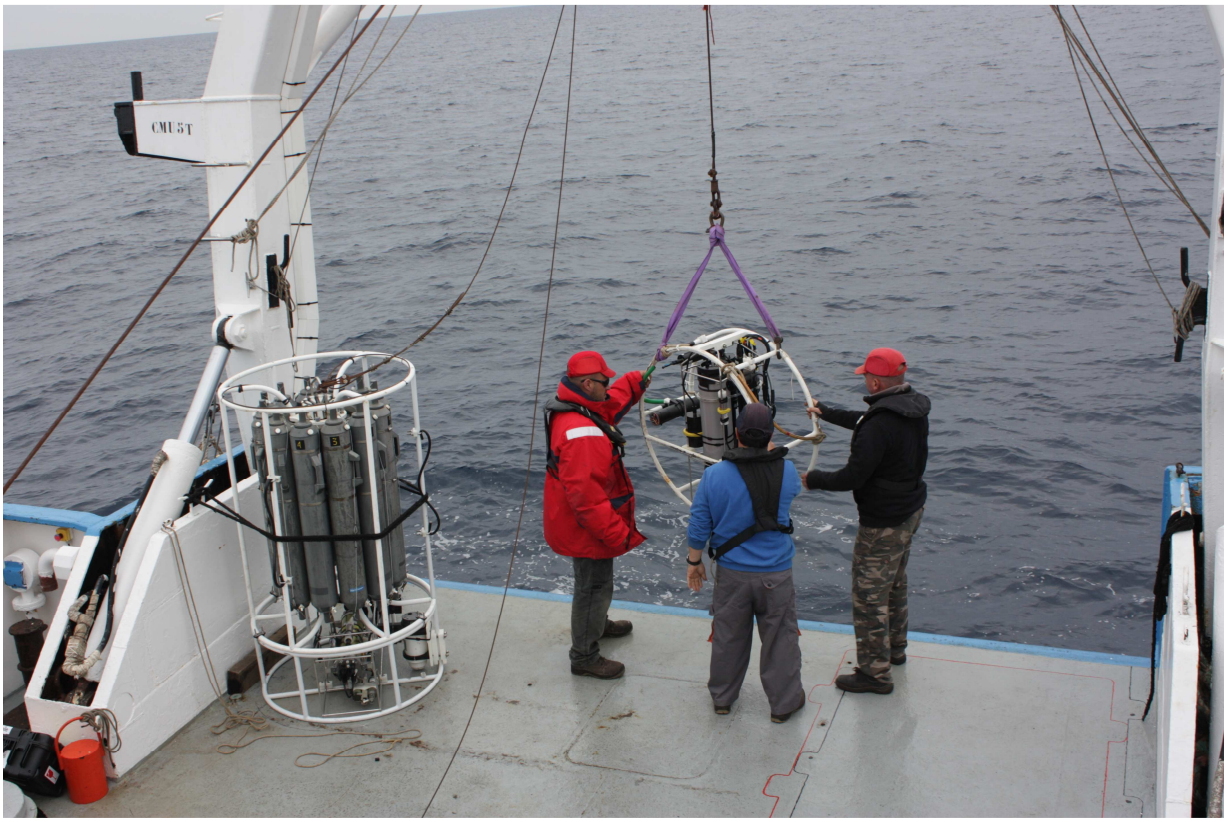
# BOUSSOLE Monthly Cruise Report

## Cruise 165
## November 09–12, 2015

Duty Chief: Melek Golbol (golbol@obs-vlfr.fr)
Vessel: R/V Téthys II
(Captain: Dany Deneuve)

Science Personnel: Guillaume De Liège, Jean De Vaugelas, Melek Golbol, David Luquet, Collin Roesler, Vincent Talliandier and Vincenzo Vellucci.

*Laboratoire d'Océanographique de Villefranche (LOV), 06238 Villefranche sur mer cedex, France*




Deployment of the new IOP package from the deck of the R/V *Téthys II*. The package includes absorption meters (a WETLabs ac9plus, a WETLabs acS and a Turner ICAM) and fluorimeters (3X1M sensors).

**BOUSSOLE project**

**ESA/ESRIN contract N° 4000111801/14/I-NB**

*December 03, 2015*

# Foreword

This report is part of the technical report series that is being established by the BOUSSOLE project.

BOUSSOLE is funded and supported by the following Agencies and Institutions

European Space Agency

Centre National d'Etudes Spatiales, France

Centre National de la Recherche Scientifique, France

Université Pierre & Marie Curie, France

Observatoire Océanologique de Villefranche/mer, France

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# Cruise Objectives

## Routine operations

Multiple Biospherical's C-OPS (Compact Optical Profiling System) radiometric profiles are performed at the BOUSSOLE site around solar noon, under optimal conditions: clear blue skies and flat, calm sea surface. If the sky is clear and sea conditions are reasonably calm (no whitecaps or large swell), hand held CIMEL sun photometer measurements are to be performed consecutively where possible with C-OPS profiles. If sea conditions are poor but sky is good, hand held CIMEL sun photometer measurements can be made at intervals throughout the day to measure atmospheric optical thickness. CTD deployments are required at the start and the end of the C-OPS profiling day and around noon in the longer summer days or when there is a high possibility of a satellite matchup. The CTD package also includes a Chl fluorometer. Additional instrumentation for measurement of inherent optical properties has been added from December 2011. The package includes a hyperspectral absorption meter (Hobilabs a-sphere), a multispectral backscattering meter (Hobilabs Hydroscat-6) and a multispectral beam transmissometer (Hobilabs Gamma-4). Seawater samples are to be collected, filtered and stored into liquid nitrogen for subsequent HPLC pigment and particle absorption spectrophotometric filter analysis in the lab. Three replicates samples are to be collected at surface for total suspended matter weighting in the lab.

A new sensor ("Master REM A") was added to the IOP package and connected to the CTD. This sensor is identical to the ones installed on the Bio-Argo floats, and is planned to be used as a "gold standard" to inter-calibrate sensors among the Bio-Argo fleet. This sensor measures fluorescence of Chla, fluorescence of Coloured Dissolved Organic Matter (CDOM), and backscattering at 700nm. The objective is to evaluate what this instrument provides in terms of Chl and CDOM fluorescence, by comparing its measurements to those from the BOUSSOLE Chl and CDOM fluorometers (the ones installed on the BOUSSOLE IOP package), to the chlorophyll concentrations from the HPLC analyses, and to the CDOM absorption measurements from the CDOM analyses.

Operations that have to be performed in each cruise include:
- Collection and filtration of seawater samples for colored dissolved organic matter (from June 2005).

- One CTD transect is performed between the BOUSSOLE site and the Port of Nice. This transect consists of six fixed stations on-route from BOUSSOLE. Whenever feasible, this transect should be performed at a similar time for each cruise, in order to minimise the influence of possible diurnal variability.

- Divers check the underwater state of the buoy structure and instrumentation, take pictures for archiving, clean the sensor optical surfaces, and then take again some pictures after cleaning. Divers also put a neoprene cap on the backscattering meter and on the transmissometers for acquiring dark measurements (started in April 2009).

In addition, water samples are to be collected at two depths (5m and 10m) for dissolved oxygen (DO), total alkalinity (TA) and total inorganic carbon (TC) analysis (from March 2014). This operation is part of the BIOCAREX ANR project, in collaboration with the LOCEAN in Paris (J. Boutin and collaborators). The TA/TC samples will be processed by the National service for such analyses (SNAPOCO – LOCEAN in Paris). The results will allow checking the data collected by the two pCO2 CARIOCA sensors installed on the buoy at 3m and 10m.

Further details about these operations and the data collection and processing protocols are to be found in:
Antoine, D. M. Chami, H. Claustre, F. D'Ortenzio, A. Morel, G. Bécu, B. Gentili, F. Louis, J. Ras, E. Roussier, A.J. Scott, D. Tailliez, S. B. Hooker, P. Guevel, J.-F. Desté, C. Dempsey and D. Adams. 2006, BOUSSOLE: a joint CNRS-INSU, ESA, CNES and NASA Ocean Color Calibration And Validation Activity. NASA Technical memorandum N° 2006 - 214147, 61 pp.
(http://www.obs-vlfr.fr/Boussole/html/publications/pubs/BOUSSOLE_TM_214147.pdf)

## Additional operations

Collin Roesler (from Bowdoin College, Maine, USA) was on board to deploy a new IOP package. This package includes a Turner ICAM, a WET Labs AC-9plus and a WET Labs AC-S for absorption measurement and three 3X1M sensors (001,004 and F3-4115) for fluorescence measurement. The data acquired from these instruments will be compared to those acquired from the BOUSSOLE instruments. For each IOP package (the new one and the BOUSSOLE one) 2 casts were performed at the BOUSSOLE site : one cast with, and one cast without, 0.2µm filters on the absorption meters (a-Sphere, AC-S, AC-9, ICAM) for the dissolved matter absorption measurements.

It is planned to use this new package during a few subsequent cruises.

Maintenance operations were performed on the buoy: it appeared before the cruise that the cables between the Eu and Lu sensors which are connected to the OCP (data logger of the radiometers) at 4m were inverted. So these cables were reconnected by the divers to their respective instruments.

