BOUSSOLE Monthly Cruise Report

Cruise 232
July 12-13, 2021

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Vessel: R/V Téthys II
(Captain: Arnaud Behoteguy)

Science Personnel: Cyril Debost, Emilie Diamond Riquier, Céline Dimier, Bastien Gaucher, Melek Golbol and Flavien Petit.

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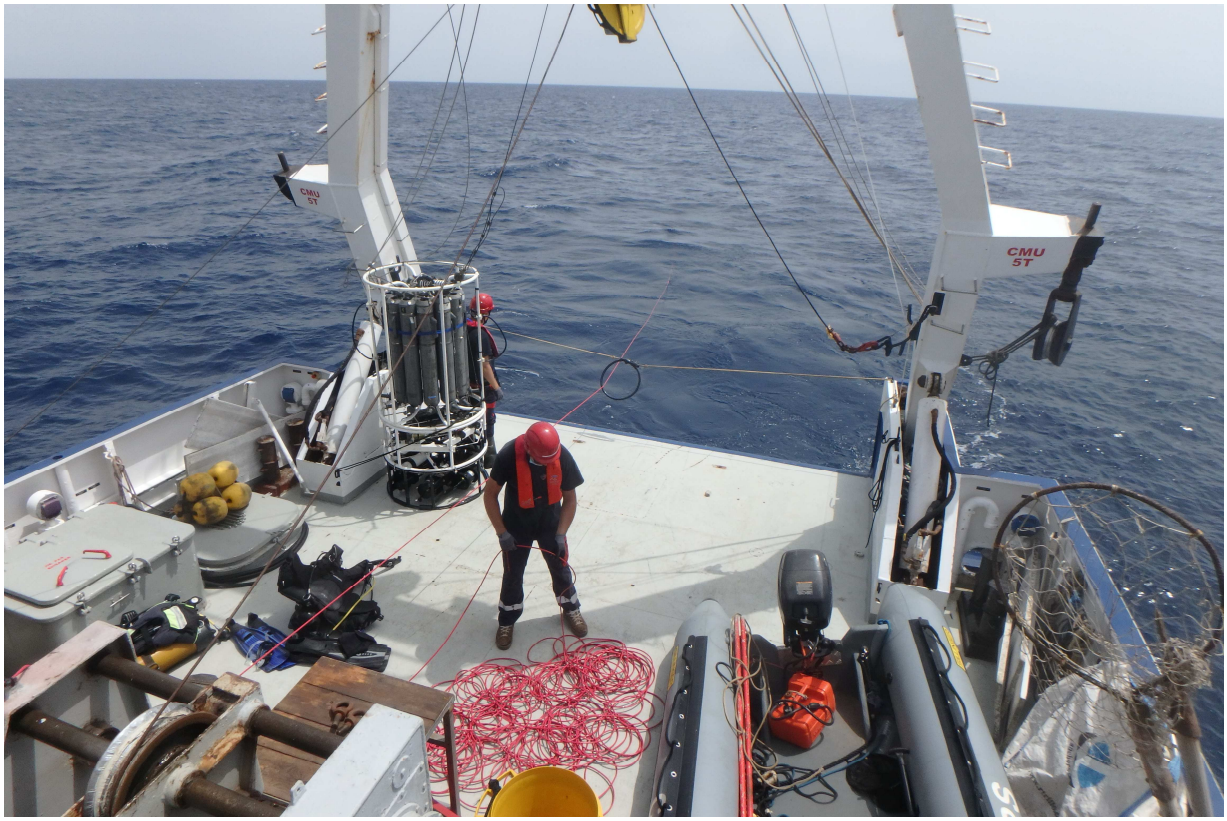

Recovery of the Biospherical COPS (Compact Optical Profiling System) after its deployment at the BOUSSOLE site.

BOUSSOLE project

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

July 30, 2021

Foreword

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

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European Space Agency

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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), handheld CIMEL sun photometer measurements are to be performed consecutively where possible with C-OPS profiles. If sea conditions are poor but sky is good, handheld 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 replicate 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 5 m depth for dissolved oxygen (DO), total alkalinity (TA) and total inorganic carbon (TC) analysis (from March 2014). 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.
Water samples are to be collected at four depths for metagenomic analyses of different types of Synechococcus, cytometry and nutrients (from March 2020). This operation is part of the EFFICACY ANR project in collaboration with the *Roscoff Biological Station.* The aim is to study the distribution of different types of Synechococcus populations characterized by distinct pigmentation and adaptation to the colour of light. It includes two years of cytometry and metagenomic sampling at the BOUSSOLE site.

