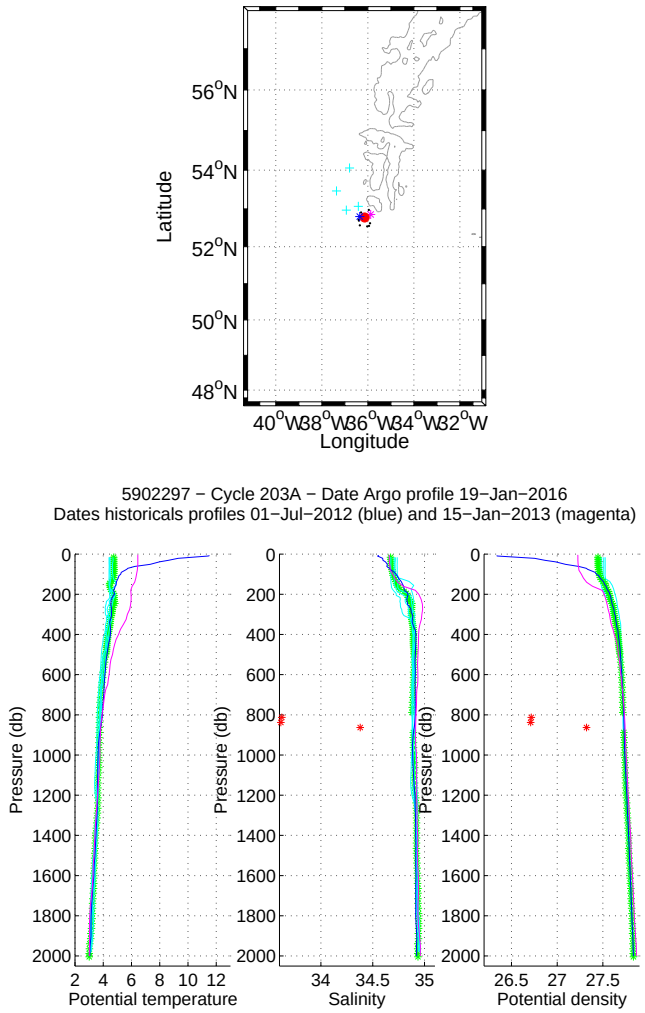


Figure 20: Flotteur 5902297, cycle 203A. Upper panel: Position of the analysed Argo profile (red) and of the nearest Argo profiles (black). The nearest Argo profile in time is in magenta while the nearest CTD profile in space is in blue. Lower panels: Temperature, salinity and potential density as function of pressure for the analysed Argo profile (stars) and for the nearest Argo profile in time (magenta line) and for the nearest Argo profile in space (blue line). The color of the analysed Argo profile represents the QC flag (green for a QC=1; blue for a QC=2; orange for a QC=3 and red for a QC=4).