## Cruise Summary

The first day, bad weather prevented the work at the BOUSSOLE site, so we took advantage of this day to test the new IOP package next to the coast off Nice, where the weather was better. The second day was used for IOP casts, a CTD cast with water sampling, a Secchi disk at the BOUSSOLE site and for the CTD transect. This day was also used for cleaning solar panels, ARGOS connector and surface sensors on the top of the buoy. The third day was used for the diving operations, for downloading data directly from the buoy, for IOP casts, for CTD casts with water sampling, for optical profiles and a Secchi disk at the BOUSSOLE site. The last day was used for CTD casts with water sampling, for optical profiles and for a Secchi disk at the BOUSSOLE site.
CIMEL measurements could not be performed during this cruise because of the nebulosity conditions (sky overcast and hazy).

### Monday 09 November 2015

Bad weather prevented the work at the BOUSSOLE site. So this day was used to install equipment on the R/V *Téthys II* and to perform tests with the new IOP package next to the coast off Nice, just out of the Nice harbour. One IOP cast was performed for testing. Unfortunately, the ICAM was flooded.

### Tuesday 10 November 2015

The sea state was calm with a gentle breeze. The sky was overcast and the visibility was medium. When arrived at BOUSSOLE, 2 IOP casts and 2 CTD casts were performed including one with water sampling. The first IOP cast and the first CTD cast were performed with a 0.2µm filter added on the absorption meters. Then, the connectors, the solar panels and the surface sensors on the top of the buoy were cleaned and 1 Secchi disk was performed at the BOUSSOLE site. The C-OPS profiles and the CIMEL measurements could not be performed this day because the sky was overcast and illumination was unstable. Finally, the CTD transect was completed. IOP casts were performed at stations 05 and 06.

### Wednesday 11 November 2015

The sea state was calm with a light breeze. The sky was overcast yet the visibility was good. When arrived at the BOUSSOLE site, divers went at sea to clean the sensors, to take pictures and to perform dark measurements of the transmissometers and the backscattering meters. They also swapped the cables between the Eu and Lu connected on the OCP at 4m depth. Buoy data and $pCO_2$ data at 10m were downloaded using the cables available on the top of the buoy. Then 2 IOP casts and 2 CTD casts including 1 with water sampling. The first IOP cast and the first CTD cast were performed with a 0.2µm filter added on the absorption meters. Then, a Secchi disk and 2 C-OPS profiles were performed at the BOUSSOLE site.

### Thursday 12 November 2015

The sea state was calm with a light breeze. The sky was overcast and the visibility was medium. 3 CTD casts including 1 with a cap installed on the backscattering meter for dark measurements and 1 with water sampling were performed at the BOUSSOLE site. The first CTD cast was performed with a 0.2µm filter added on the absorption meter. Then 2 C-OPS profiles and 1 Secchi disk were performed. CIMEL measurements could not be performed because the sky was hazy.

Pictures taken during this cruise can be found at:
https://picasaweb.google.com/114686870380724925974/2015_11_boussole165

Data from the BOUSSOLE cruises and buoy are available at:
http://www.obs-vlfr.fr/Boussole/html/boussole_data/login_form.php

# Cruise Report

## Monday 09 November 2015 (UTC)

People on board: Melek Golbol and Collin Roesler.

0930 Arrival at the Nice harbour.
Installations of hardware on the *Téthys II*.
1030 IOPs packages testing.
1100 Lunch.
1430 Departure from the Nice harbour to the test station.
1525 IOP cast N1.1.
1545 Departure to the Nice harbour.
1600 Arrival at the Nice harbour.

## Tuesday 10 November 2015 (UTC)

People on board: Melek Golbol, Collin Roesler and Vincent Taillandier.

0500 Departure from the Nice harbour.
0820 Arrival at the BOUSSOLE site.
0830 IOP cast N2.1.
1030 CTD 01, 400 m (with 0.2 µm filter on a-sphere).
1100 CTD 02, 400 m with water sampling at 200, 150, 80, 70, 60, 50, 40, 30, 20, 10 and 5 m for HPLC, $a_p$ and TSM.
1145 Attempt of C-OPS profile: failed (sky overcast and unstable).
1200 Cleaning of the ARGOS and CISCO connector, surface sensors and solar panels on the top of the buoy.
1230 Secchi 01, 19.5 m.
1240 Departure to the first station transect.
1320 CTD 03, 400 m, station 01 (43°25'N 07°48'E).
1425 CTD 04, 400 m, station 02 (43°28'N 07°42'E).
1520 CTD 05, 400 m, station 03 (43°31'N 07°37'E).
1610 CTD 06, 400 m, station 04 (43°34'N 07°31'E).
1705 CTD 07, 400 m, station 05 (43°37'N 07°25'E).
1730 IOP cast N2.2, station 05.
1815 CTD 08, 400 m, station 06 (43°39'N 07°21'E).
1840 IOP cast N2.3, station 06.
1905 Departure to the Nice harbour.
2005 Arrival at the Nice harbour.

## Wednesday 11 November 2015 (UTC)

People on board: Guillaume De Liège, Jean De Vaugelas, Melek Golbol, David Luquet, Collin Roesler, Vincent Talliandier and Vincenzo Vellucci.

0615 Departure from the Nice harbour.
0935 Arrival at the BOUSSOLE site.
0940 Diving on the BOUSSOLE buoy: cleaning of the sensors, performing dark measurements, taking pictures, replacement of Eu and Lu cables at 4m depth.
0950 Secchi 02, 24 m.
1000 Direct connection with the buoy and data retrieval. Downloading of pCO2 data at 10m depth.
Cleaning of solar panels and surface sensors.
1150 IOP cast N3.1.
1215 C-OPS attempt: failed.
1315 CTD 09, 400 m (with 0.2 µm filter on a-sphere).
1100 CTD 10, 400 m with water sampling at 400, 200, 150, 70, 60, 50, 40, 30, 20, 10 and 5 m for HPLC, $a_p$, CDOM and TSM.
1400 Secchi 01, 35 m.
1435 C-OPS 01, 02.
1500 Departure to the Nice harbour.

1800 Arrival at the Nice harbour.

## Thursday 12 November 2015 (UTC)

People on board: Melek Golbol and Vincent Taillandier.

0730 Departure from the Nice harbour.
1045 Arrival at the BOUSSOLE site.
1050 CTD 11, 400 m (with 0.2 µm filter on a-sphere + dark Hydroscat-6)
1100 CTD 12, 400 m with water sampling at 400, 200, 150, 70, 60, 50, 40, 30, 20, 10 and 5 m for HPLC, $a_{p,}$ TA/TC, $O_2$ and TSM.
1200 Filtrations.
1315 CTD 13, 400 m.
1345 C-OPS 03, 04.
1420 Secchi 03, 28 m.
1430 Departure to the Nice harbour.
1730 Arrival at the Nice harbour.

# Problems identified during the cruise

- During the testing day: the Turner ICAM was flooded. So it did not function during the cruise. The AC-9 data collection stopped during the first cast and the AC-S stopped during upcast because the batteries were low.

- Only $pCO_2$ data at 10 m were downloaded during this cruise because the $pCO_2$ CARIOCA sensor at 3 m depth was found not functioning. So we have sampled the TA/TC parameters only at 10 m depth.

- The third day, during the C-OPS profile the computer stopped working. The C-OPS was taken on board and the software was restarted. Then, it resumed normal operation.

- CTD 02: Niskin bottle #8 did not close, so there was no sampling at 30m. CTD 10: Niskin bottle #4 did not close, so there was no sampling at 80m. The mechanical pieces of the carrousel that allow the closing of the bottles were broken. They were repaired the last day during the way up to BOUSSOLE.

- The last day, during the CTD cast #12, the switch of the IOP package was unfortunately turned off. An additional CTD cast (CTD 13) was performed with the IOP package turned on.

- There were no fluorescence data valid for the Master REM A sensor for this cruise. The cap inadvertently stayed on the sensor when it was used during the CTD cast #10.