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

Seawater is to be sampled at 3 depths for micro-, nano- and pico-phytoplankton analysis by microscopy and cytometry. This operation is part of the OBOO (*From Optics to Biodiversity in the world Open Oceans: application to BGC-Argo floats*) LEFE-CYBER (*Les Enveloppes Fluides et l'Environnement – CYcles Biogéochimiques, Environnement et Ressources*) project of the *Marine optics and remote sensing group* of the *Laboratoire d'Océanographie de Villefranche (LOV).* In addition, two sensors were added to the Rosette CTD from September 2020 in the frame of this project: an Eco FLBB2 sensor that measures fluorescence (excitation at 470 nm, emission at 695 nm) and backscattering at 700 nm and an Eco 3X1M sensor that measures multispectral fluorescence (excitation at 440, 470 et 532 nm, emission at 695 nm).

The "MOOSE DYFAMED" cruise scheduled for 14th July was cancelled because of bad weather forecasts, so their operations were performed during the BOUSSOLE cruise.

The buoy is currently not working. The problem could maybe be solved via maintenance on the DACNET. So, the DACNET was recovered from the buoy by the divers in order to perform maintenance on it and tests in the lab.

Cruise Summary

Only the first day was used for BOUSSOLE and DYFAMED operations due to bad weather forecasts the next day. It was used for diving and buoy maintenance operations, for a Secchi disk, for CTD casts with water sampling, for optical profiles, for sun photometer measurements (CIMEL CE317) at the BOUSSOLE site, and for DYFAMED operations.

Monday 12 July 2021

The sea state was slight with a moderate to fresh breeze. The sky was overcast then blue, the visibility was medium. Firstly, divers went at sea to switch off the buoy battery and the two DL3 (data loggers) at 4 m and 9 m and to recover the DACNET. In the meantime, the Junction Box and the DL3 at surface were switched off at the top of the buoy. It appeared on data downloaded during a previous cruise that the CTD located at 9 m was not working, so divers checked the cable of the CTD from the instrument connector up to the surface: nothing unusual was reported. They also cleaned the instruments.
In the meantime, a Secchi disk was performed at the BOUSSOLE site. Then a CTD cast with water sampling and a cap put on the backscattering meter for dark measurements and three C-OPS profiles were performed at the BOUSSOLE site. Then three CIMEL measurements and two CTD casts with water sampling were performed. Finally, we went at the DYFAMED site to perform MOOSE operations: zooplankton nets and a deep CTD cast with water sampling before returning to the Nice harbour.

Tuesday 13 July 2021

Bad weather prevented departure from the Nice harbour.

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

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 12 July 2021 (UTC)

People on board: Cyril Debost (diver), Emilie Diamond Riquier, Céline Dimier, Bastien Gaucher (diver), Melek Golbol and Flavien Petit.

0545 Departure to the BOUSSOLE site.
0900 Arrival at the BOUSSOLE site.
0910 Diving and buoy maintenance operations (recovery of the DACNET, cleaning and CTD cable checking).
1010 Secchi 01, 18 m.
1100 CTD 01, 300 m with water sampling at 51, 42 and 4m for TSM, O_2, TA/TC and phytoplankton microscopy, cytometry, PIC, POC, HPLC (with cap on the HS6).
1155 C-OPS 01, 02, 03.
1250 CTD 02, 400 m with water sampling at 400, 200, 150, 80, 70, 60, 50, 40, 30, 20, 10 and 5m for HPLC and $a_{p.}$
1315 CIMEL 01, 02, 03.
1350 CTD 03, 100 m with water sampling at 60, 40, 20 and 5 m for metagenomic, cytometry and nutrients analyses.
1410 Departure to the DYFAMED station.
1430 Arrival to the DYFAMED station.
1450 Zooplankton nets: failed.

1520 CTD MOOSE 153, 2000 m.
1650 Departure to the Nice harbour.
1945 Arrival to the Nice harbour.

Tuesday 13 July 2021

Bad weather prevented departure from the Nice harbour.

Problems identified during the cruise

- We had a problem with the dinghy during its first launch for diving operations: the choke was blocked, so the engine stalled when starting. The dinghy was put back on board and repaired. Then it was launched again and worked without any problem.

- Because of the lack of time due essentially to bad weather, it was not possible to perform the CTD cast including a 0.2 µm filter installed on the inlet tube of the a-Sphere for the dissolved matter absorption measurements.

