BOUSSOLE Monthly Cruise Report

Cruise 166
December 11–14, 2015

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

Science Personnel: Malik Ait Kaci, Emilie Diamond, Jean De Vaugelas, Melek Golbol, David Luquet, Didier Robin, Collin Roesler, Vincenzo Vellucci and Mohammed Zerrouki.

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

CTD Rosette on the deck of the *R/V Tethys II*. In the background, a Tethys-II crew member on the dinghy and V.Vellucci on the buoy for downloading data.

BOUSSOLE project

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

January 12, 2016

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

Contents

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).2 CTD casts are to be performed at each data acquisition at the BOUSSOLE site: one cast with, and one cast without, a 0.2µm filter added on the a-sphere for the dissolved matter absorption measurements.

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.
The first day, a 3X1M-004 fluorometer sensor was installed on the buoy at 9m by the divers in the frame of the work with Collin Roesler.

During the diving, a dummy “test fluorometer" (which is not functioning) for the Marine Optics and Remote Sensing Lab - Laboratoire d’Océanographie de Villefranche was affixed at 9m on the buoy structure. The aim is to measure the biofilm deposited on the surface of the sensor, which has an impact on CDOM fluorescence sensors of profiling floats. It will be recovered during a subsequent cruise.

Cruise Summary

The first day was programmed for the MOOSE DYFAMED program. The diving operations were performed this day because the weather forecasts were better than for the following days. The second day and the third day, bad weather prevented the work at the BOUSSOLE site. The fourth day was used to clean solar panels, ARGOS connector and surface sensors on the top of the buoy, to perform IOP casts, CTD casts with water sampling, optical profiles, a Secchi disk at the BOUSSOLE site and the CTD transect.
The last day was used to perform optical profiles, CTD casts with water sampling, IOP casts and a Secchi disk at the BOUSSOLE site. CIMEL measurements could not be performed during this cruise because of the nebulosity conditions (overcast sky).

Thursday 10 December 2015

The sea state was slight with a moderate breeze on the morning and a gentle/light breeze on the afternoon. The first day was used for DYFAMED operations and for the diving at the BOUSSOLE site and at the Meteo-France buoy site. Divers went at sea on the afternoon in order to install a fluorometer on the BOUSSOLE buoy at 9m depth, to clean the sensors and to perform dark measurements of the transmissometers and the backscattering meter. They installed a fluorometer test on the buoy structure at 9m depth for the biofilm measurements.

Friday 11 December 2015

Bad weather prevented departure from the Nice harbour.

Saturday 12 December 2015

Bad weather prevented departure from the Nice harbour.

Sunday 13 December 2015

The sea state was slight with a moderate breeze. The sky was overcast with a medium visibility. When arrived at BOUSSOLE, the dinghy was launched and data were retrieved directly using the cable available on the top of the buoy. Solar panels, surface sensors and ARGOS connector were cleaned. After, C-OPS tests were performed in order to adjusted it during the descent phase of the profiles. Then, 2 C-OPS profiles, 2 CTD casts with water sampling, 2 IOPs casts including 1 cast with 0.2 µm filters on the ac meters and a Secchi disk were performed at the BOUSSOLE site. Finally, the CTD transect was performed totally.

Monday 14 December 2015

The sea state was slight with a moderate breeze. The sky was overcast and the visibility was medium. During this day 3 C-OPS profiles, 2 CTD casts with water sampling and 2 IOPS casts including 1 cast with 0.2µm filters on the ac meters and a Secchi disk were performed at the BOUSSOLE site.

Pictures taken during this cruise can be found at:
https://picasaweb.google.com/114686870380724925974/2015_12_boussole166

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

Cruise Report

Thursday 10 December 2015 (UTC)

People on board: Malik Ait Kaci, Emilie Diamond, David Luquet, Didier Robin, Jean De Vaugelas and Mohammed Zerrouki.
Captain: Dany Deneuve.

0625 Departure from the Nice harbour.
0930 Arrival at the DYFAMED site.
0935 Zooplancton nets (MOOSE DYFAMED program).
1025 CTD MOOSE 92, 2340m (MOOSE DYFAMED program).
1210 Departure to the BOUSSOLE site.
1245 Arrival at the BOUSSOLE site.
1315 Diving on the BOUSSOLE buoy: cleaning of the sensors, dark measurements, installation of fluorometers at 9m.
1425 Departure to buoy Meteo-France site.
1455 Arrival at the buoy Meteo-France site
1500 Diving on the Meteo-France buoy for testing the fixations of the ISUS sensor.
1530 Departure to the Nice harbour.
1810 Arrival at the Nice harbour.

Friday 11 December 2015

Bad weather prevented departure from the Nice harbour.

Saturday 12 December 2015

Bad weather prevented departure from the Nice harbour.

Sunday 13 December 2015 (UTC)

People on board: Melek Golbol and Vincenzo Vellucci.
Captain: Dany Deneuve.

0615 Departure from the Nice harbour.
0930 Arrival at the BOUSSOLE site.
1000 Direct connection with the buoy and data retrieval. Downloading of pCO2 data at 10m depth.
Cleaning of solar panels, surface sensors and AGOS connectors.
1035 C-OPS adjustment tests.
1105 C-OPS 02, 03.
1150 CTD 01, 400 m with water sampling at 5 m for TSM (with 0.2 µm filter on a-sphere).
1220 CTD 02, 400 m with water sampling at 200, 150, 80, 70, 60, 50, 40, 30, 20, 10 and 5 m for HPLC and $a_{p.}$
1255 IOP cast D1.1, 400m.
1345 Secchi 01, 16 m.
1350 Departure to the first station transect.
1425 CTD 03, 400 m, station 01 (43°25'N 07°48'E).
1525 CTD 04, 400 m, station 02 (43°28'N 07°42'E).
1615 CTD 05, 400 m, station 03 (43°31'N 07°37'E).
1710 CTD 06, 400 m, station 04 (43°34'N 07°31'E).
1810 CTD 07, 400 m, station 05 (43°37'N 07°25'E).
1855 CTD 08, 400 m, station 06 (43°39'N 07°21'E).
1915 Departure to the Nice harbour.
2000 Arrival at the Nice harbour.

Monday 14 December 2015

People on board: Melek Golbol, Collin Roesler and Vincenzo Vellucci.
Captain: Vincent Le Duvehat.