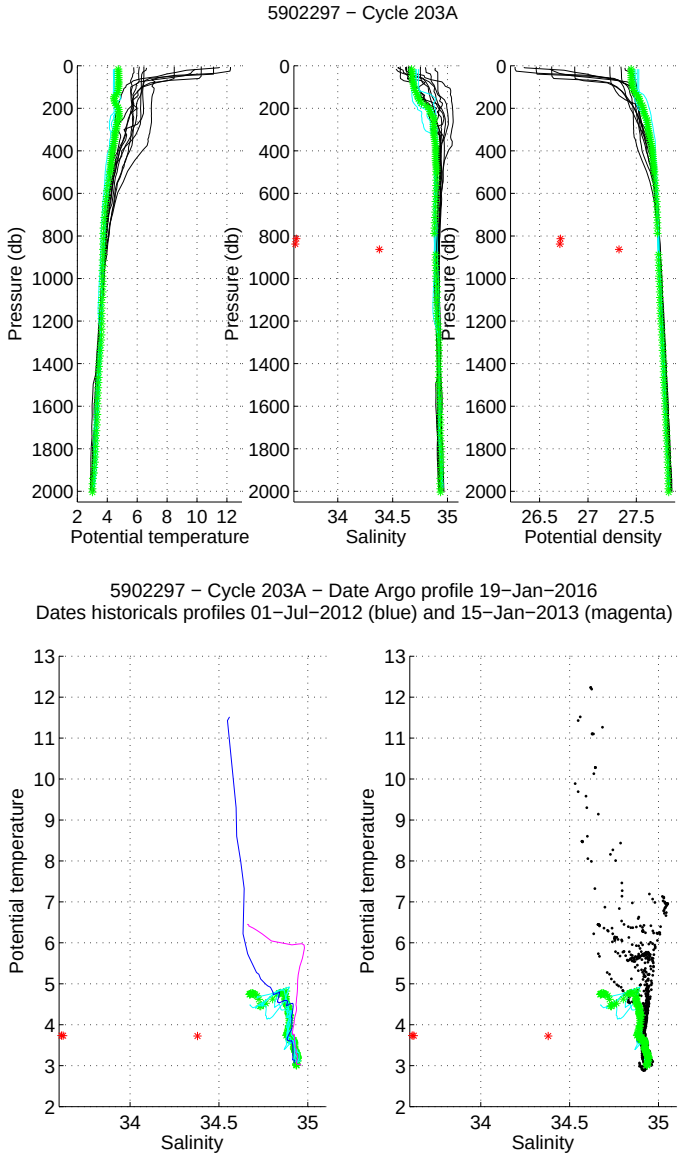


Figure 21: Float 5902297, cycle 203A. The analysed Argo profile (stars) is compared to the nearest Argo profiles (black line) and to two specific profiles: the nearest Argo profile in time (magenta) and the nearest Argo profile in space (blue). The color of the analysed Argo profile represents the QC flag (green for a QC=1; blue for a QC=2; orange for a QC=3 and red for a QC=4). (Upper panels) Temperature (left panel), salinity (middle panel) and potential density (right panel) as function of pressure. (Lower panels) θ/S diagrams.

10 OW method, CONFIGURATION # 129

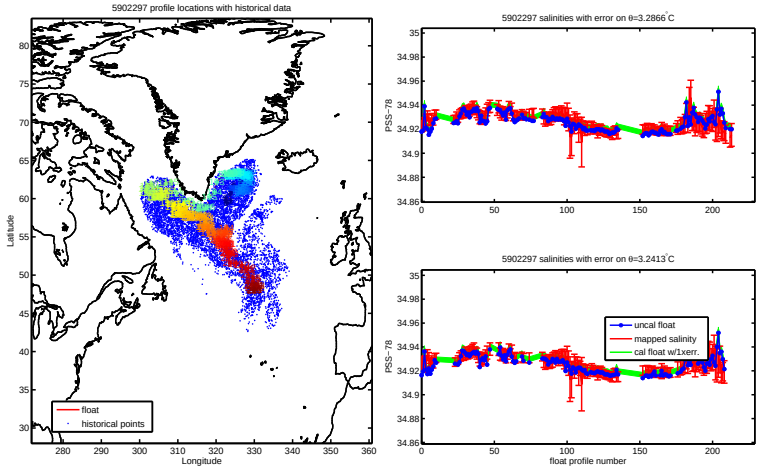


Figure 22: Figures from the OW method. (Left) Position of the historical and float data. (Right) Comparison, on various θ levels, between the float data and the historical data interpolated at the float position.

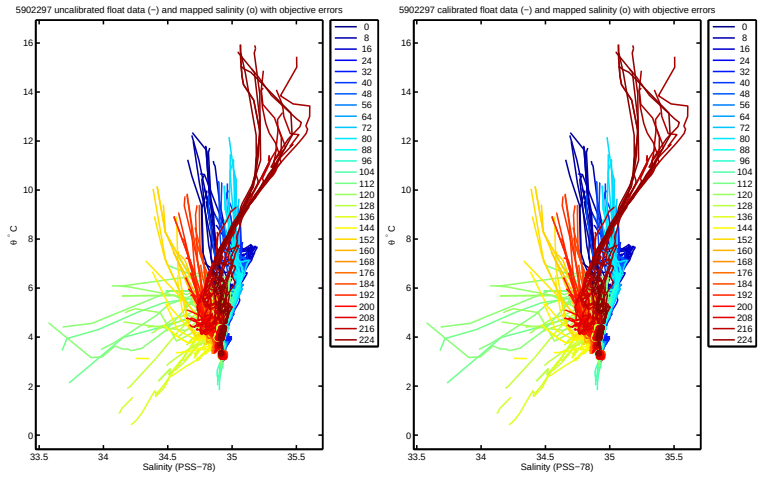


Figure 23: Figures from the OW method. Compararison of the θ/S diagram of the float with the historial database. (left) raw data; (right) corrected data using the OW correction.