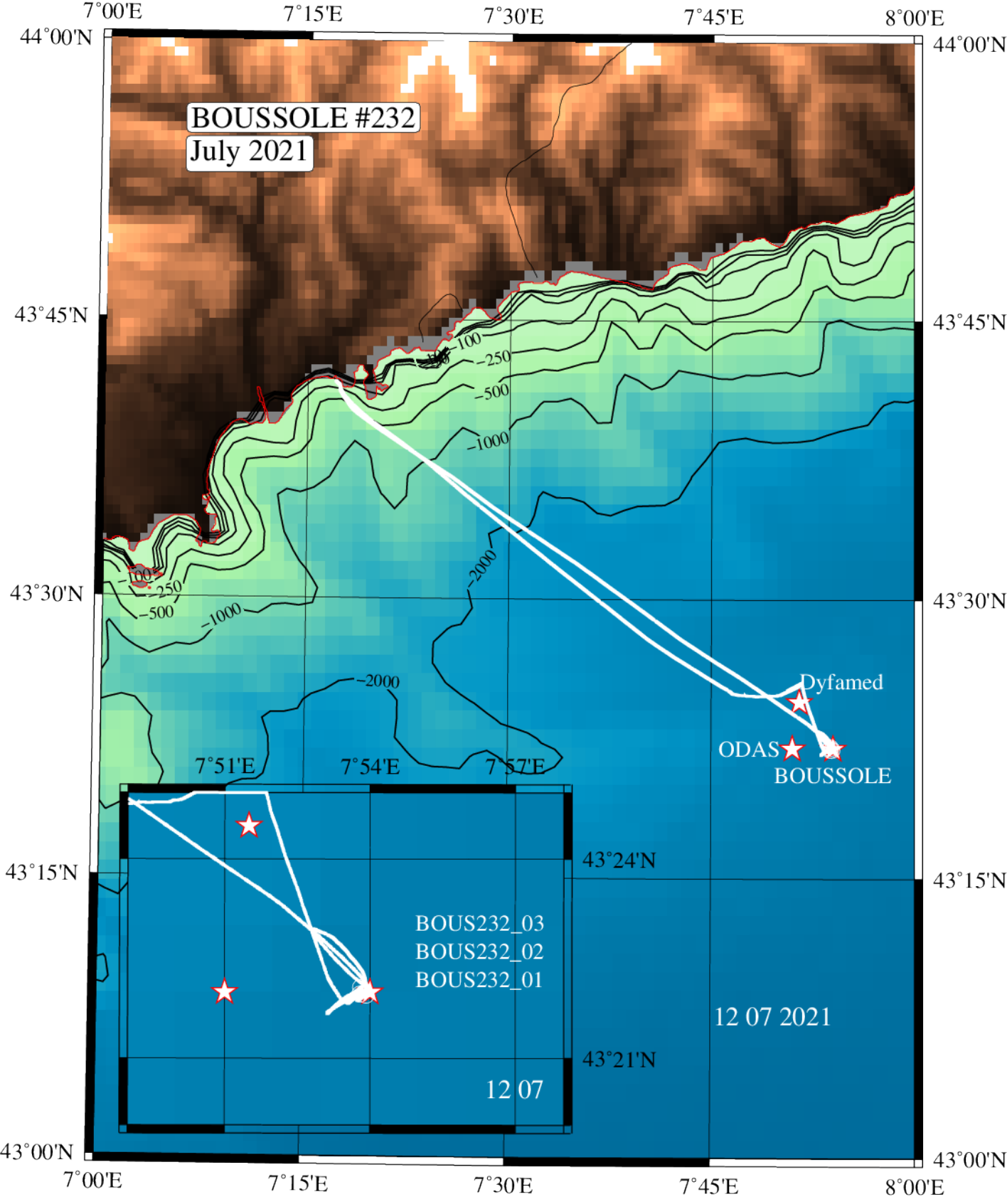
- The peristaltic pump for the metagenomic analyses stopped working during the filtrations. It was due to an internal electrical problem. The pump was repaired by the chief engineer and then functioned correctly.

- During the deployment of the zooplankton net at 200 m, the cable of the winch came off its pulley at 20 m. This was probably due to the strong wind.