0620 Departure from the Nice harbour.
0930 Arrival at the BOUSSOLE site.

0945 C-OPS 04, 05, 06.
1040 CTD 09, 400 m with water sampling at 400, 200, 150, 80, 70, 60, 50, 40, 30, 20, 10 and 5 m for HPLC, a_p, CDOM and cytometry (10m).
1115 IOP cast D2.1, 400m.
1220 CTD 10, 400 m with water sampling at 10m and 5 m for TSM, O_2 and TA/TC (with 0.2 µm filter on a-sphere).
1250 Secchi 01, 22 m.
1300 Departure to the Nice harbour.
1610 Arrival at the Nice harbour.

Problems identified during the cruise

- The Turner ICAM was not included on the new IOP package because it was flooded during the previous cruise. It was sent to the manufacturer and a new ICAM arrived just before the cruise but without the battery. So it could not be deployed during this cruise.

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

- The Master REM A sensor was not functioning during the first four days of the cruise because of an issue with a communication cable. A cable was found and installed the last day. So the data are available only for the CTD cast #10.

- The C-OPS commonly used on the BOUSSOLE missions was still under calibration at *Biospherical*. The C-OPS used for this cruise was the one shared among the marine optics and remote sensing group at LOV. The instrument is similar to the BOUSSOLE one, yet has a Lu sensor instead of a Eu one**.**