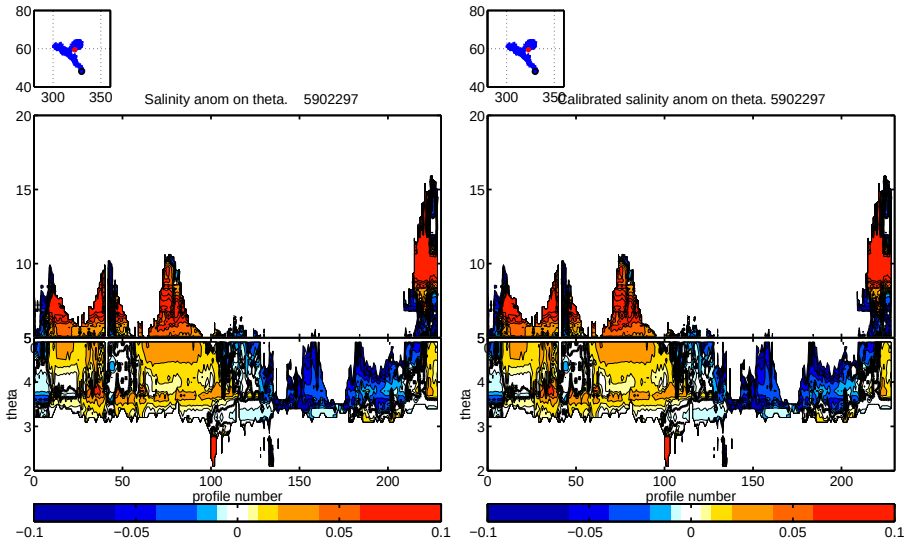


Figure 24: Figures from the OW method. Salinity anomaly:(left) raw data; (right) corrected data using the OW correction.

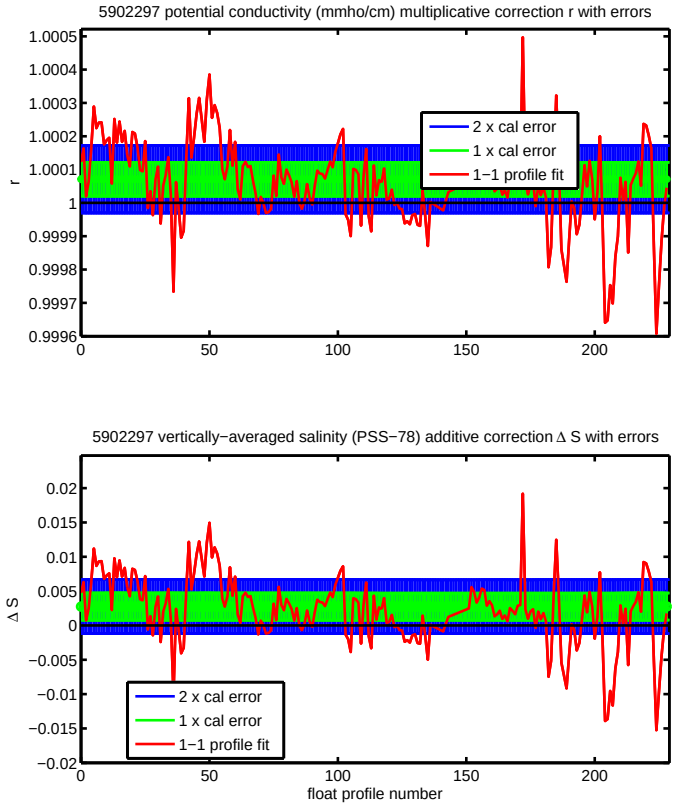


Figure 25: Correction proposed by the OW method.

