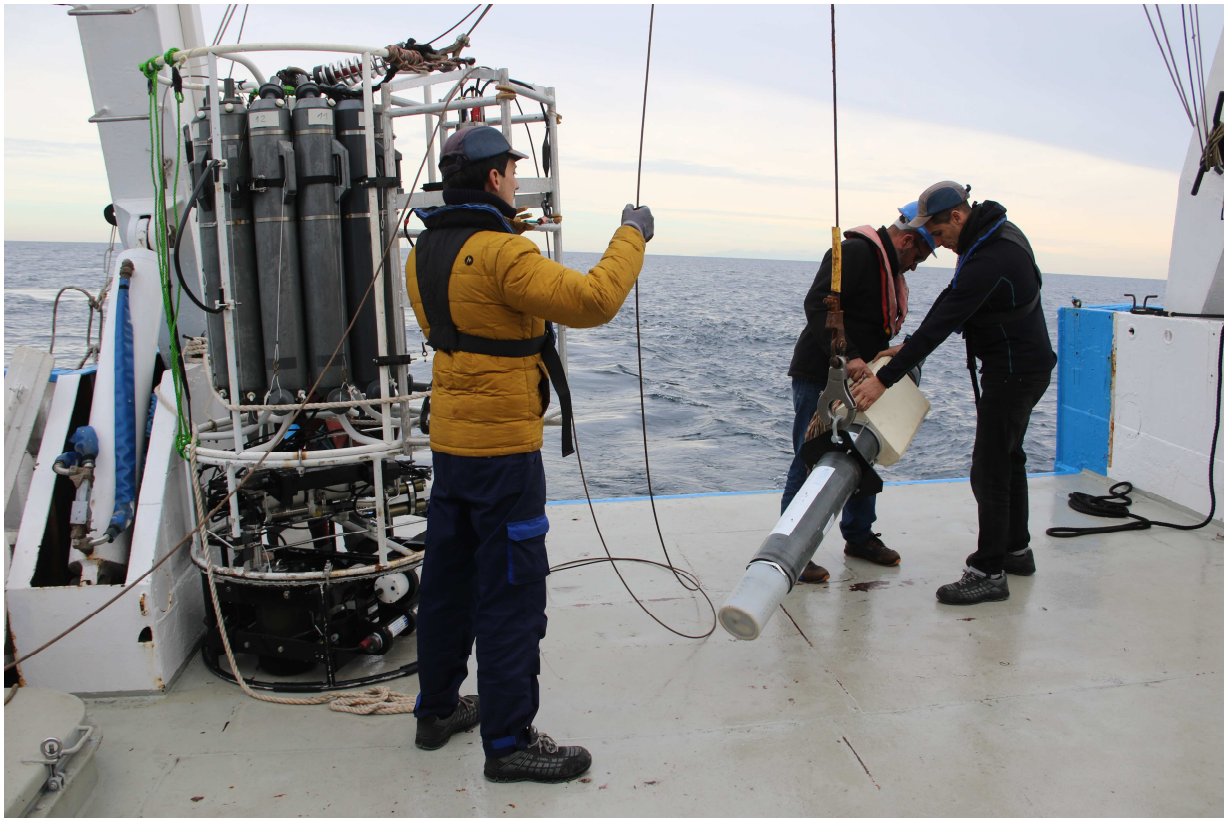
BOUSSOLE Monthly Cruise Report

Cruise 215
December 09-11, 2019

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

Science Personnel: Emilie Diamond, Melek Golbol, Larry Georges, Loic Le Ster, Alice Pierret and Eduardo Soto Garcia.

Laboratoire d'Océanographie de Villefranche (LOV), 06230 Villefranche-sur-Mer, France



The CTD Rosette with IOP package and UVP (on left) and the deployment of a profiling float (on right) from the deck of the *Téthys II*.

BOUSSOLE project

ESA/ESRIN contract N° 4000119096/17/I-BG

December 19, 2019

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

Sorbonne Université, France

Institut de la Mer de Villefranche, 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). A CTD cast including a 0.2 µm filter installed on the inlet tube of the a-Sphere is to be performed once per cruise at the BOUSSOLE site for the dissolved matter absorption measurements. This cast will be stopped at ten depths during 2 or 7 min depending on the depths in order to ensure that the integrating cavity of the a-Sphere be completely filled at each of these depths during the ascent of the CTD.