Appendices

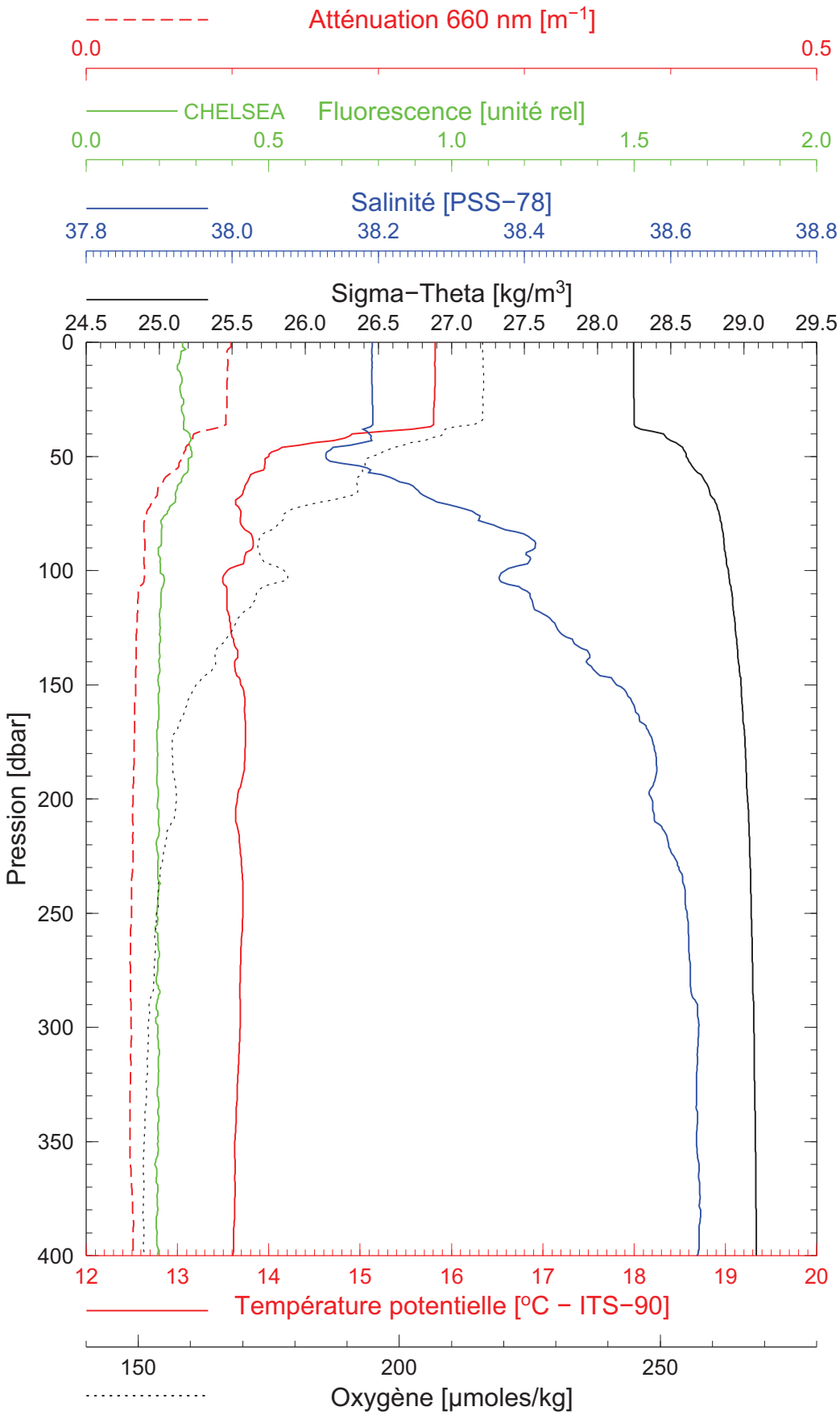
Cruise Summary Table for Boussole 166

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
10/12/15	DYFAMED cruise																							
11/12/15	Bad weather																							
12/12/15	Bad weather																							
		bou_c-ops_151213_0944_001_data.csv			10:36	4:20	108	43	22.254	7	53.856	overcast	Cu	8	13	236	1023.7	69	medium	14.9		calm	0.8		no
		bou_c-ops_151213_0944_003_data.csv			11:03	4:06	101	43	22.233	7	53.914	overcast	Cu	8	13	236	1023.7	69	medium	14.9		calm	0.8		no
		bou_c-ops_151213_0944_004_data.csv			11:14	4:09	99	43	22.549	7	53.813	overcast	Cu	8	13	236	1023.7	69	medium	14.9		calm	0.8		no
			CTDBOUS001	TSM	11:48	21:00	400	43	22.222	7	54.179	overcast		8	13	232	1023.4	66		14.9	15.83	calm			
			CTDBOUS002	HPLC & Ap	12:23	25:00	400	43	22.169	7	54.172	overcast		8	12	230	1023.0	69		14.9	16.30	calm			
				IOP D1.1	12:55	NA	400	43	22	7	54	ovecast		8	12	230	1023.0	69		14.9	16.30				
13/12/15				Secchi01	13:45	4:00	16	43	22	7	54	overcast		8	13	221	1022.3	72	medium	14.9	16.30	calm			
			CTDBOUS003		14:26	19:00	400	43	24.968	7	48.055	blue		3	12	222	1022.1	70		14.8	16.40	calm			
			CTDBOUS004		15:25	19:00	400	43	27.934	7	41.912	overcast		7	13	220	1022.0	72		14.7	16.40	calm			
			CTDBOUS005		16:17	18:00	400	43	30.984	7	36.935	overcast		7	12	215	1022.0	71		14.7	16.40	calm			
			CTDBOUS006		17:10	20:00	400	43	33.956	7	30.892	night			12	226	1022.0	70		14.8	17.10	calm			
			CTDBOUS007		18:07	19:00	400	43	36.947	7	24.936	night			3	323	1022.3	75		14.4	16.58	calm			
			CTDBOUS008		18:55	19:00	400	43	39.028	7	21.072	night			2	342	1022.6	77		14.3	16.90	calm			
		bou_c-ops_151214_0916_001_data.csv			09:42	4:12	104	43	22.101	7	53.360	overcast	Cu	7	13	62	1024.7	69	medium	14.3		calm	0.7		no
		bou_c-ops_151214_0916_002_data.csv			09:55	3:58	99	43	22.167	7	53.170	overcast	Cu	7	13	62	1024.7	69	medium	14.3		calm	0.7		no
		bou_c-ops_151214_0916_003_data.csv			10:06	04:06	102	43	22.222	7	52.791	overcast	Cu	7	13	62	1024.7	69	medium	14.3		calm	0.7		no
14/12/15			CTDBOUS009	HPLC, Ap, CDOM, Cyto & Ap	10:39	18:00	400	43	22.012	7	53.680	overcast		8	15	71	1024.5	69		14.2	16.10	calm			
				IOP D2.1	11:15	NA	400	43	22	7	54	overcast		8	15	71	1024.5	69		14.2	16.10				
			CTDBOUS010	TSM, TA/TC & O_2	12:20	20:00	400	43	21.988	7	53.686	overcast		8	17	56	1023.9	67		14.0	15.74	calm			
				Secchi02	12:50	4:00	22	43	22	7	54	overcast										calm			