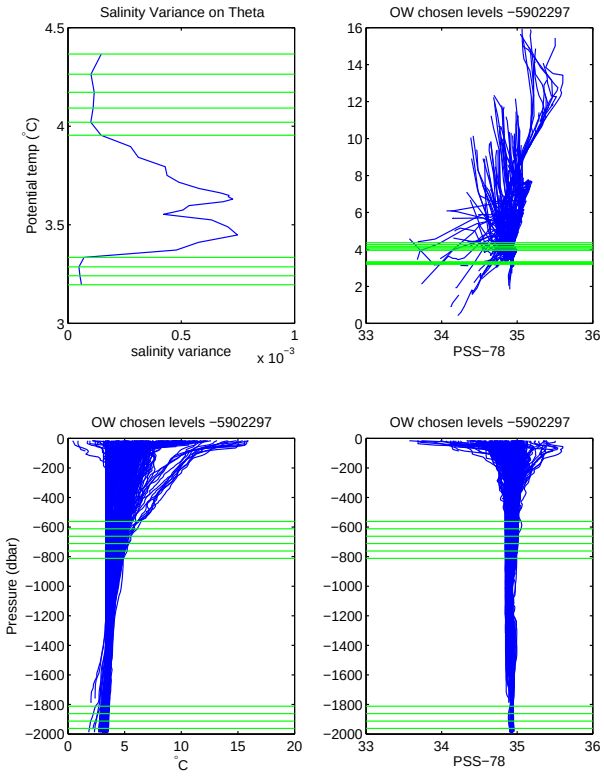


Figure 26: Chosed levels by the OW method.

1 Oxygen correction with LOCODOX

Number	Deployment (cycle OD) cycle OD	Last cycle 228
Provor WMO 5902297	27/06/2010 23h11	
CTS3 DO 9	N 59.432 W 37.0478	

Date of DOXY control	Float status	Last cycle
May 2017	DEAD	25/09/2016
Coriolis transmission		15/05/2017

This software is used to correct Oxygen data (parameter DOXY) contained in the files BR(real time) and/or BD(Delayed Mode) associated to files R (Real Time T/S) and/or D(Delayed Mode T/S).

PI suggests : The Oxygen corrections have been done only when Salinity and Temperature were available in Delayed Mode (D files). Theorically, the corrections should be done from adjusted values (TEMP and PSAL). However, when there is a few bad values in salinity (of about few tens of PSU), and if there is no bias in salinity (OW method), PSAL data can be used instead of PSAL_ADJUSTED, because the impact of those values on the oxygen correction is not significant.

To correct Oxygen data, LOCODOX software gives 3 choices to work :

- from a reference profile
- from WOA climatology
- from in air measurements

The reference profile for this float is the station 79 of Ovide 2010 cruise. This float is in the Oxygen grey list, only 3 DOXY good profiles

LOPS options are :

Options	Choice
Unit DOXY	Mumol/kg
Suppress hooks	YES
Drift correction with	PRES
Vertical scale	PRES
Apply drift correction	NO
Correction using : PSAT/DOXY	PSAT
kind of error	RELATIVE

Table 1: LOCODOX Options

Applied DOXY correction

PSAT=f(DOXY); PSAT_ADJUSTED=A*PSAT+B;DOXY_ADJUSTED=f(PSAT_ADJUSTED) with A=1.250; B=-15.997

Percent saturation corrected as a linear function of PSAT; Comparison to a single reference profile (isobaric match as in Takeshita et al. (2013)) on cycle 0; PSAT converted from DOXY and DOXY_ADJUSTED converted from PSAT_ADJUSTED.