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.

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 (5 m and 10 m) 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 pCO_2 CARIOCA sensors and the two optodes installed on the buoy at 3 m and 10 m.

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

A prototype sensor from Sea-Bird Scientific Company "BBFL2 ECO V2 - B00128" was tested by the *Marine optics and remote sensing group* of the *Laboratoire d'Océanographie de Villefranche* (LOV) in order to check its functioning. It measures Chla and CDOM fluorescence and the backscattering coefficient b_b at 700 nm. It was installed on the CTD Rosette for comparison with the BOUSSOLE main CTD.

A BGC-Argo profiling float (LOVBIO066) was deployed by the Marine optics and remote sensing group of the Laboratoire d'Océanographie de Villefranche (LOV) at the DYFAMED site. This float is equipped with a RemA pack (CDOM and Chla fluorometers, backscattering meter and PAR sensor)

The MOOSE DYFAMED cruise of 12th December was cancelled because of a bad weather forecast, so their operations were performed during the last day of the BOUSSOLE cruise (11th December).

Several CTD beacons equipped with fluorometers that are planned to be deployed on Southern ocean elephant seals by the *Centre d'Etudes Biologiques de Chizé* (CEBC) and *Laboratoire d'Océanographie et du Climat*

(LOCEAN) were tested during this cruise. They were installed on the CTD Rosette for comparison with the BOUSSOLE main CTD. The UVP (Underwater Vision Profiler) was affixed on the CTD Rosette with a beacon equipped with a micro-sonar in order to compare particulate data from both sensors.

A minute's silence was observed in memory of Didier Le Meur, member of the ship crew, which had passed away last October. Bouquets of flowers were thrown at sea in the vicinity of the BOUSSOLE site.

Cruise Summary

The first and second day of the cruise were canceled because of bad weather. The last day of the cruise was used for CTD casts with water sampling, for optical profiles and for a Secchi disk at the BOUSSOLE site. This day was also used for the deep CTD cast with water sampling and zooplankton net at the DYFAMED site in the frame of the MOOSE program. Diving operations for buoy maintenance were not carried out because the buoy currently does not function. Data acquisition will not resume until replacement of the data acquisition system is possible.

Monday 9 December 2019

Bad weather prevented departure from the Nice harbour.

Tuesday 10 December 2019

Bad weather prevented departure from the Nice harbour.

Wednesday 11 December 2019

The sea state was slight with a light breeze in the morning and a gentle breeze in the afternoon. The sky was overcast and the visibility was excellent. Firstly bouquets of flowers were thrown at sea in the vicinity of the BOUSSOLE site, in the memory of Didier Le Meur. Then 1 CTD cast with water sampling was performed at the BOUSSOLE site. Then the C-OPS was tested in order to check its balance and adjust pitch and roll values during the descent phase. Three C-OPS profiles were then performed. The first and third cast (C-OPS 01 and C-OPS 03) had however to be stopped before completion because clouds appeared during the acquisition and sky conditions became unstable. Further, the communication between the deckbox (deck unit of the C-OPS) and radiometers was lost during the recovery of the C-OPS. The sky conditions finally improved (more stable irradiance), so that a fourth profile was performed and then a CTD cast with water sampling. The communication between the deckbox (deck unit of the C-OPS) and radiometers was however lost again during the recovery of the C-OPS. Before the CTD cast, a cap was put on the Hydroscat-6 for dark measurements and a 0.2 µm filter on the a-Sphere absorption meter for the dissolved matter absorption measurements. This CTD cast was stopped at 7 depths during the ascent of the CTD. Finally, a Secchi disk was performed at the BOUSSOLE site before the departure to the DYFAMED site. When arrived at DYFAMED, the profiling float was deployed and finally, the deep CTD cast and a zooplankton net were performed before returning to the Nice harbour. During the deployment of the plankton net, the cable came out of its pulley when the net was at 96 m depth and was therefore immediately recovered manually.

Pictures taken during this cruise can be found at:
https://photos.app.goo.gl/mepQZJZpq5B7deSJA

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 9 December 2019

Bad weather prevented departure from the Nice harbour.

Tuesday 10 December 2019

Bad weather prevented departure from the Nice harbour.