Cruise Summary Table for Boussole 166

BOUSSOLE 166 **13/12/2015** **BOUS151213_01**

BOUS001

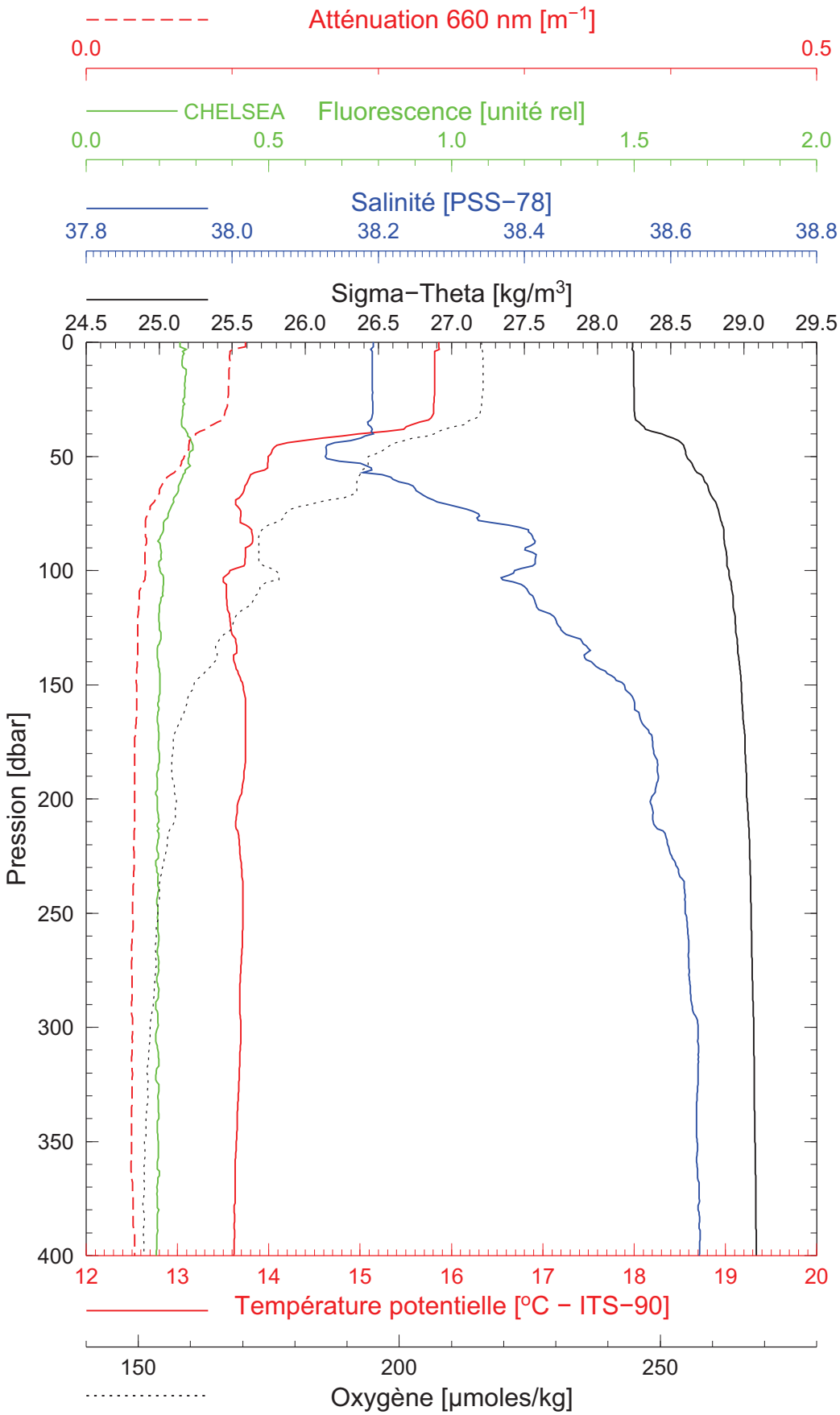


Date *13/12/2015* *Latitude* *43°22.222 N*

Heure déb *11h 48min [TU]* *Longitude* *07°54.179 E*

BOUSSOLE 166 **13/12/2015** **BOUS151213_02**

BOUS002

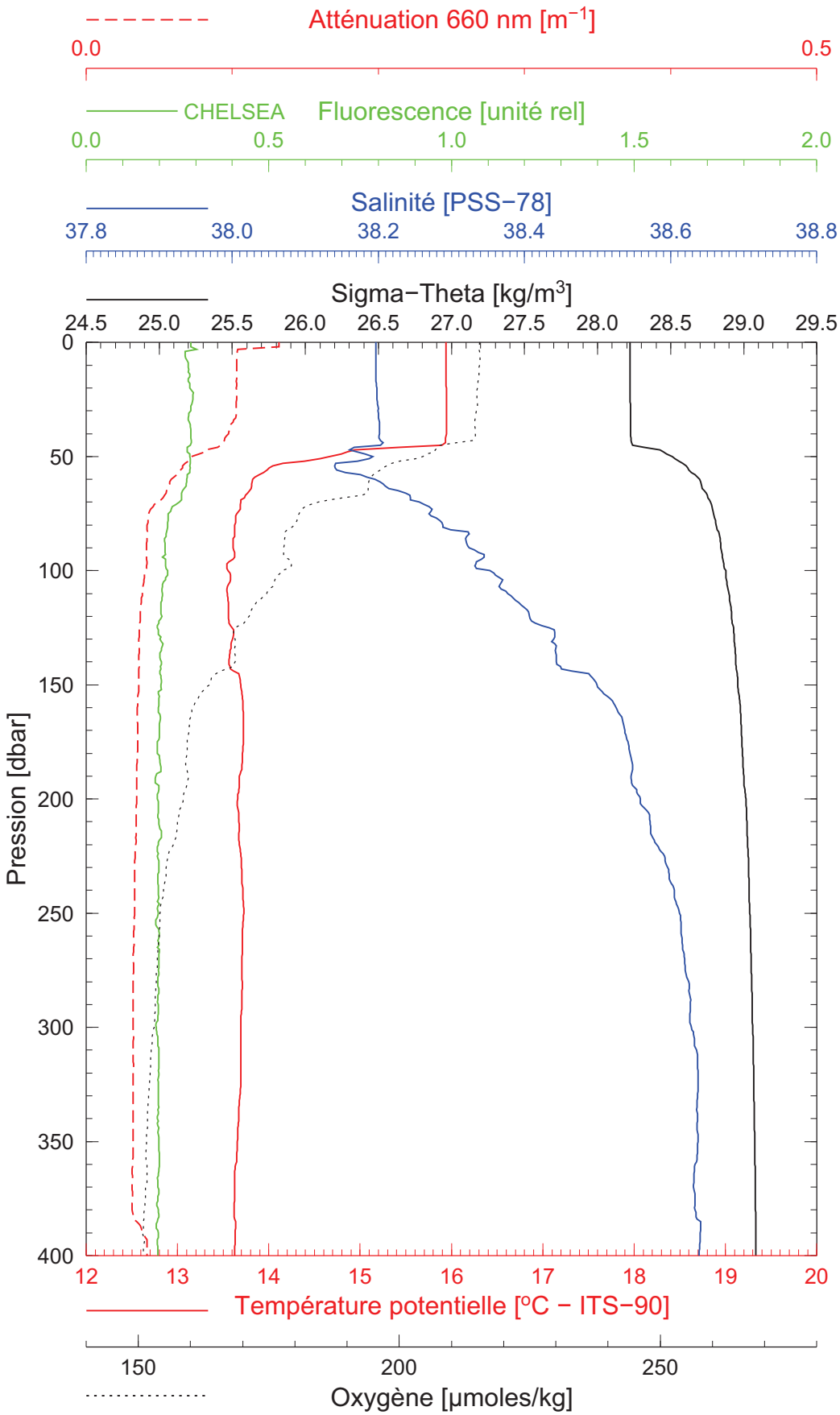


Date *13/12/2015* *Latitude* *43°22.169 N*