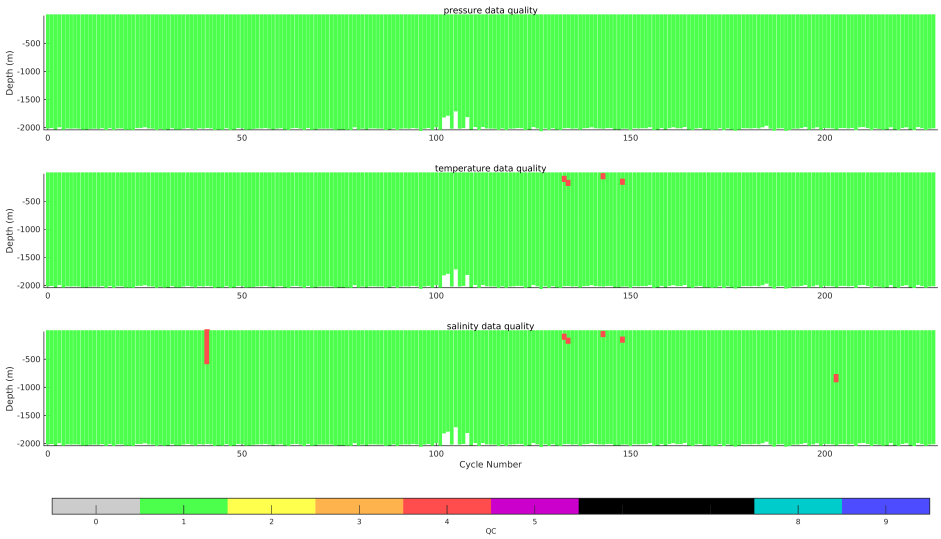


Figure 1: QC controls of Pressure, Temperature and Salinity. No bias in salinity for this float. Correction done with PSAL.

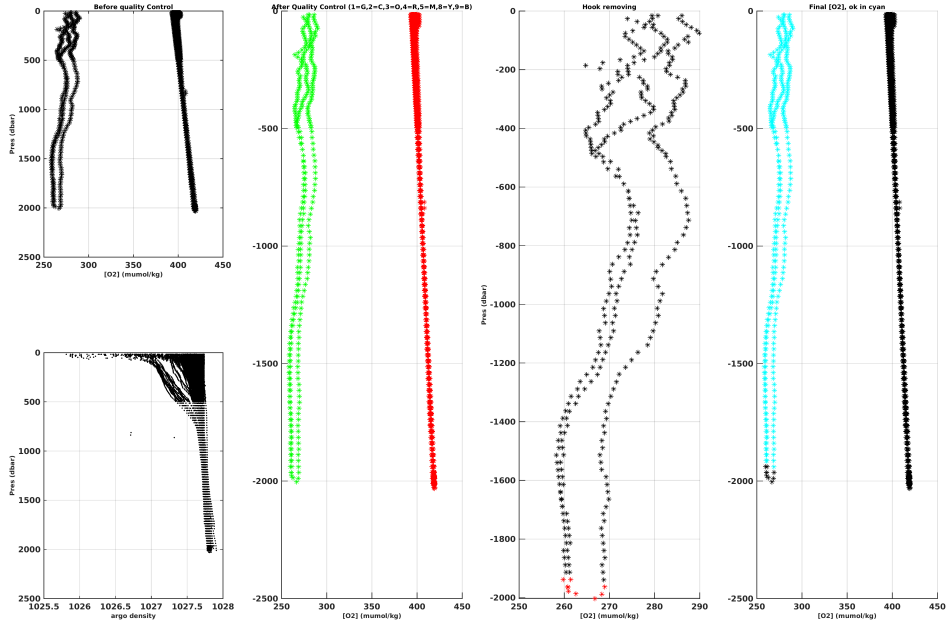


Figure 2: The first 50 meters from the bottom are suppressed because data are incertain; Only data in cyan are taken for the correction.