Wednesday 11 December 2019 (UTC)

People on board: Emilie Diamond, Larry Georges, Melek Golbol, Loïc Le Ster (engineer at LOCEAN), Alice Pierret and Eduardo Soto Garcia.

0615 Departure from the Nice harbour.
0940 Arrival at the BOUSSOLE site.
0945 Minute's silence for Didier Le Meur.
1000 CTD 01, 400 m with water sampling at 400, 200, 150, 80, 70, 60, 50, 40, 30, 20 and 10 m for HPLC and a.
1050 C-OPS 01, 02, 03.
1145 C-OPS 04.
1215 CTD 02, 400 m with water sampling at 10 and 5 m for HPLC, a_p, O_2, TA/TC and TSM (with cap on the HS6 and a 0.2 µm filter on a-Sphere and with 2 minutes stop at 400, 150, 5m and 7 minutes stop at 80, 50, 30, 10 m).
1325 Secchi disk 01, 16m.
1330 Departure to the DYFAMED site.
1345 Arrival to DYFAMED site.
1350 Deployment of profiling float: 43°24,750' N, 07°51,536'E.
1415 CTD MOOSE 137 with water sampling (MOOSE program).
1605 Zooplankton net, 96 m (MOOSE program)
1630 Departure to the Nice harbour.
1930 Arrival to the Nice harbour.

Problems identified during the cruise

- 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 L_u sensor instead of a E_u one**.**

- The GPS of the C-OPS system did not work. It was sent to Biospherical for repair.

- The connection between the deckbox (deck unit of the C-OPS) and radiometers was lost during the recovery of the C-OPS. It appeared that the connections between the C-OPS radiometers Y-cable and the sea cable was flooded. The sea cable was a new one and it had never been used with this C-OPS system. The connector of the sea cable was not compatible with the connector of the Y-cable of this C-OPS system.

- CTD 01: The Niskin bottle #12 (5m) was empty so this depth was sampled again during CTD 02 cast

- Because of a lack of time due to an unusually loaded program (BOUSSOLE and DYFAMED operations combined the same day), the CTD 02 cast was stopped only at 7 depths (400, 150, 80, 50, 30, 10 and 5m) during the ascent of the CTD.

- During the deployment of the zooplankton net during DYFAMED operations, the cable came out of its pulley when the net was at 96 m depth and was therefore immediately recovered manually.