Heure déb *12h 23min [TU]* *Longitude* *07°54.172 E*

BOUSSOLE 166 **13/12/2015** **BOUS151213_03**

BOUS003

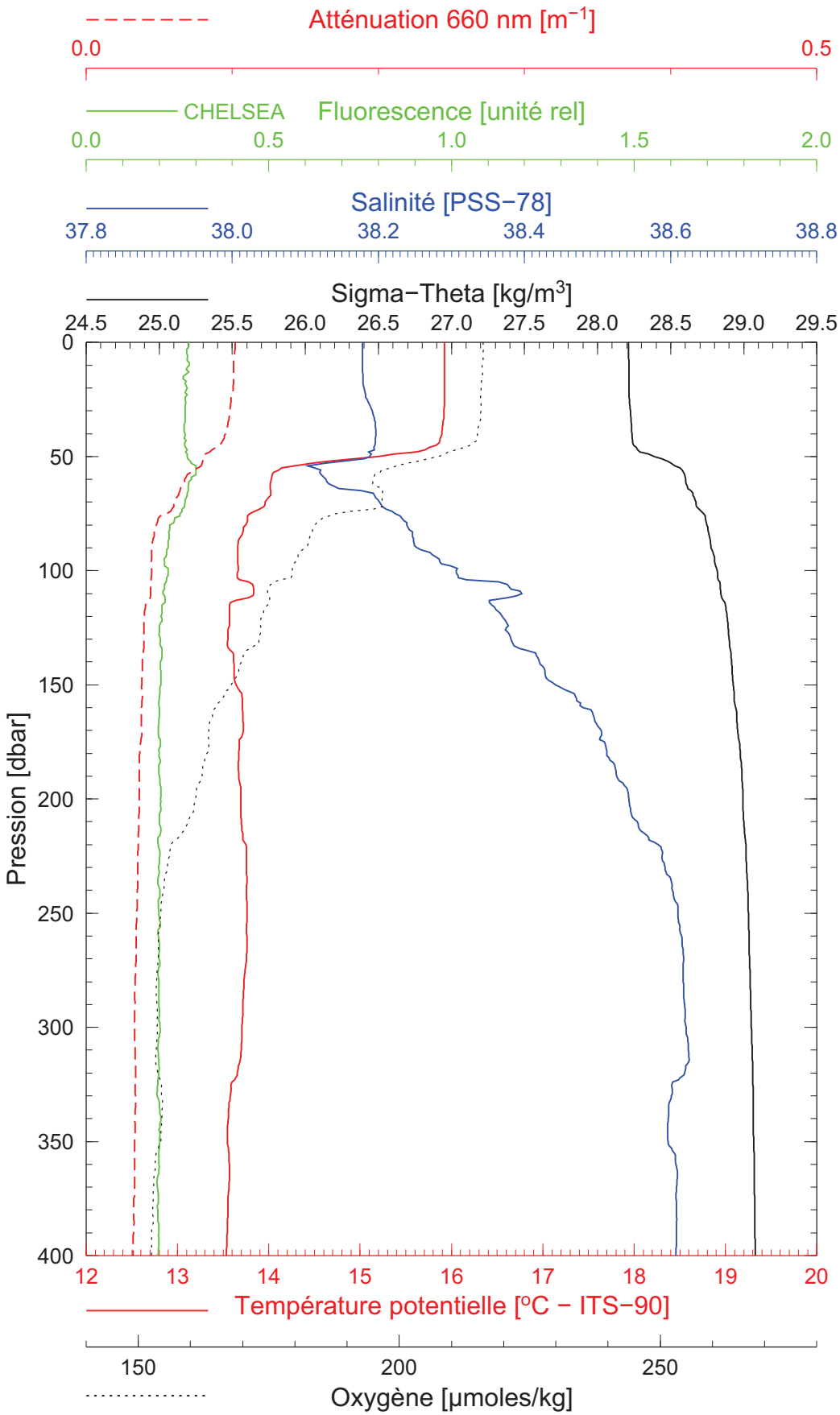


Date *13/12/2015* *Latitude* *43°24.968 N*

Heure déb *14h 26min [TU]* *Longitude* *07°48.055 E*

BOUSSOLE 166 **13/12/2015** **BOUS151213_04**

BOUS004

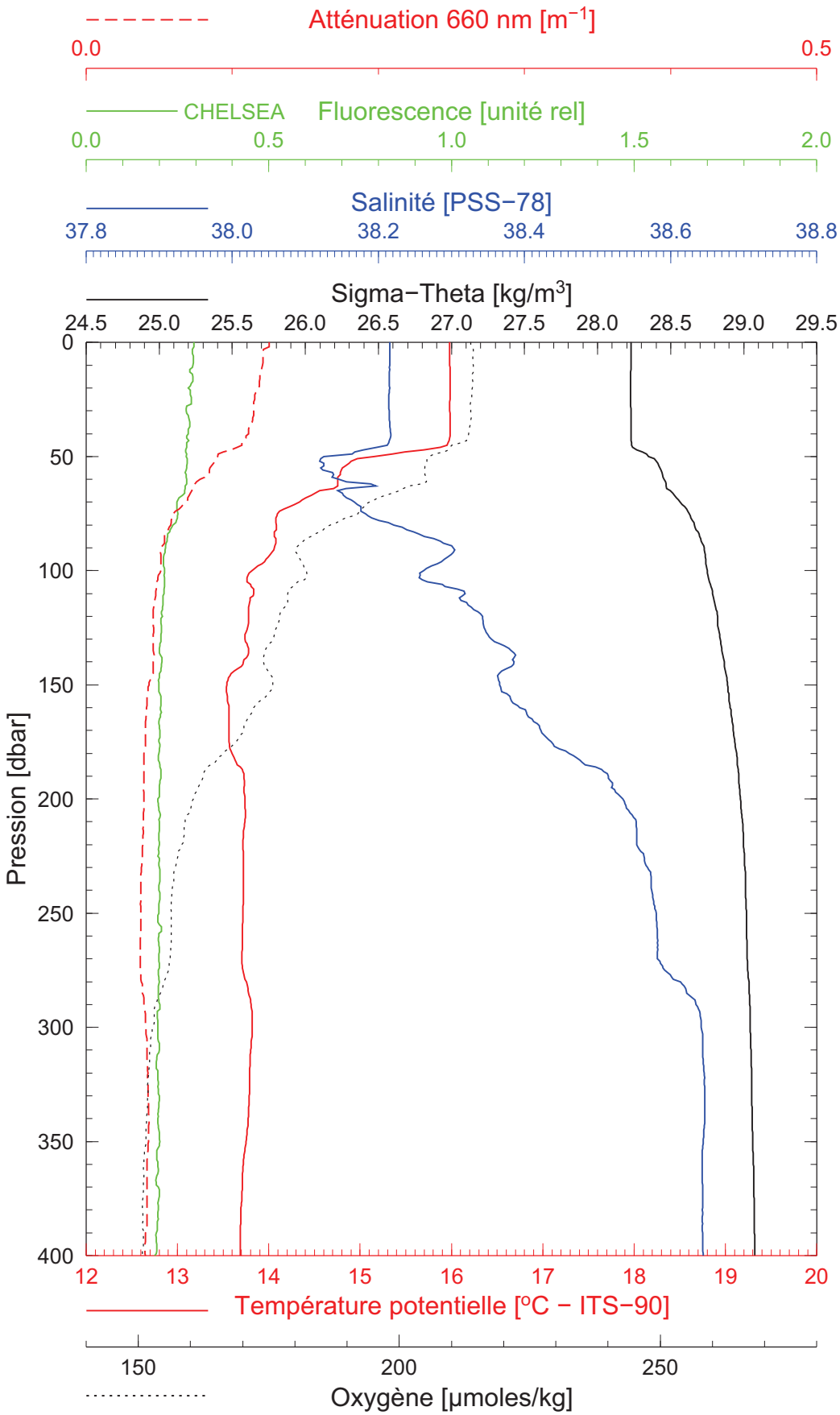


Date *13/12/2015* *Latitude* *43°27.934 N*