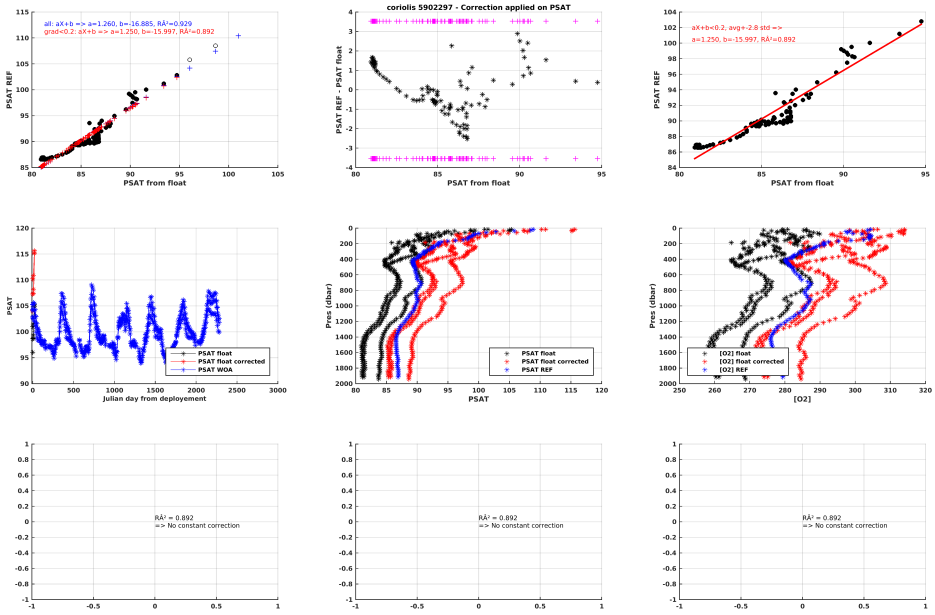


Figure 3: Plots produced by LOCODOX

Float 5902299 was corrected based on a comparison of the first ascending profile of the float with an in situ reference profile acquired at float deployment. The correction is done in considering the percentage of saturation (PSAT).

Upper panels : The three panels show the regression between the Argo profile and the reference profile.

Middle left panels : PSAT in the upper 10m from the raw data (black curve) and the corrected data (red curves). PSAT estimated from the World Ocean Atlas at the float position is also provided for comparison (blue curves).

Middle center panel : PSAT values from the raw data (black curves), the adjusted data (red curves) and the reference profile (blue curve).

Middle right panel : Same as the center panel but for dissolved oxygen concentration value (DOXY et DOXY_ADJUSTED) in mumol/kg.

Lower panels : Same as the middle panels but when LOCODOX proposes a constant correction.

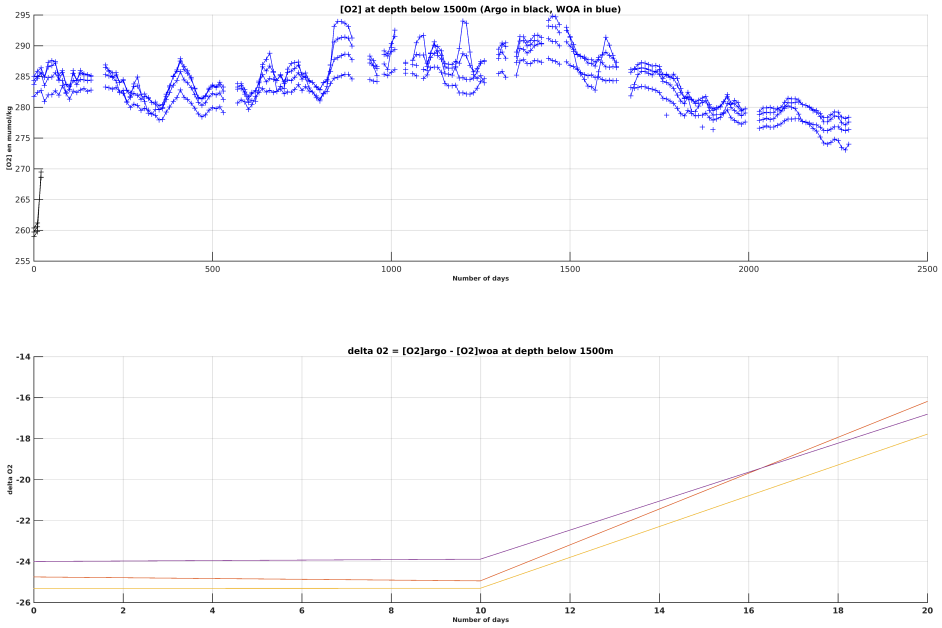


Figure 4: Comparison in the deeper levels (below 1500m) between the float data and WOA data interpolated at the float position (horizontal and vertical). The temporal evolution of the difference is used to estimate a possible sensor drift.