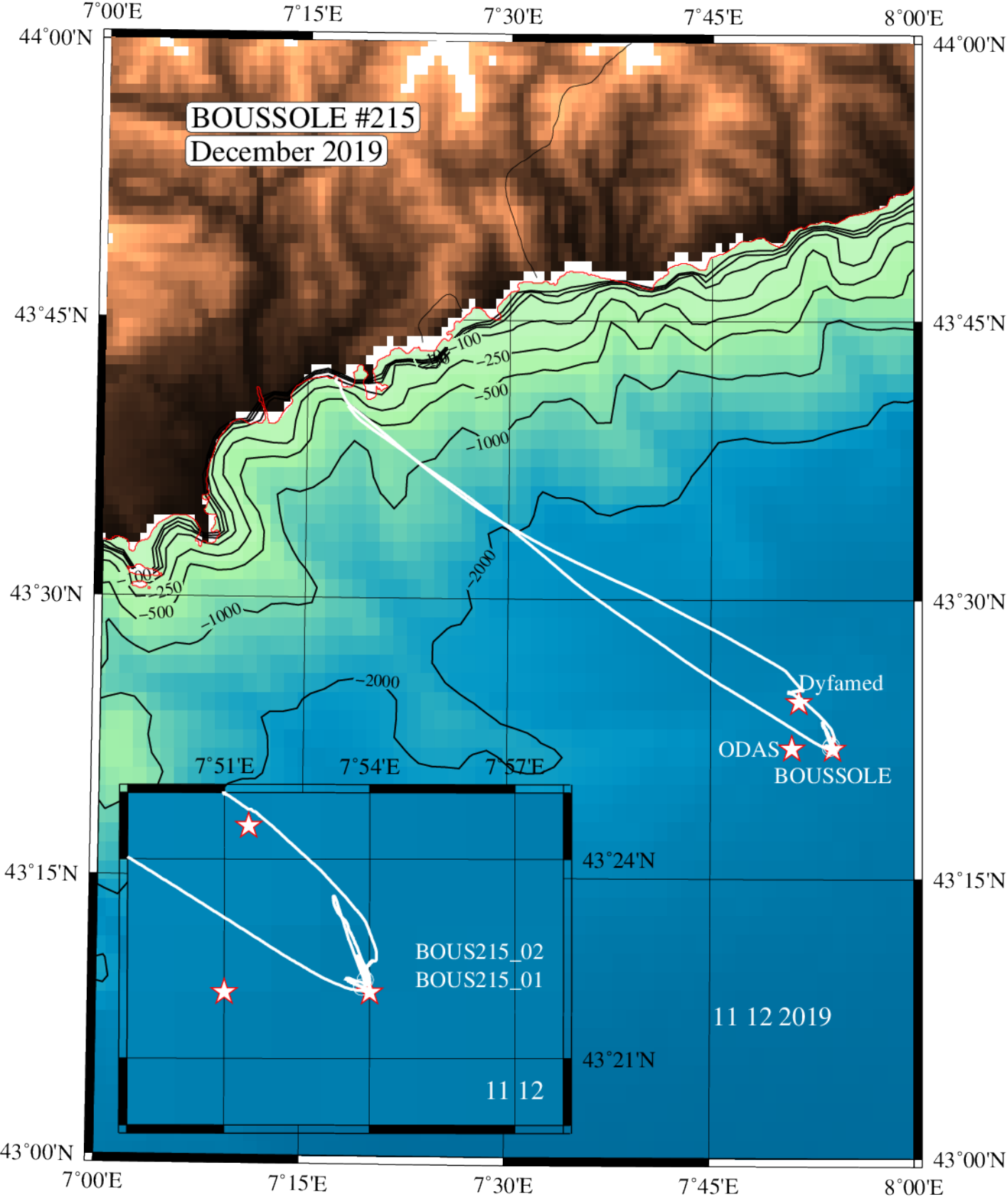
- The weather station of the *Téthys II* did not function correctly. There were missing parameters (air temperature and hygrometry).

- Diving and maintenance operations of the buoy were not carried out because the buoy currently does not function. Data acquisition will not resume until replacement of the data acquisition system is possible.