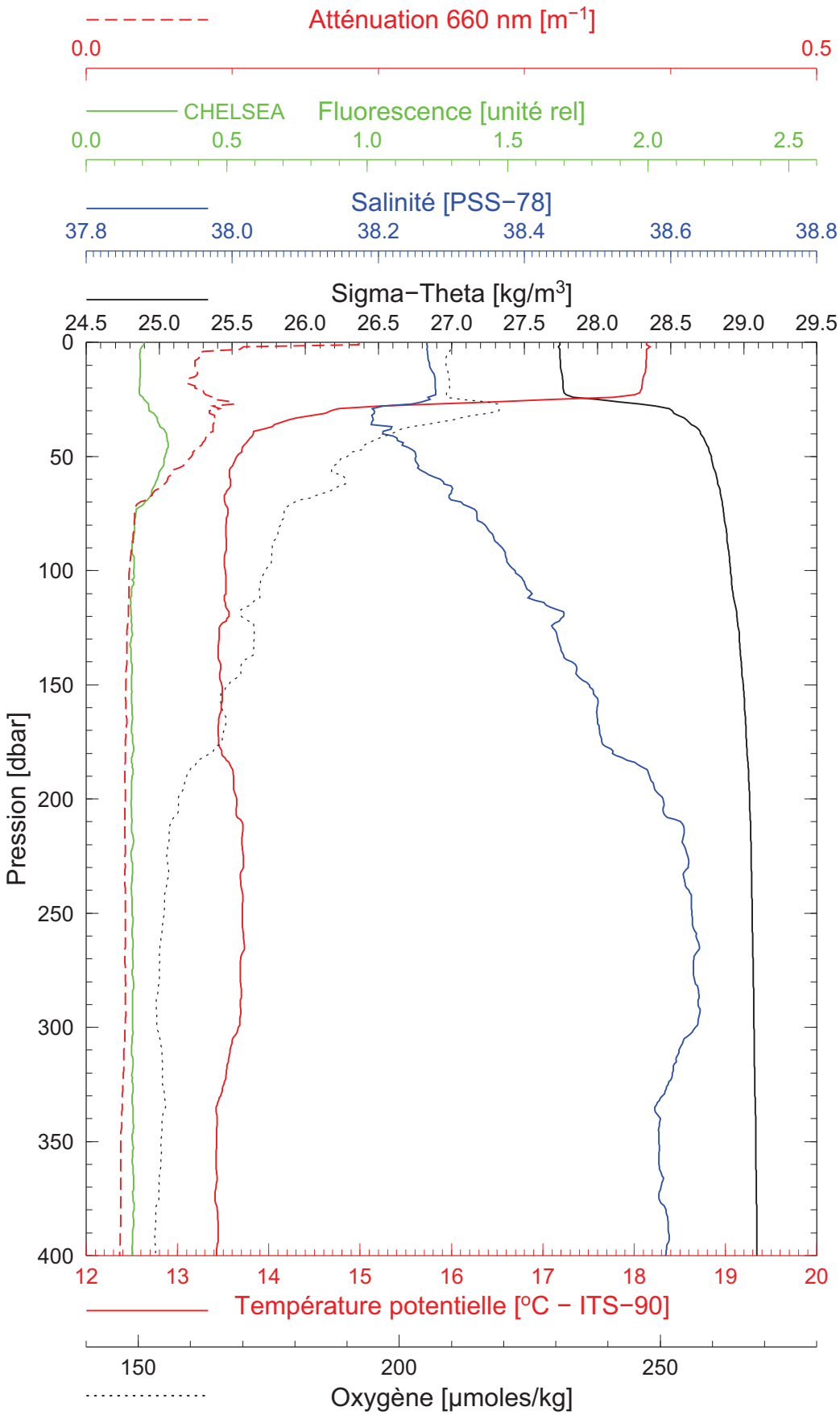
# Appendices

Cruise Summary Table for Boussole 165

| Date | Black names | Profile names | CTD notées | Other sensors | Start Time | Duration | Depth max | Latitude (N) | | longitude | | | | | Weather | | | | | | | Sea | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | (file ext: ".raw") | (file extension: ".raw") | | | GMT (hour.min) | (min.sec) | (meter) | (Degree) | (Minute) | (Degree) | (Minute) | Sky | Clouds | Quantity (#/8) | Wind sp. (kn) | Wind dir. | Atm. Pressure (hPa) | Humidity (%) | Visibility | T air | T water | Sea | Swell H (m) | Swell dir. | Whitecaps |
| 09/11/15 | Bad weather | | | | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | | | | |
| 10/11/15 | | | | IOP N2.1 | 08:30 | NA | NA | 43 | 22.060 | 7 | 53.740 | overcast | | 8 | 8 | 37 | 1026.8 | 80 | | 17.9 | 18.60 | calm | | | |
| | | | CTDBOUS001 | | 10:26 | 21:00 | 400 | 43 | 22.010 | 7 | 53.350 | overcast | | 8 | 9 | 67 | 1026.6 | 82 | | 17.9 | 18.05 | calm | | | |
| | | | CTDBOUS002 | HPLC, Ap & TSM | 11:00 | 39:00 | 400 | 43 | 21.950 | 7 | 53.760 | overcast | | 8 | 9 | 65 | 1026.3 | 84 | | 18.1 | 18.14 | calm | | | |
| | | | | Secchi01 | 12:30 | 4:00 | 19.5 | 43 | 22 | 7 | 54 | overcast | | 8 | | | | | | | | calm | | | |
| | | | CTDBOUS003 | | 13:15 | 20:00 | 400 | 43 | 24.810 | 7 | 47.590 | overcast | | 8 | 6 | 85 | 1025.6 | 83 | | 18.0 | 18.50 | calm | | | |
| | | | CTDBOUS004 | | 14:22 | 22:00 | 400 | 43 | 28.050 | 7 | 41.650 | blue | | 3 | 6 | 102 | 1025.4 | 76 | | 18.8 | 18.80 | calm | | | |
| | | | CTDBOUS005 | | 15:18 | 19:00 | 400 | 43 | 31.020 | 7 | 36.960 | cloudy | | 4 | 6 | 107 | 1025.5 | 74 | | 19.2 | 19.00 | calm | | | |
| | | | CTDBOUS006 | | 16:10 | 19:00 | 400 | 43 | 34.000 | 7 | 31.180 | blue | | 2 | 5 | 114 | 1025.3 | 78 | | 18.5 | 18.90 | calm | | | |
| | | | CTDBOUS007 | | 17:03 | 19:00 | 400 | 43 | 37.160 | 7 | 25.030 | night | | 8 | 2 | 107 | 1025.7 | 77 | | 18.1 | 18.20 | calm | | | |
| | | | | IOP N2.2 | 17:30 | NA | NA | 43 | 37.310 | 7 | 25.094 | night | | 8 | 2 | 107 | NA | 77 | | 18.1 | 18.20 | calm | | | |
| | | | CTDBOUS008 | | 18:15 | 19:00 | 400 | 43 | 39.064 | 7 | 20.878 | night | | 8 | 4 | 16 | 1026.1 | 80 | | 17.6 | 18.47 | calm | | | |
| | | | | IOP N2.3 | 18:40 | NA | NA | 43 | 39.064 | 7 | 20.878 | night | | 8 | 4 | 16 | 1026.1 | 80 | | NA | NA | | | | |
| | | | | | | | | | | | | | | | | | | | | | | | | |
| 11/12/15 | | | | IOP N3.1 | 11:50 | NA | NA | 43 | 22 | 7 | 54 | overcast | | 8 | NA | NA | NA | NA | NA | NA | NA | calm | | | |
| | | | CTDBOUS009 | | 13:15 | 19:00 | 400 | 43 | 21.990 | 7 | 53.950 | overcast | | 8 | 3 | 184 | 1024.2 | 73 | | 18.2 | 18.20 | calm | | | |
| | | | CTDBOUS010 | HPLC, Ap, CDOM & TSM | 13:46 | 34:00 | 400 | 43 | 22.000 | 7 | 53.850 | overcast | | 8 | 3 | 217 | 1024.1 | 72 | | 18.2 | 18.20 | calm | | | |
| | | | | Secchi02 | 14:00 | 4:00 | 35 | 43 | 22 | 7 | 54 | overcast | | 8 | | | | | | | | calm | | | |
| | | bou_c-ops_151111_1426_001_data.csv | | | 14:32 | 3:22 | 85 | 43 | 22.076 | 7 | 53.641 | overcast | Cu | 8 | 2 | 78 | 1024.1 | 75 | good | 18.0 | | calm | 0.1 | | no |
| | | bou_c-ops_151111_1426_002_data.csv | | | 14:43 | 3:23 | 92 | 43 | 22.334 | 7 | 53.741 | overcast | Cu | 8 | 2 | 78 | 1024.1 | 75 | good | 18.0 | | calm | 0.1 | | no |
| | | | | | | | | | | | | | | | | | | | | | | | | |
| 12/11/15 | | | CTDBOUS011 | | 10:49 | 27:00 | 400 | 43 | 21.950 | 7 | 53.960 | cloudy | | 4 | 4 | 44 | 1027.1 | 77 | | 17.7 | 18.20 | calm | | | |
| | | | CTDBOUS012 | HPLC, Ap, TA/TC, $O_2$ & TSM | 11:30 | 34:00 | 400 | 43 | 21.950 | 7 | 53.950 | cloudy | | 4 | 4 | 56 | 1026.7 | 76 | | 18.1 | 18.20 | calm | | | |
| | | | CTDBOUS013 | | 13:14 | 20:00 | 400 | 43 | 21.960 | 7 | 53.980 | cloudy | | 4 | 3 | 68 | 1026.0 | 74 | | 18.3 | 18.18 | calm | | | |
| | | bou_c-ops_151112_1316_001_data.csv | | | 13:44 | 3:59 | 105 | 43 | 21.895 | 7 | 54.058 | cloudy | Ci | 6 | 3 | 97 | 1026.0 | 75 | medium | 17.9 | | calm | 0.2 | | no |
| | | bou_c-ops_151112_1316_002_data.csv | | | 13:55 | 3:58 | 105 | 43 | 21.925 | 7 | 54.305 | cloudy | Ci | 6 | 3 | 97 | 1026.0 | 75 | medium | 17.9 | | calm | 0.2 | | no |
| | | | | Secchi03 | 14:20 | 4:00 | 28 | 43 | 22 | 7 | 54 | cloudy | | 6 | | | | | | | | calm | | | |