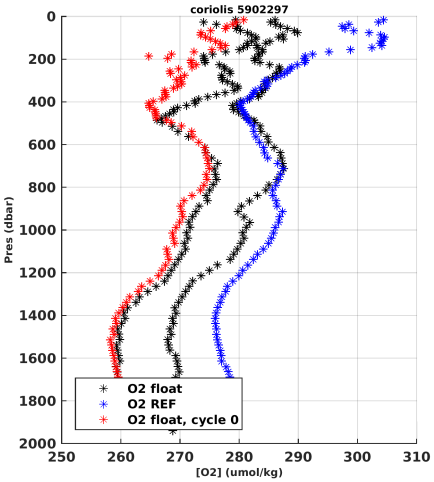


Figure 5: Profiles float 5902297 (black), O2 hydro reference (blue), O2 float cycle 0 (red)

1.1 Corrected data float

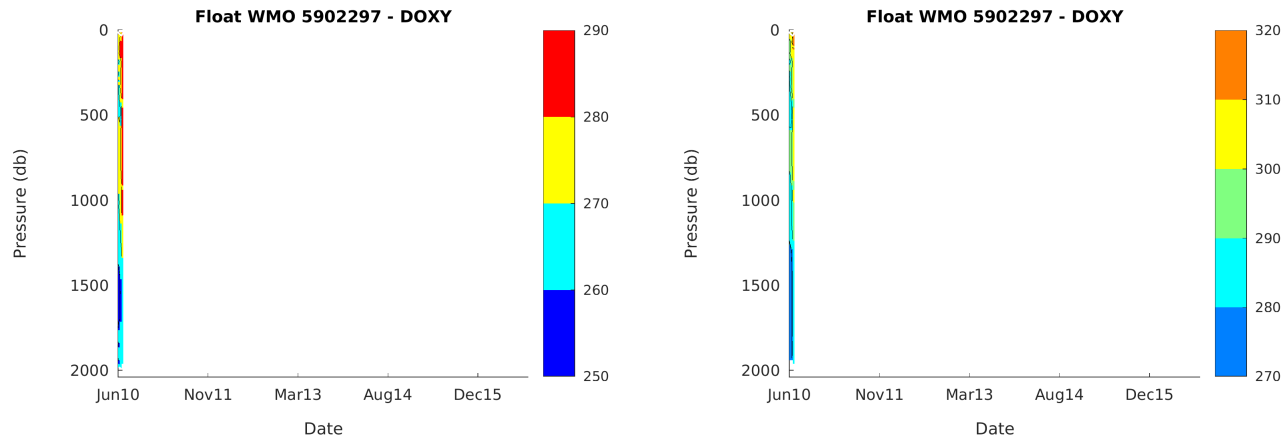


Figure 6: Oxygen section along the float trajectory (interpolated on standard levels). Quality flags are taken into account. Left plot: Raw data - Right plot : corrected data