Appendices

Cruise Summary Table for Boussole 215

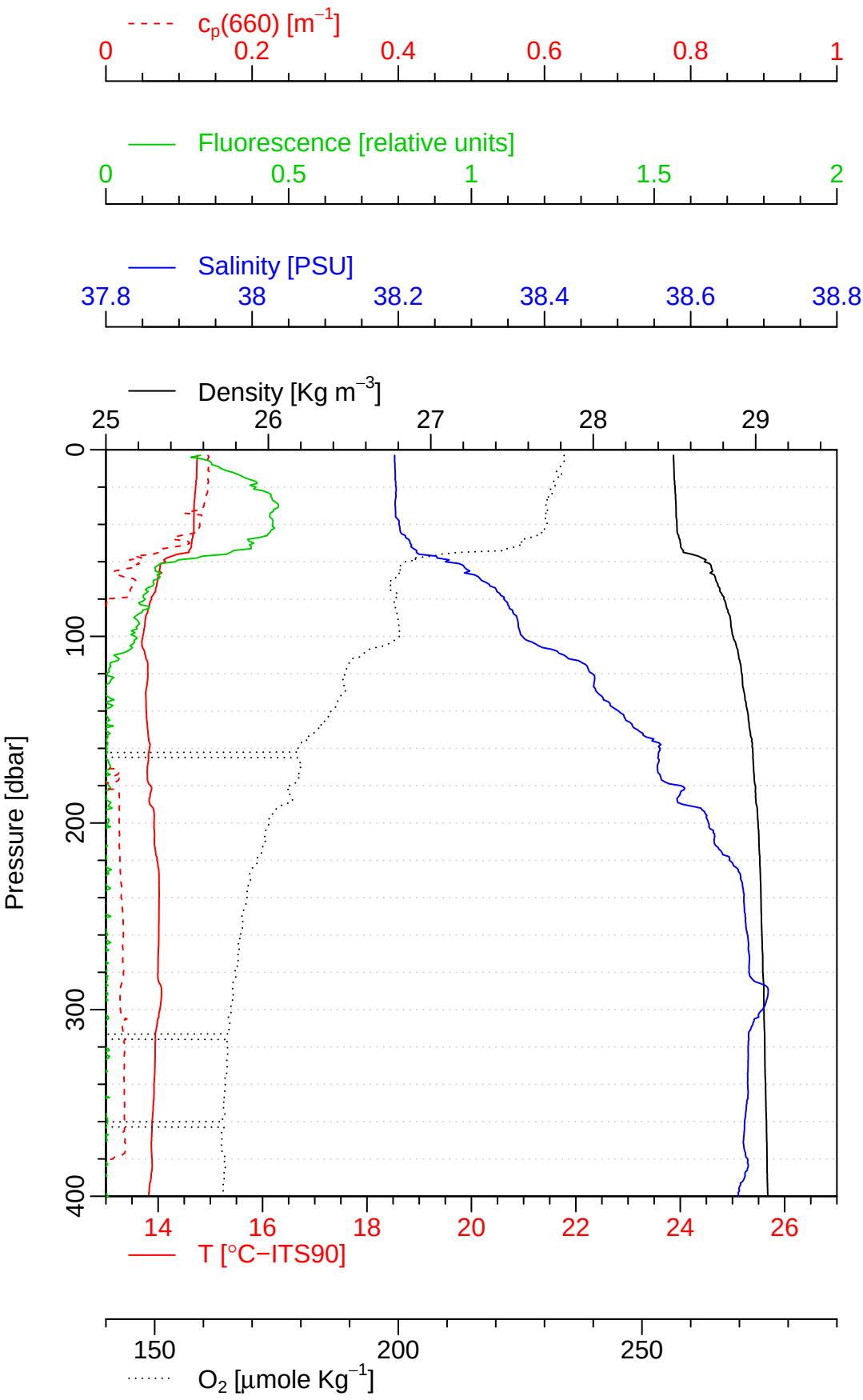
Date	Black names	Profile names	CTD notées	Other sensors	Start Time	Duration	Depth max	Latitude (N)		longitude					Weather							Sea		
	(file ext: ".raw")	(file extension: ".raw")			GMT (hour.min)	(min.sec)	(meter)	(Degree)	(Minute)	(Degree)	(Minute)	Sky	Clouds	Quantity (#/8)	Wind sp. (kn)	Wind dir.	Atm. Pressure (hPa)	Humidity (%)	Visibility	T air	T water	Sea	Swell H (m)	Swell dir.	Whitecaps
09/12/19	Bad weather																							
10/12/19	Bad weather																							
11/12/19			BOUS215_01	HPLC & ap	10:00	32:00	400	43	22.076	7	53.836	blue		2	2	219	1016.9	43		14.0	14.79	slight			
		bou_c-ops_191211_1037_001_data.csv			10:51	1:28	31	43	22.495	7	53.833	overcast	Cc,Cs	7	3	168	1015.7	48	excellent	13.7		slight	0.7		No
		bou_c-ops_191211_1037_002_data.csv			10:57	4:18	102	43	22.602	7	53.780	overcast	Cc,Cs	7	3	168	1015.7	48	excellent	13.7		slight	0.7		No
		bou_c-ops_191211_1037_003_data.csv			11:10	1:02	22	43	22.913	7	53.586	overcast	Cc,Cs	7	3	168	1015.7	48	excellent	13.7		slight	0.7		No
		bou_c-ops_191211_1129_001_data.csv			11:46	4:05	99	43	22.208	7	53.925	overcast	Cc,Cs	8	6	202	1014.9	48	excellent	13.7		slight	0.6		No
			BOUS215_02	O2, TA/TC & TSM	12:16	1:04:00	400	43	22.182	7	53.910	overcast		7	7	217	1014.4	48		13.5	14.84	slight	0.7		
				Secchi01	13:25	4:00	16	43	22	7	54	overcast							excellent			slight			