**BOUSSOLE 165** **10/11/2015** **BOUS151110_01**

*BOUS001*

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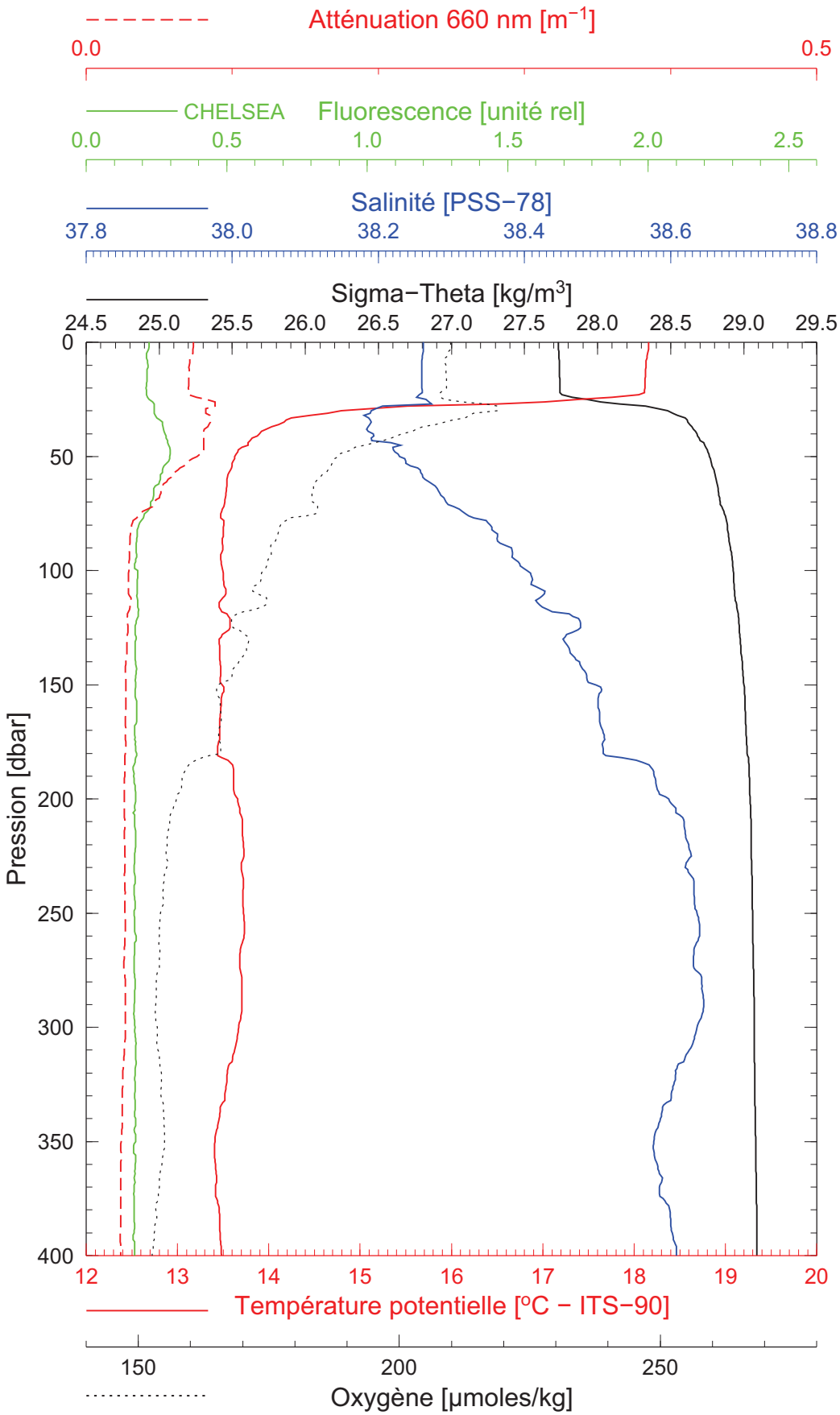
*BOUS002*

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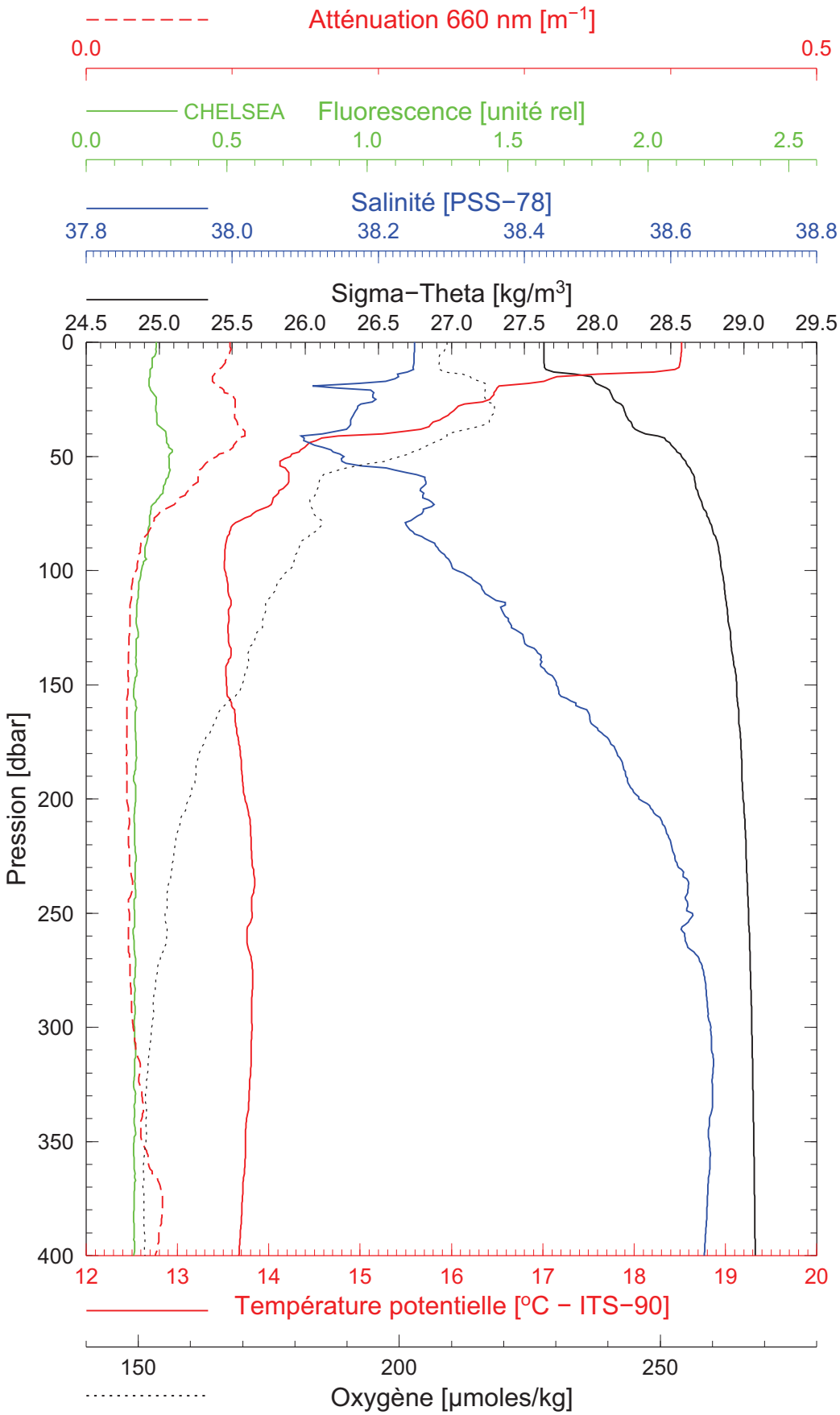
*BOUS003*