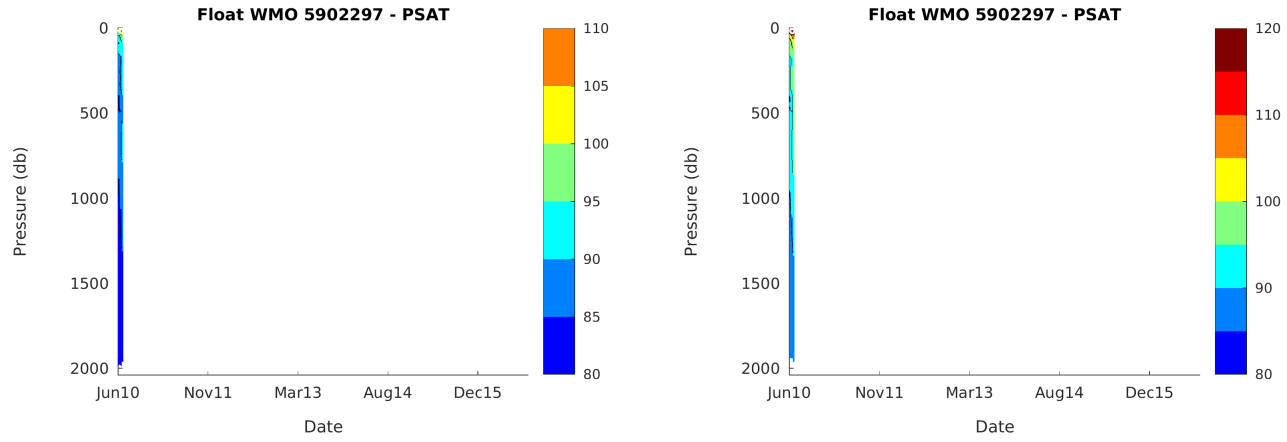


Figure 7: PSAT section along the float trajectory (interpolated on standard levels). Quality flags are taken into account. Left plot: Raw data - Right plot : corrected data

1.2 Examples of corrected profiles with LOCODOX

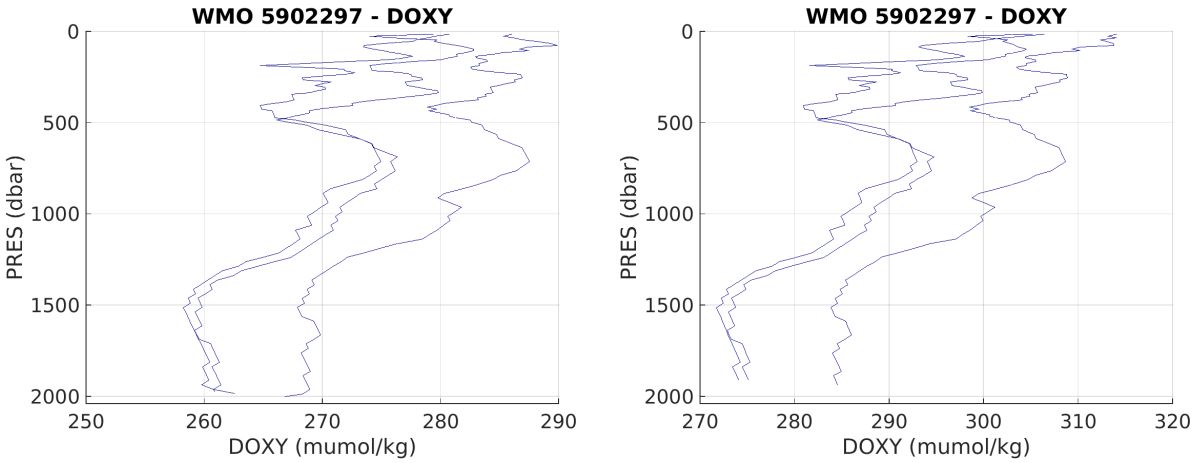


Figure 8: Oxygen profiles. Left plot: Raw data - Right plot : corrected data

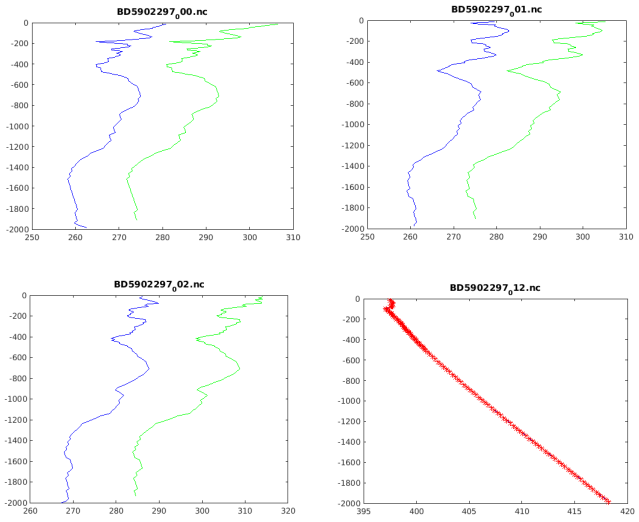


Figure 9: Float 5902297 : Corrected profiles in green