Heure déb *15h 25min [TU]* *Longitude* *07°41.912 E*

BOUSSOLE 166 **13/12/2015** **BOUS151213_05**

BOUS005

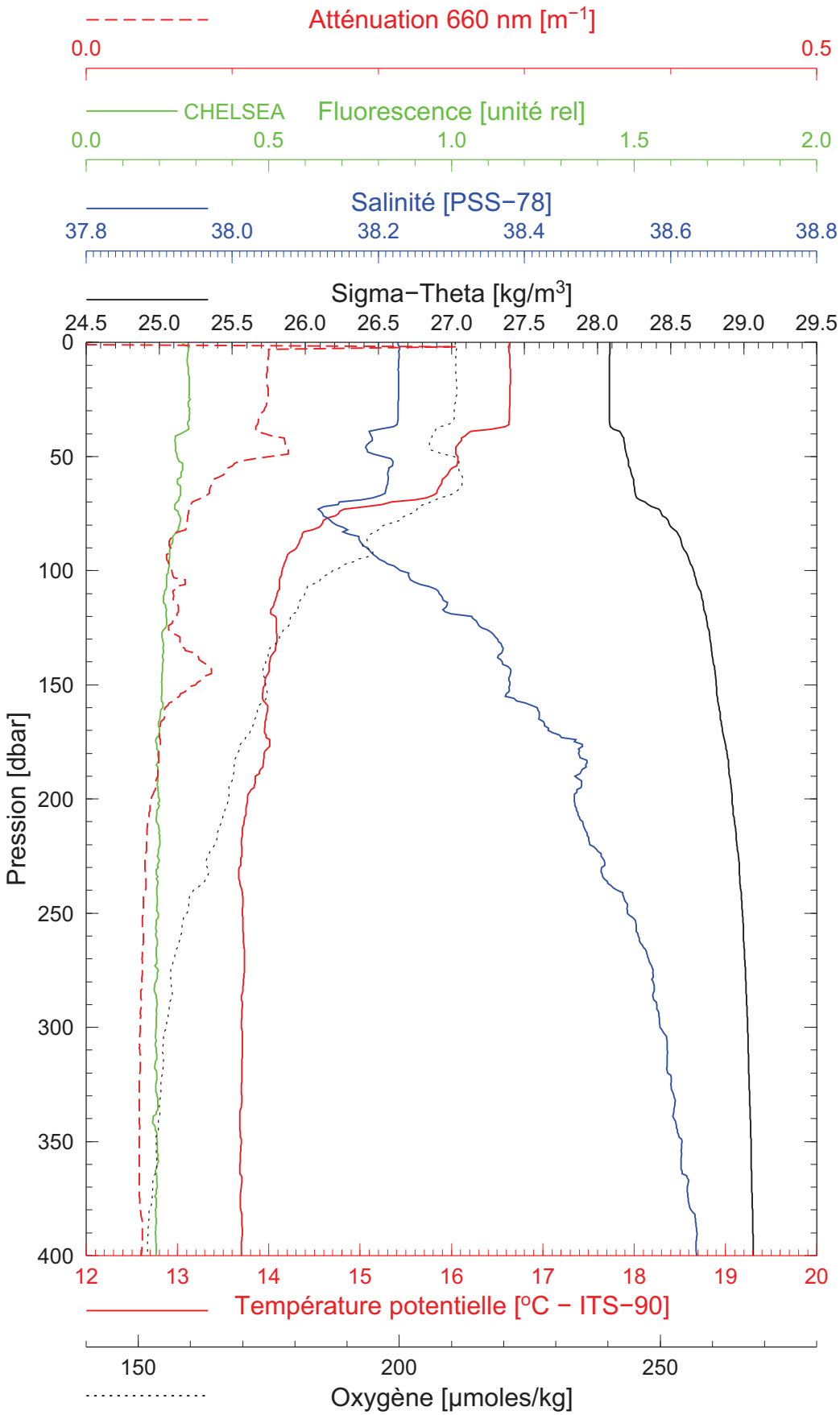


Date *13/12/2015* *Latitude* *43°30.984 N*

Heure déb *16h 17min [TU]* *Longitude* *07°36.935 E*

BOUSSOLE 166 **13/12/2015** **BOUS151213_06**

BOUS006

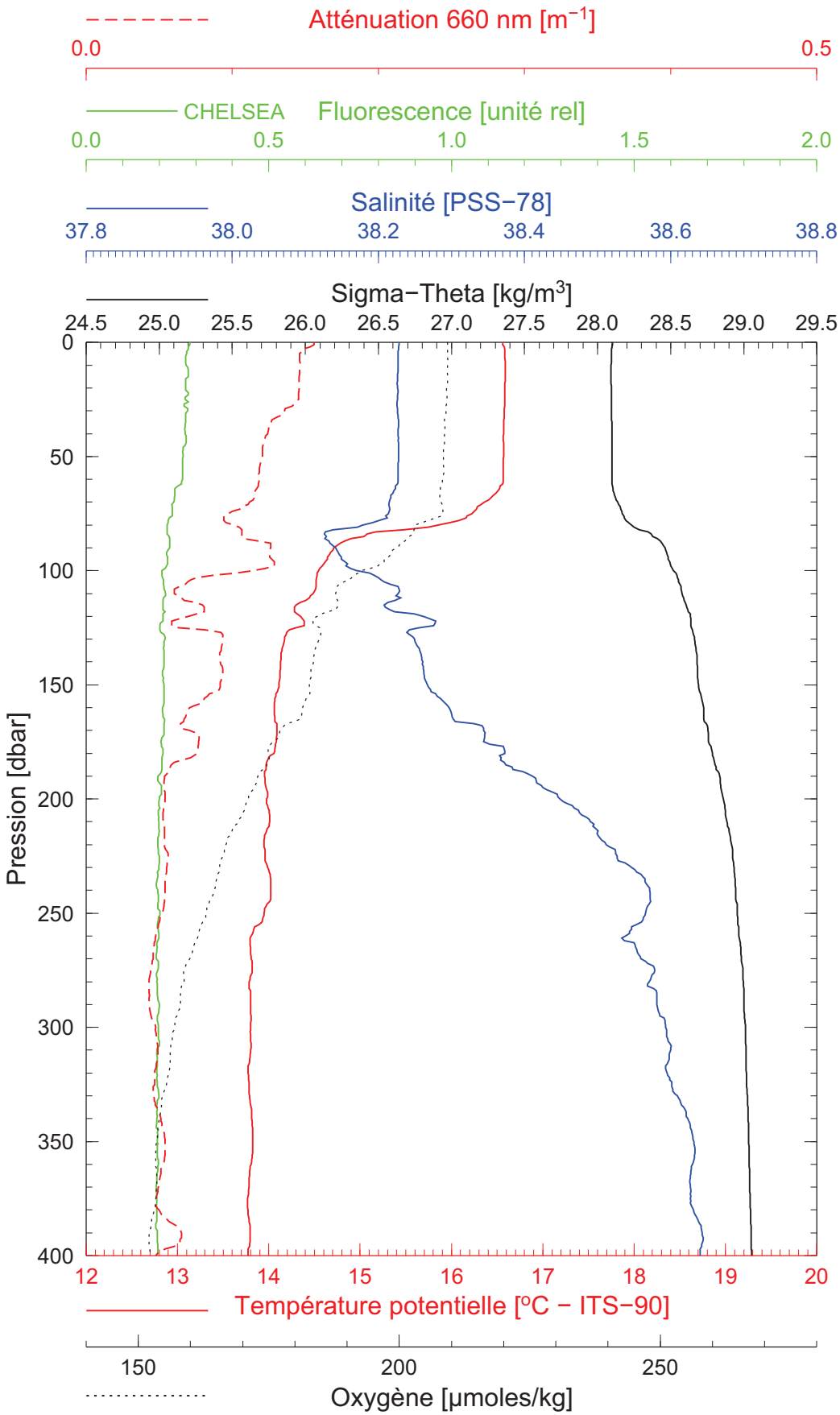


Date *13/12/2015* *Latitude* *43°33.956 N*