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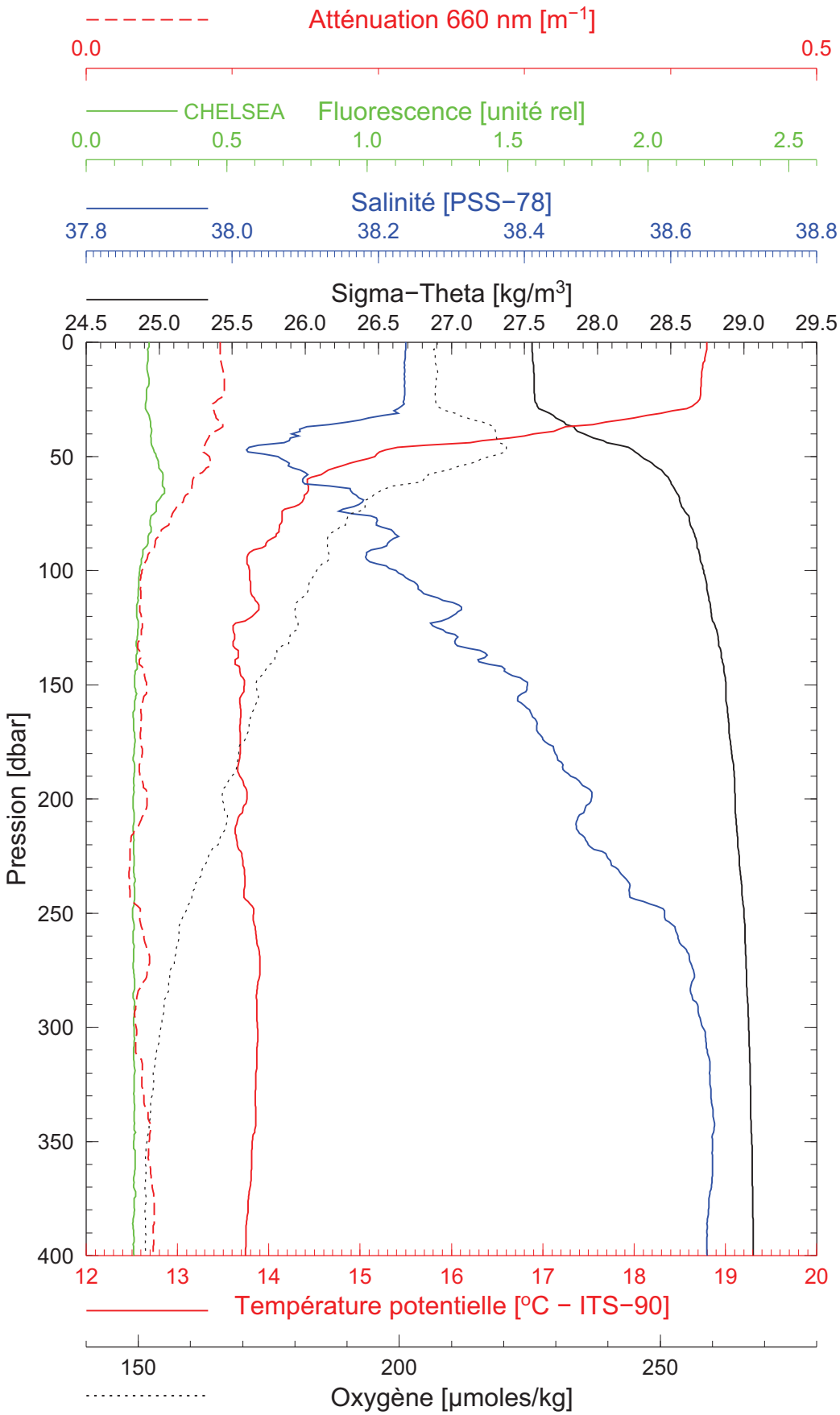
*BOUS004*

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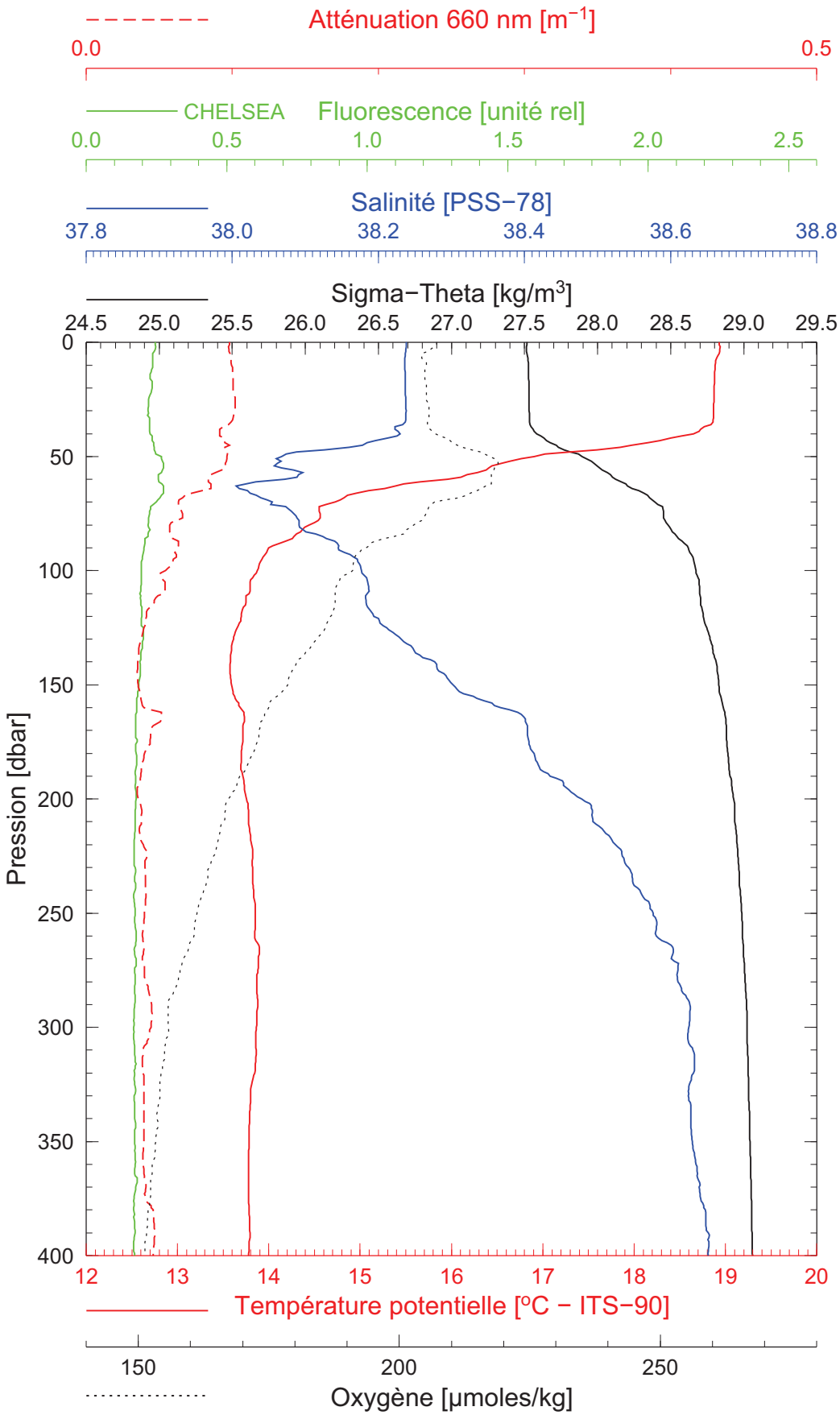
*BOUS005*

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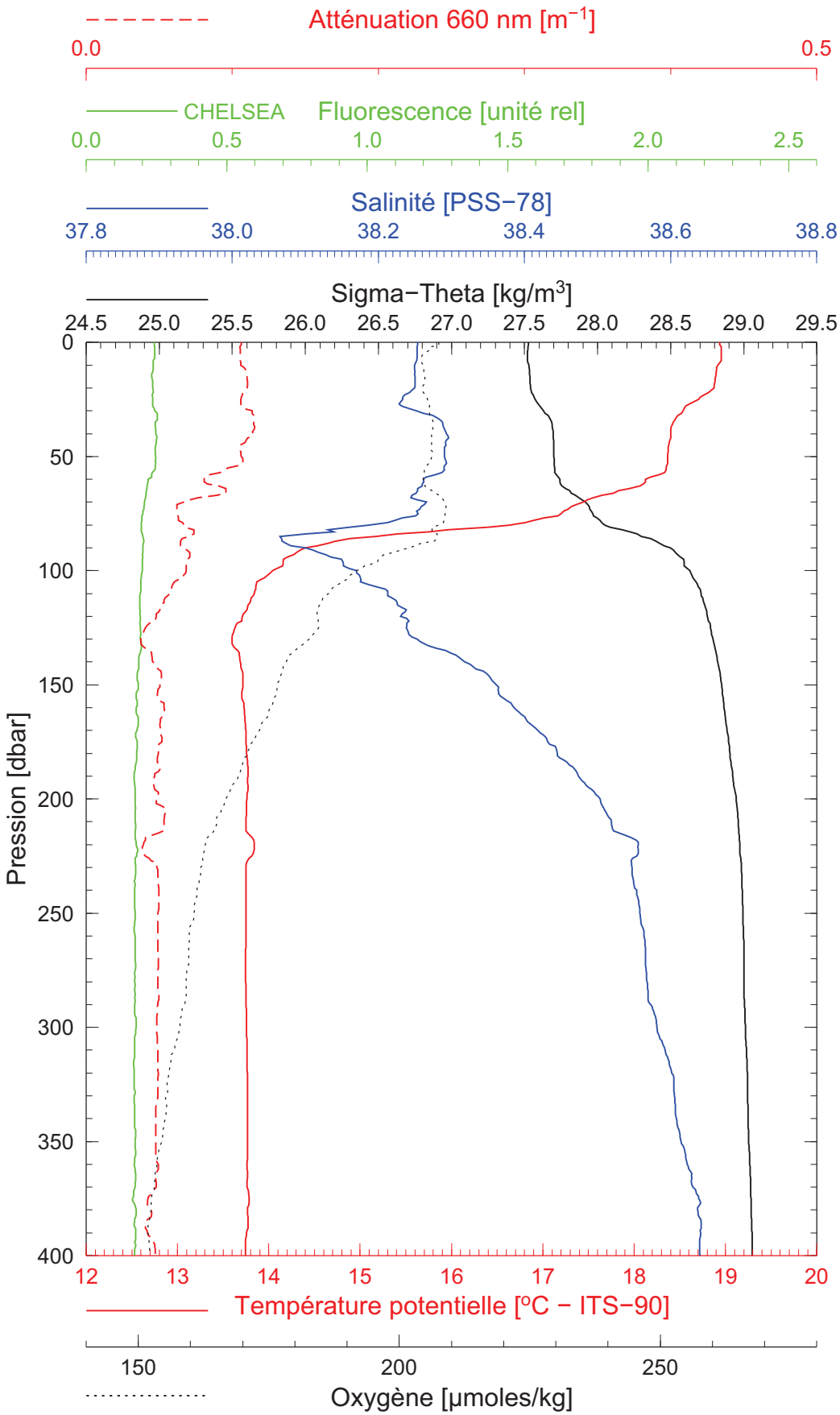
*BOUS006*