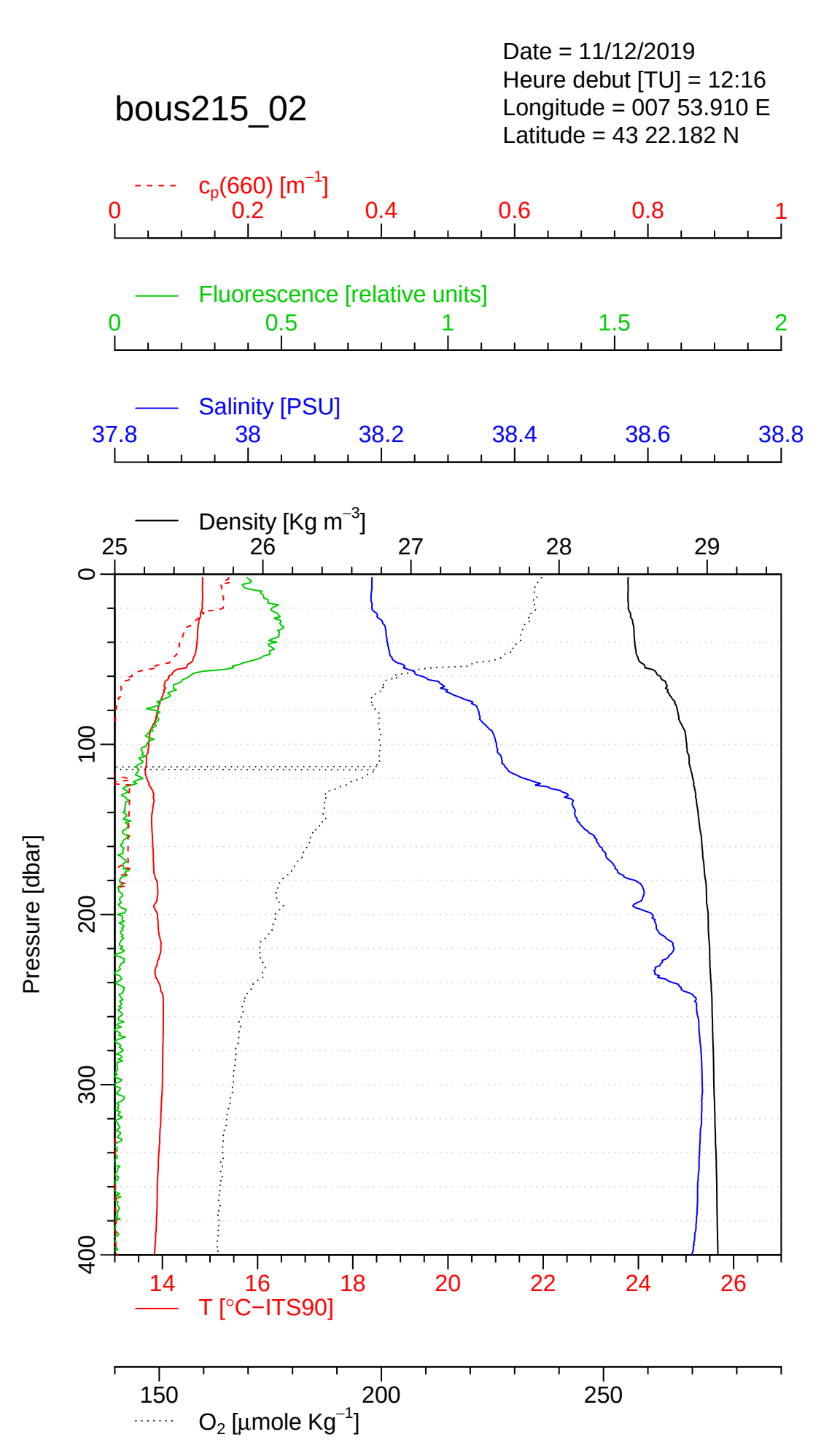


GMT 2020 Feb 01 04:47:50

bous215_01

Date = 11/12/2019
Heure debut [TU] = 10:00
Longitude = 007 53.836 E
Latitude = 43 22.076 N




bous215_02
Date = 11/12/2019
Heure debut [TU] = 12:16
Longitude = 007 53.910 E
Latitude = 43 22.182 N
cp(660) [m−1]
0
0.2
0.4
0.6
0.8
1
Fluorescence [relative units]
0
0.5
1
1.5
2
Salinity [PSU]
37.8
38
38.2
38.4
38.6
38.8
Density [Kg m−3]
25
26
27
28
29
Pressure [dbar]
0
100
200
300
400
14
16
18
20
22
24
26
T [°C−ITS90]
150
200
250
O2 [µmole Kg−1]