Heure déb *17h 10min [TU]* *Longitude* *07°30.892 E*

BOUSSOLE 166 **13/12/2015** **BOUS151213_07**

BOUS007

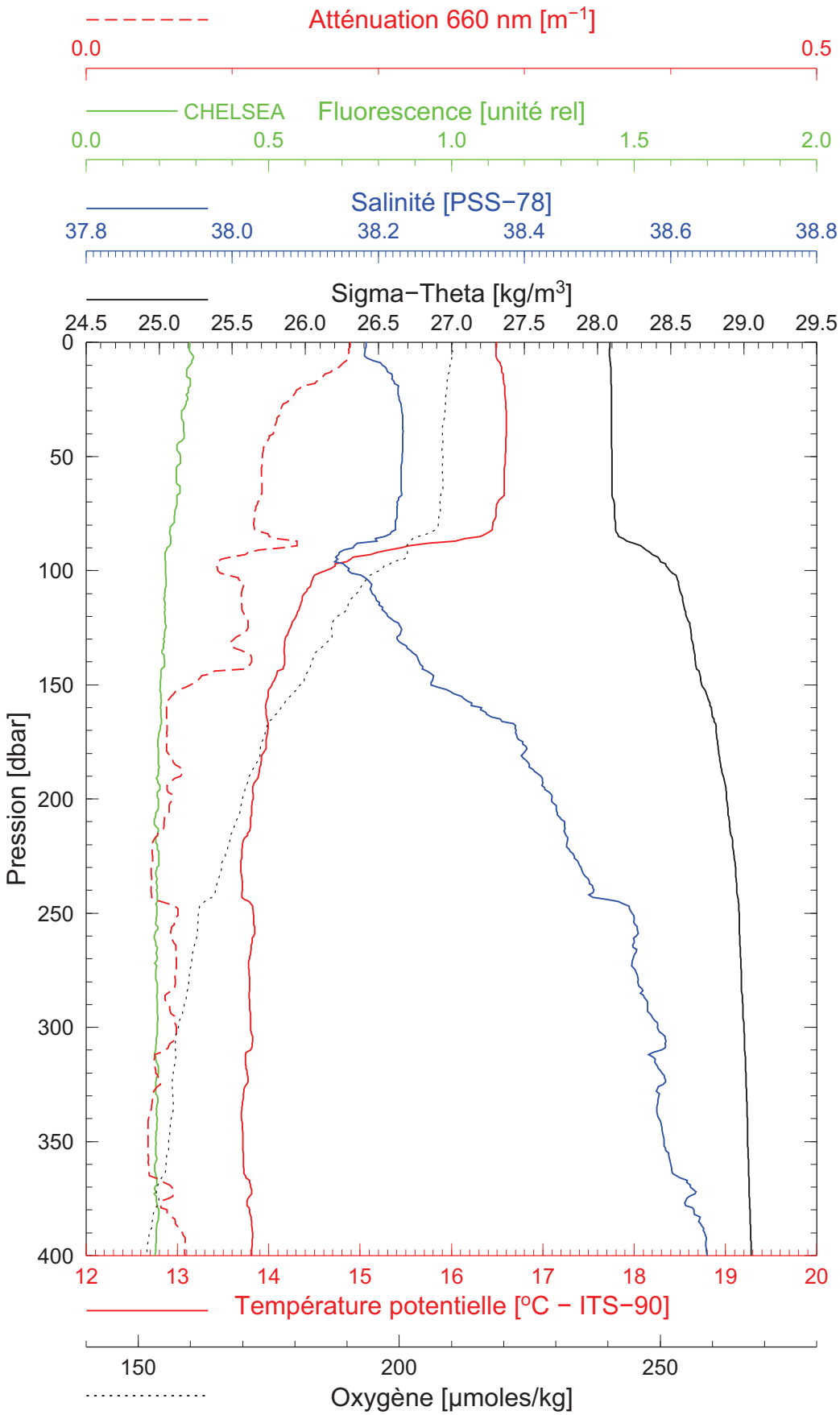


Date *13/12/2015* *Latitude* *43°36.947 N*

Heure déb *18h 07min [TU]* *Longitude* *07°24.936 E*

BOUSSOLE 166 **13/12/2015** **BOUS151213_08**

BOUS008

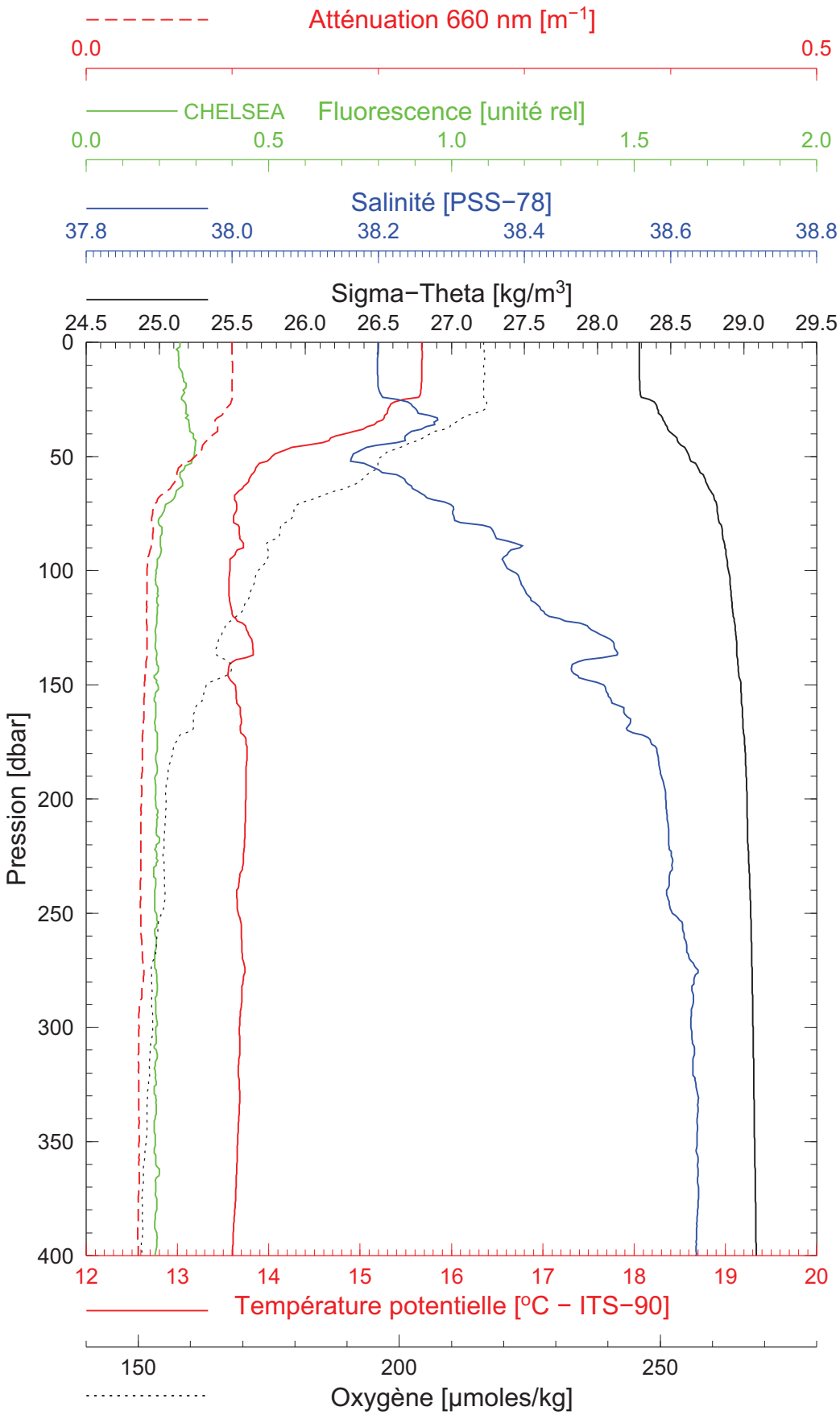


Date *13/12/2015* *Latitude* *43°39.028 N*