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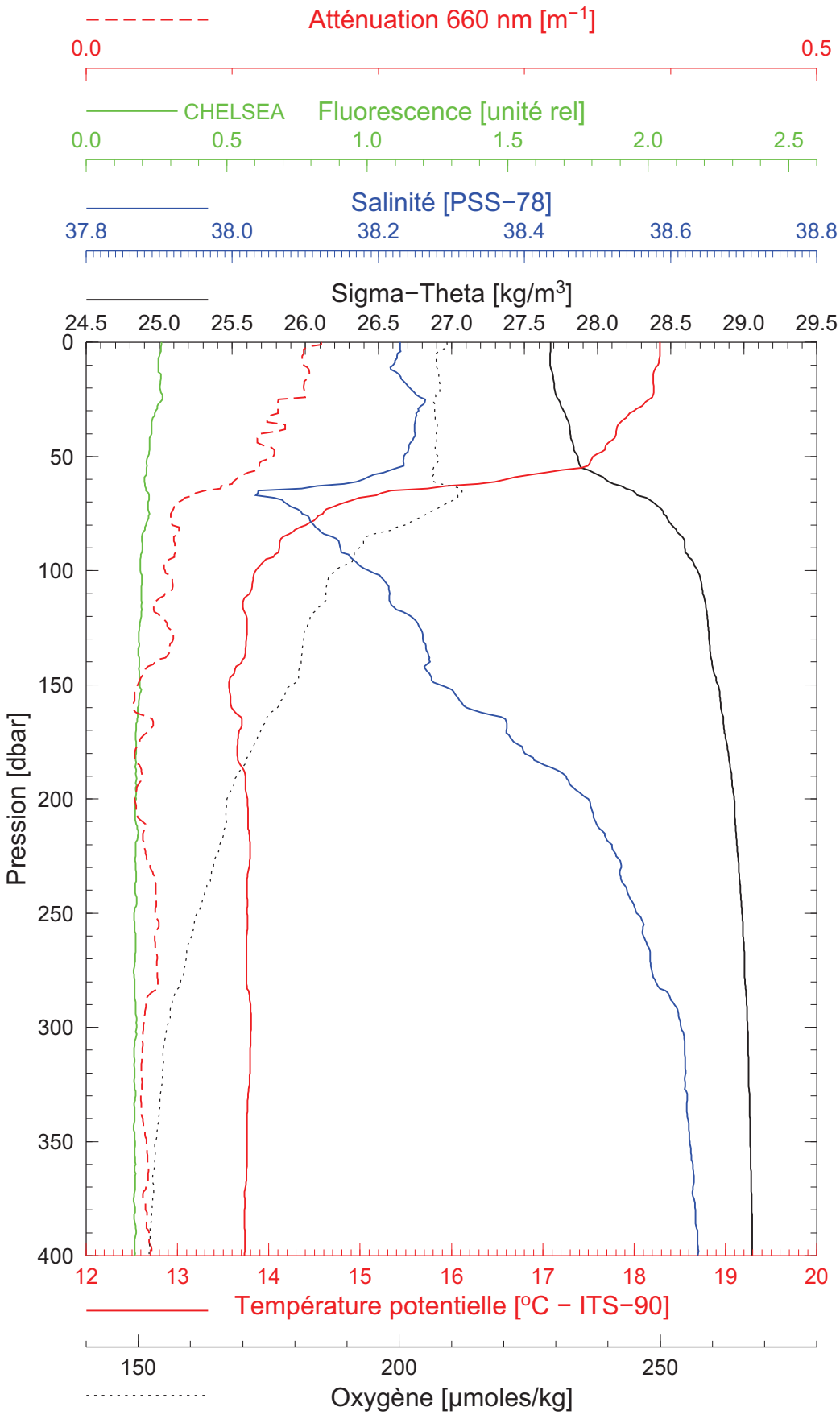
*BOUS007*

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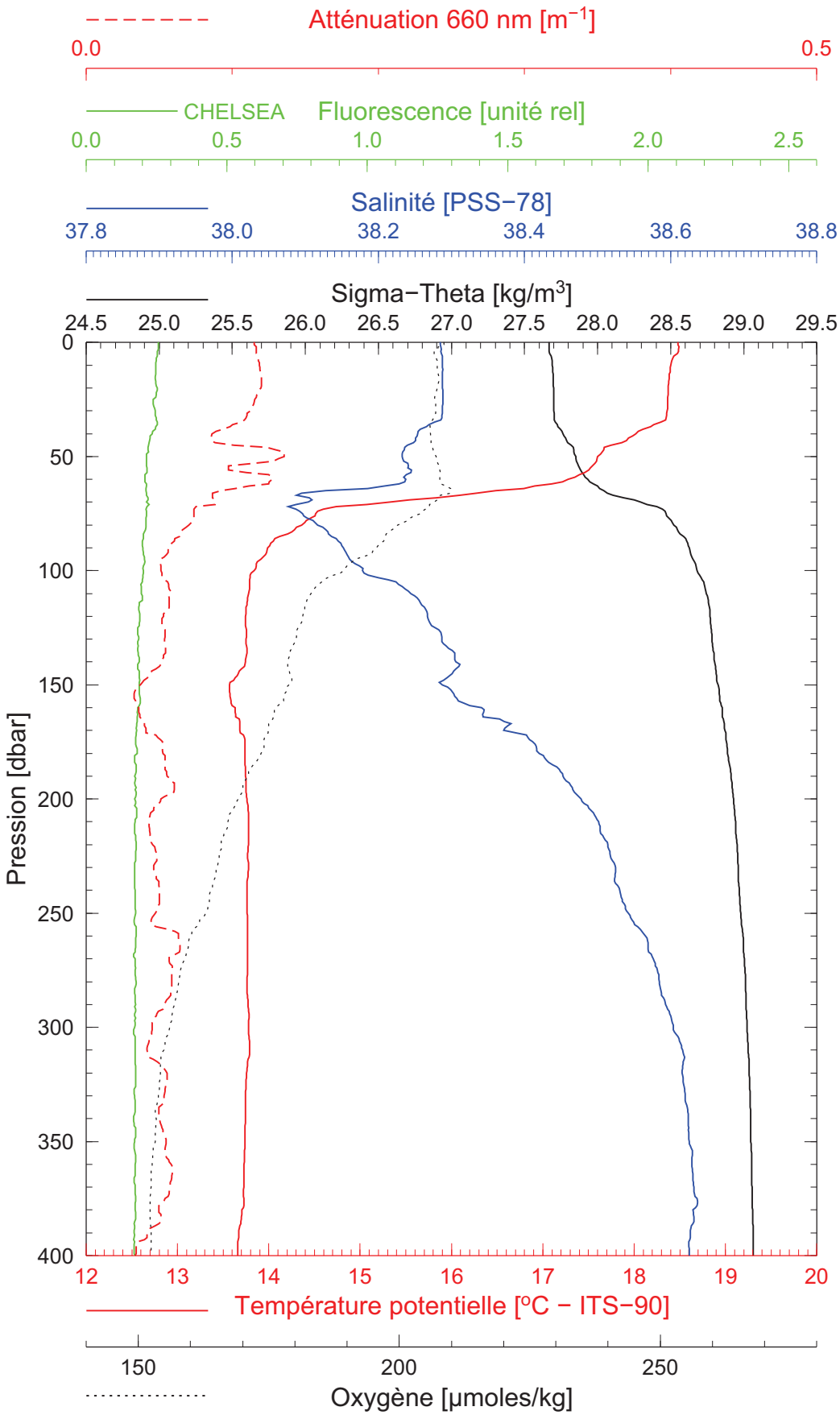
*BOUS008*

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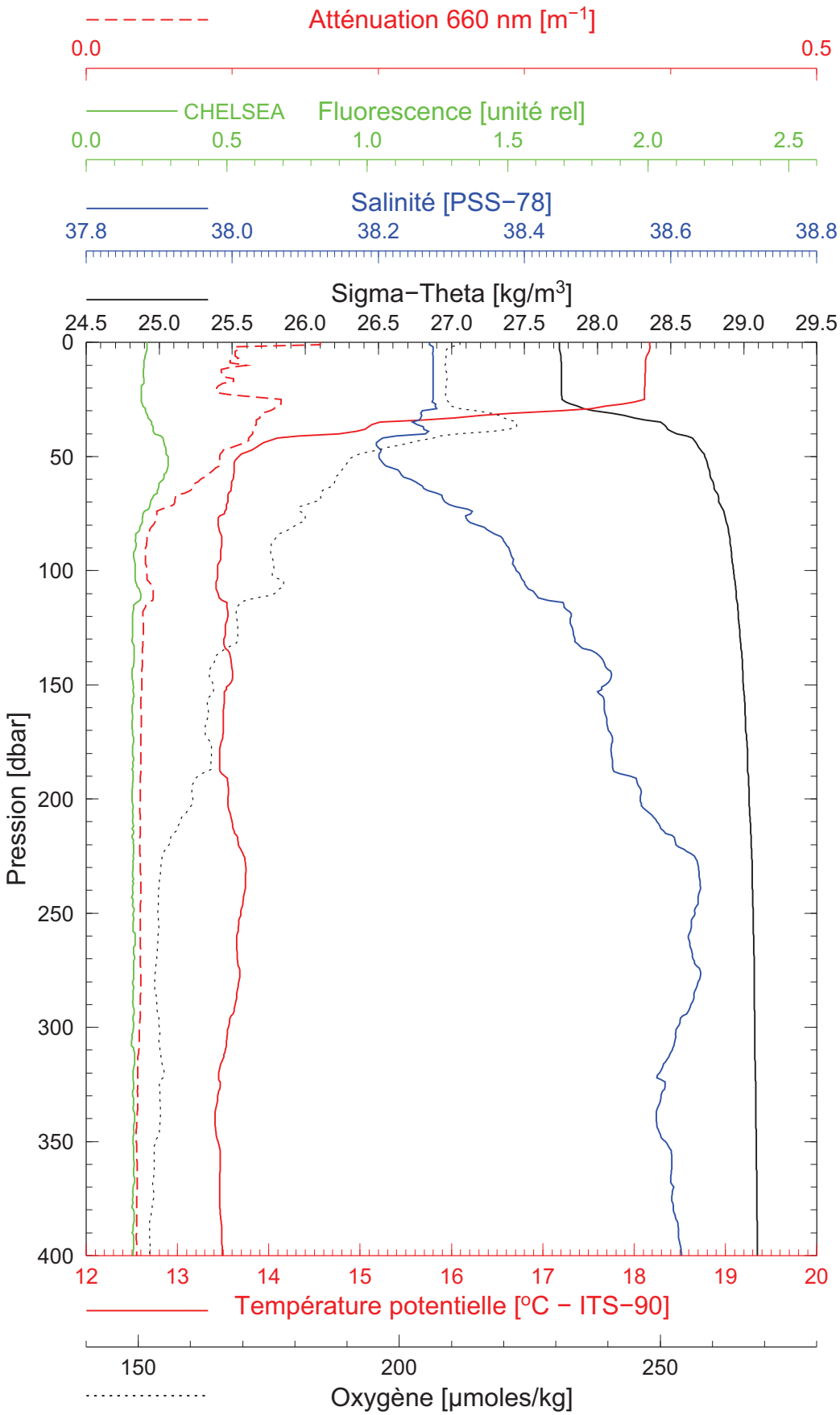
*BOUS009*

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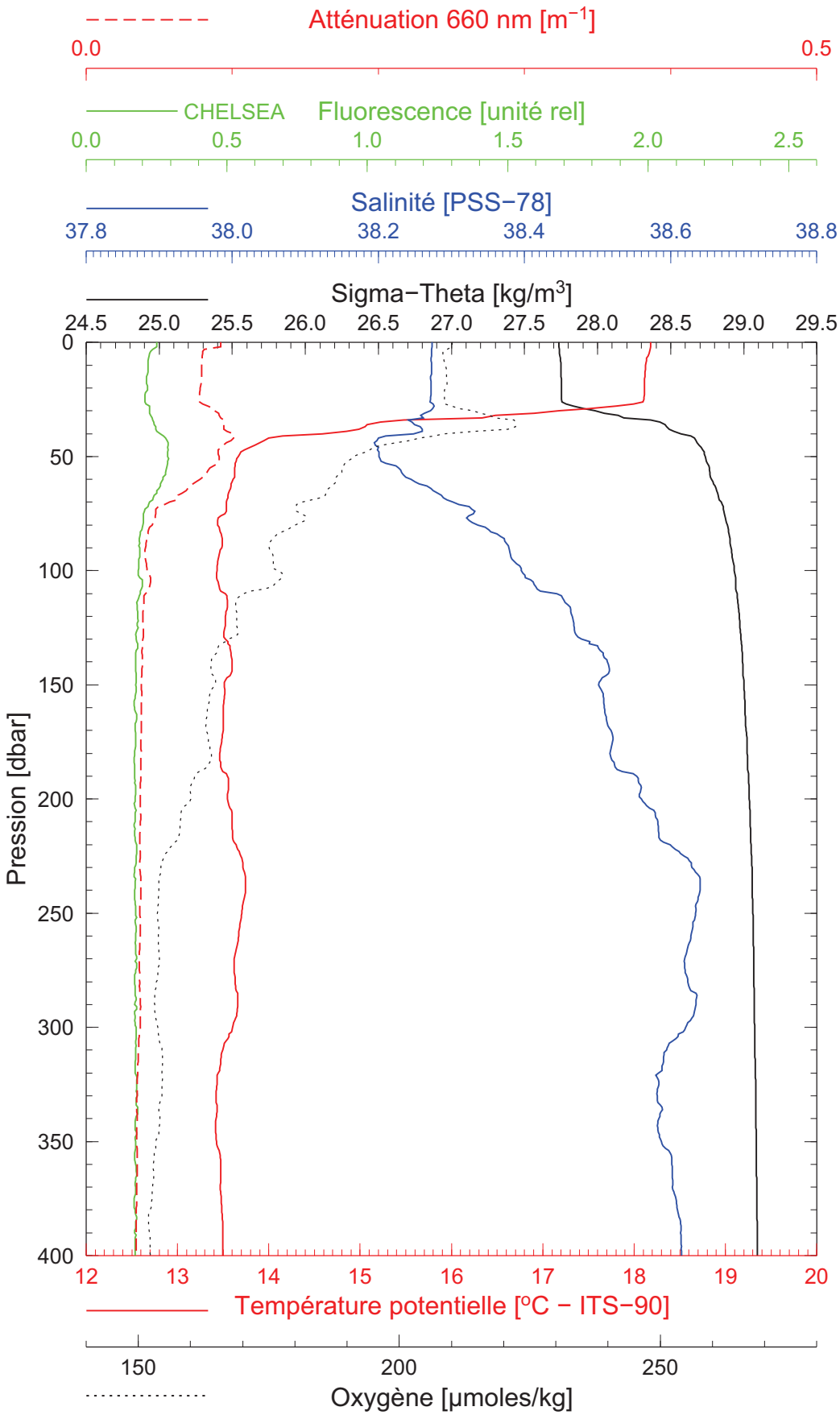
*BOUS010*

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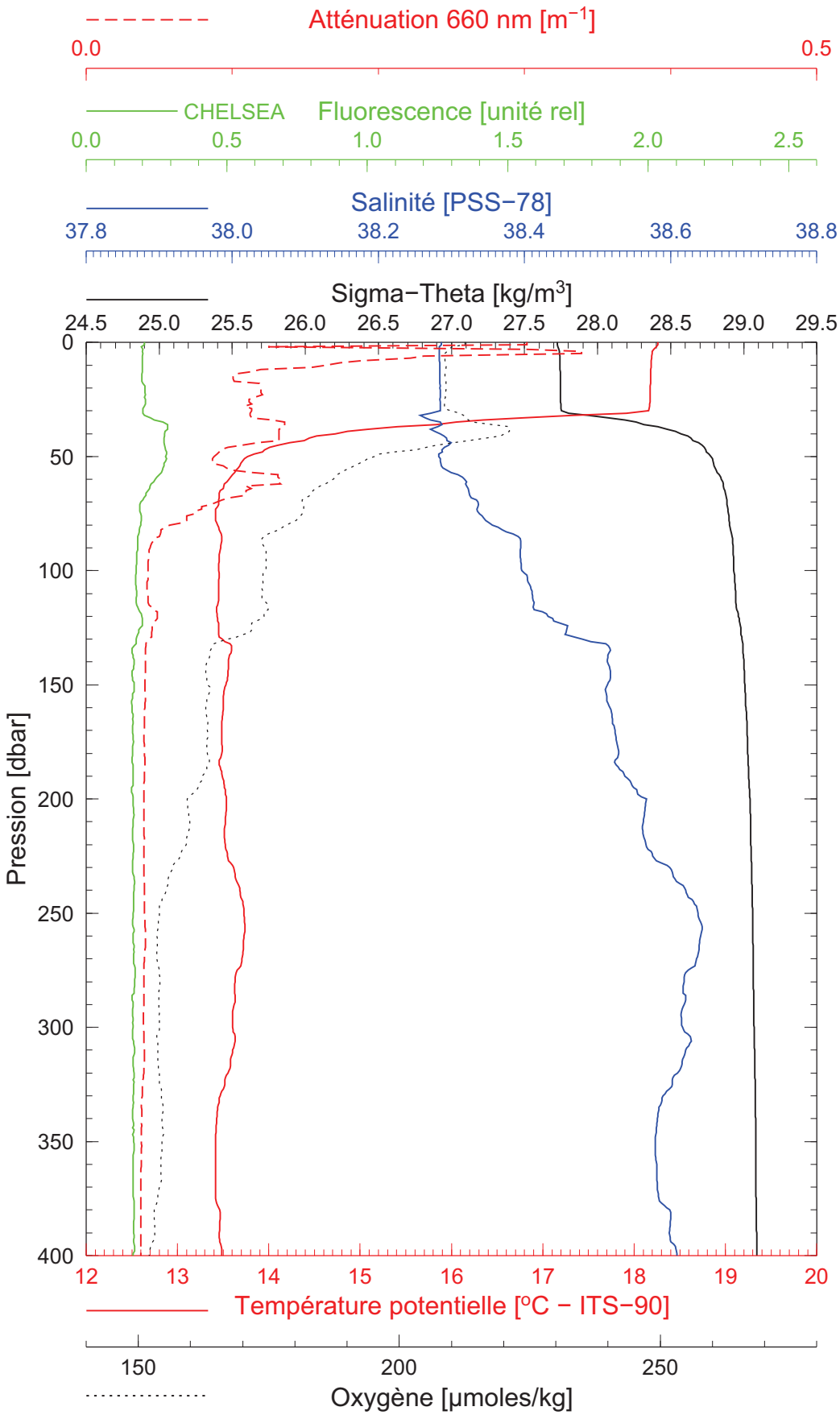
**BOUSSOLE 165** **12/11/2015** **BOUS151112_01**