Heure déb *18h 55min [TU]* *Longitude* *07°21.072 E*

BOUSSOLE 166 **14/12/2015** **BOUS151214_01**

BOUS009

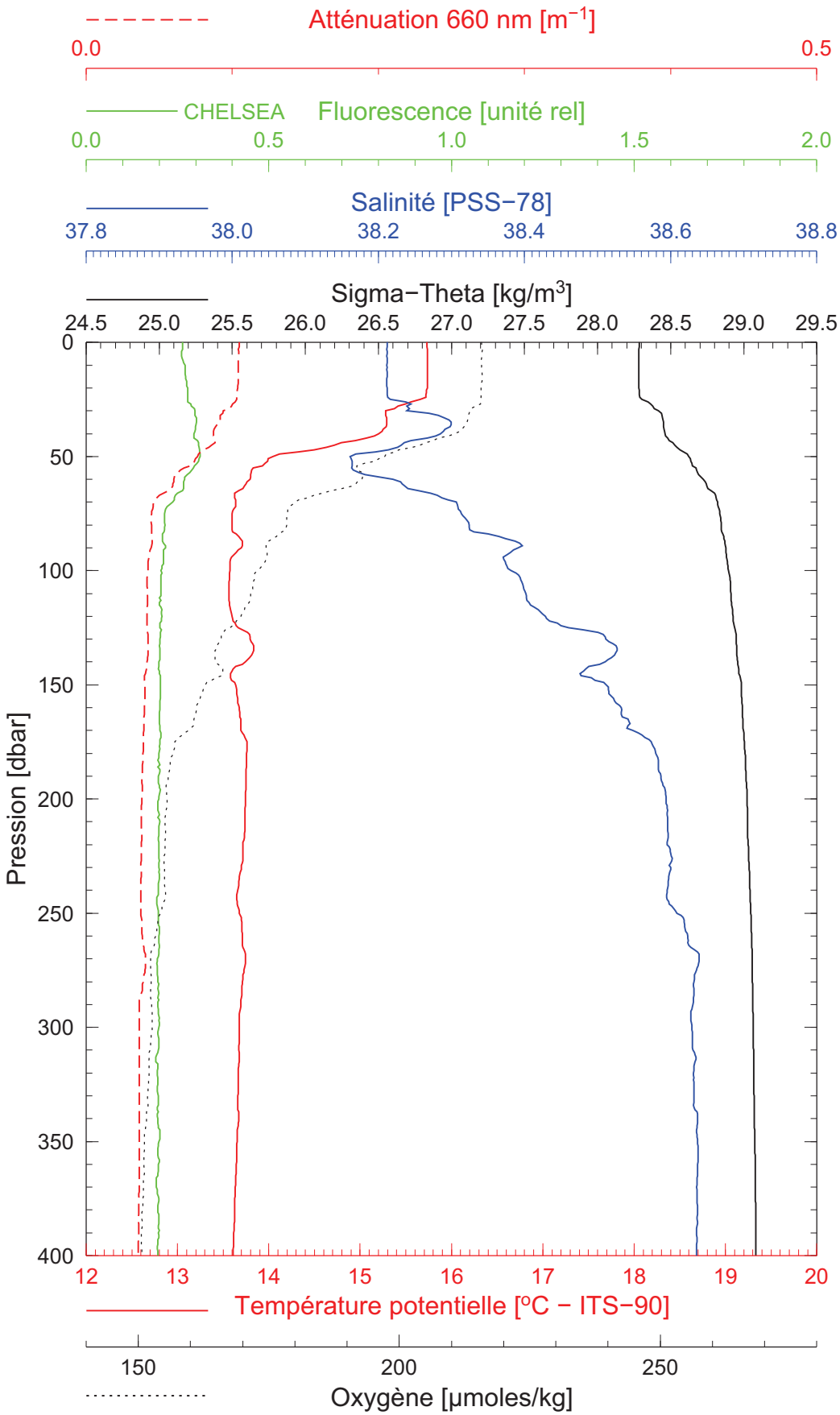


Date *14/12/2015* *Latitude* *43°22.012 N*

Heure déb *10h 39min [TU]* *Longitude* *07°53.680 E*

BOUSSOLE 166 **14/12/2015** **BOUS151214_02**

BOUS010



Date *14/12/2015* *Latitude* *43°21.988 N*

Heure déb *12h 20min [TU]* *Longitude* *07°53.686 E*