*BOUS011*

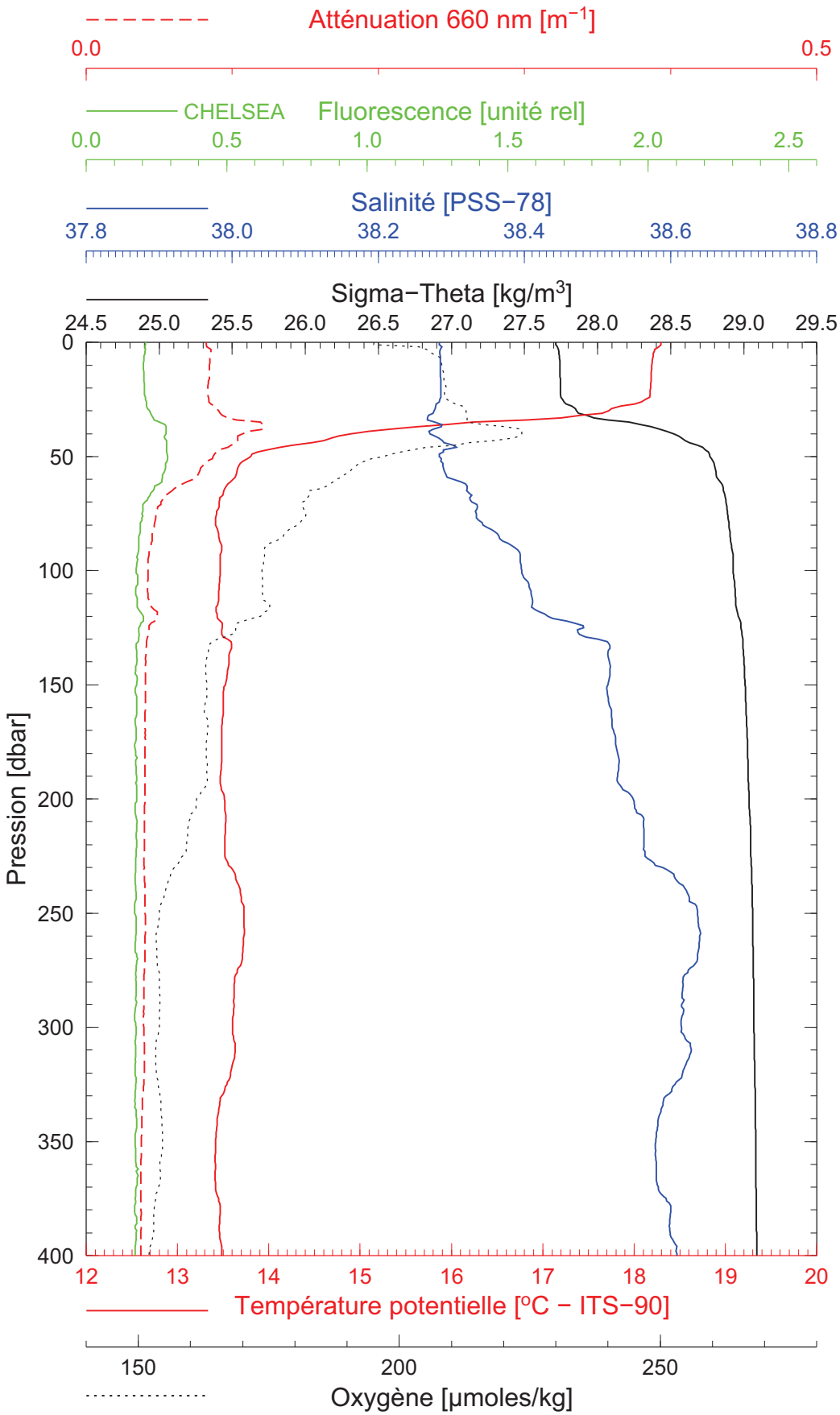



*Date* *12/11/2015* *Latitude* *43°21.950 N*

*Heure déb* *10h 49min [TU]* *Longitude* *07°53.960 E*

**BOUSSOLE 165** **12/11/2015** **BOUS151112_02**

*BOUS012*

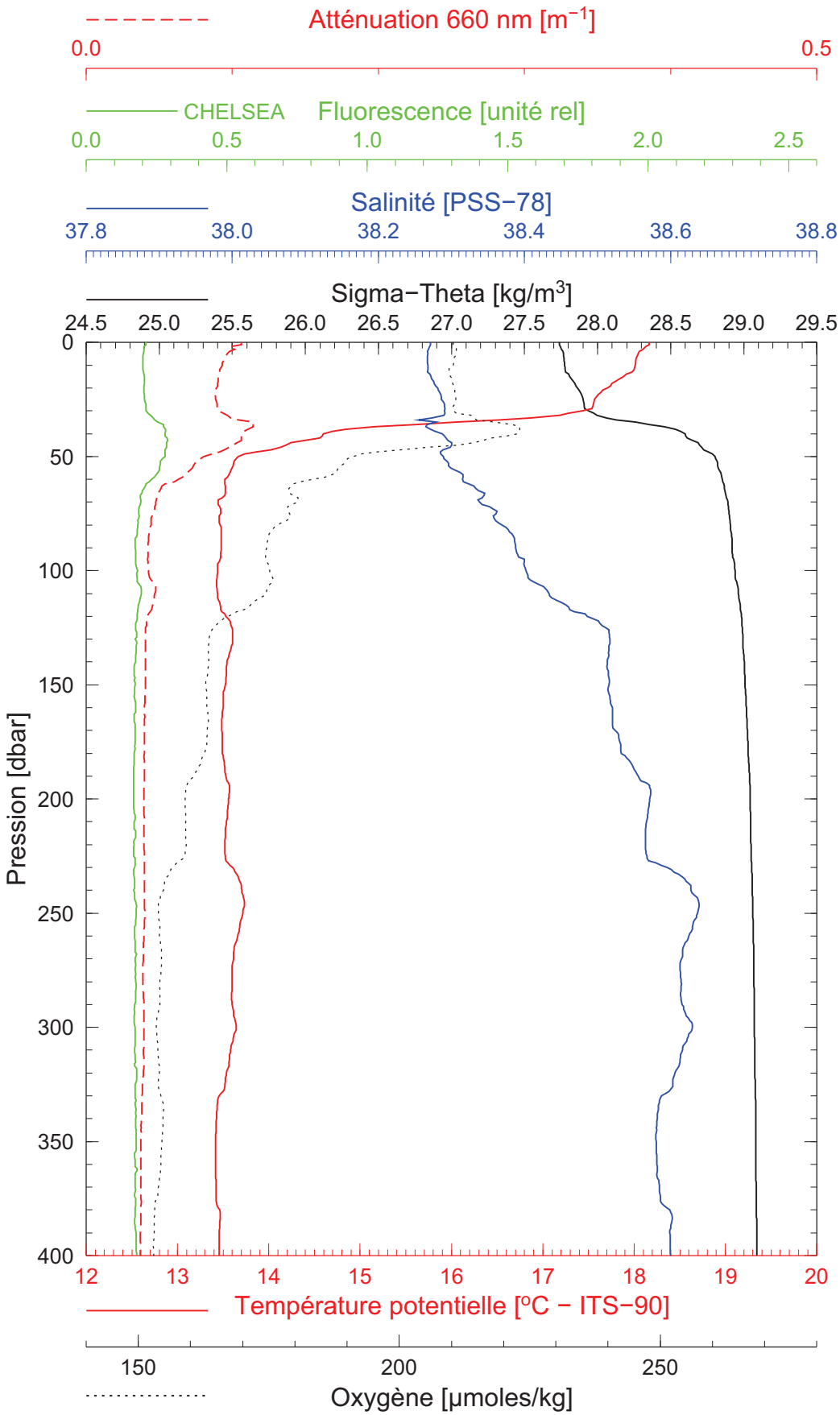



*Date* *12/11/2015* *Latitude* *43°21.950 N*

*Heure déb* *11h 30min [TU]* *Longitude* *07°53.950 E*

**BOUSSOLE 165** **12/11/2015** **BOUS151112_03**

*BOUS013*




*Date* *12/11/2015* *Latitude* *43°21.960 N*

*Heure déb* *13h 14min [TU]* *Longitude* *07°53.980 E*