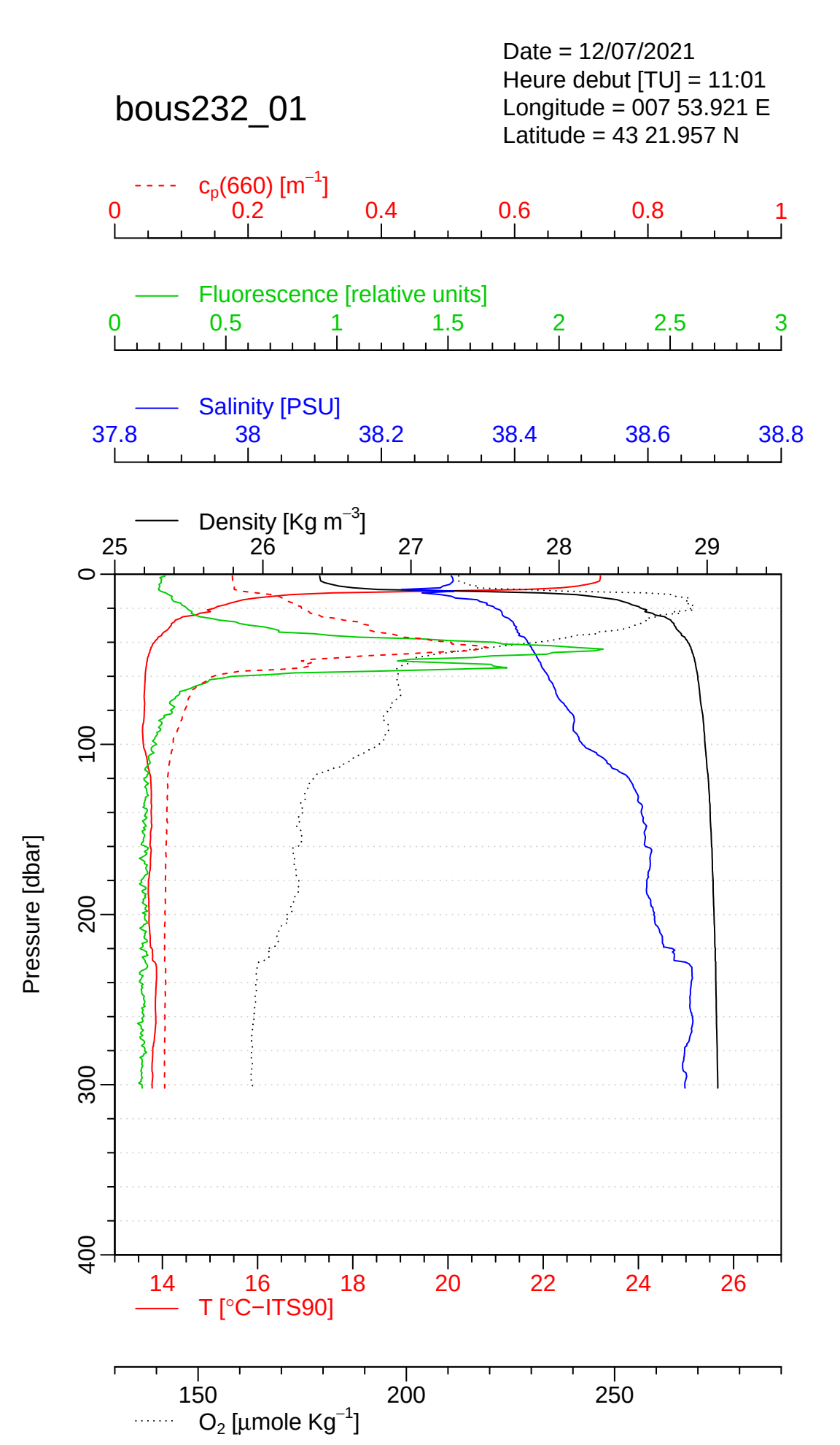
Appendices

Cruise Summary Table for Boussole 232

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)	(hour.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
12/07/21				Secchi 01	10:10	0:04:00	18	43	22	7	54	overcast		7					medium			slight			
			BOUS232_01	TSM, O2, TA/TC & Phytofloat (PIC, POC, Cyto, phyto)	11:01	0:21:00	300	43	21.957	7	53.921	overcast		7	12.5	71	1012.1	82.3		23.4	23.5	sight			
		bou_c-ops_210712_1143_002_data.csv			11:55	0:04:37	113	43	22.346	7	53.803	blue	Ac	1	15.5	57	1011.2	84.8	medium	23		slight	0.7		yes
		bou_c-ops_210712_1143_003_data.csv			12:06	0:03:30	87	43	22.522	7	53.607	blue	None	0	15.5	57	1011.2	84.8	medium	23		slight	0.7		yes
		bou_c-ops_210712_1143_004_data.csv			12:17	0:04:05	102	43	22.746	7	53.325	blue	None	0	15.5	57	1011.2	84.8	medium	23		slight	0.7		yes
			BOUS232_02	HPLC & ap	12:46	0:37:00	400	43	22.068	7	53.81	overcast		7	15	60	1011.1	86		23.8	23.2	slight			
				CIMEL01	13:47	0:05:00		43	22.03	7	53.896	blue		1			1010.8								
				CIMEL02	11:04	0:03:00		43	22.307	7	53.141	blue		1			1010.8								
				CIMEL03	11:07	0:04:00		43	22.307	7	53.141	blue		0			1010.8								
			BOUS232_03	Metagenomics, Cyto & Nutrients	13:49	0:14:00	400	43	21.969	7	53.795	blue		3	16.7	50	1010.8	85		23.6	23.23	slight			
13/07/21	Bad weather																								

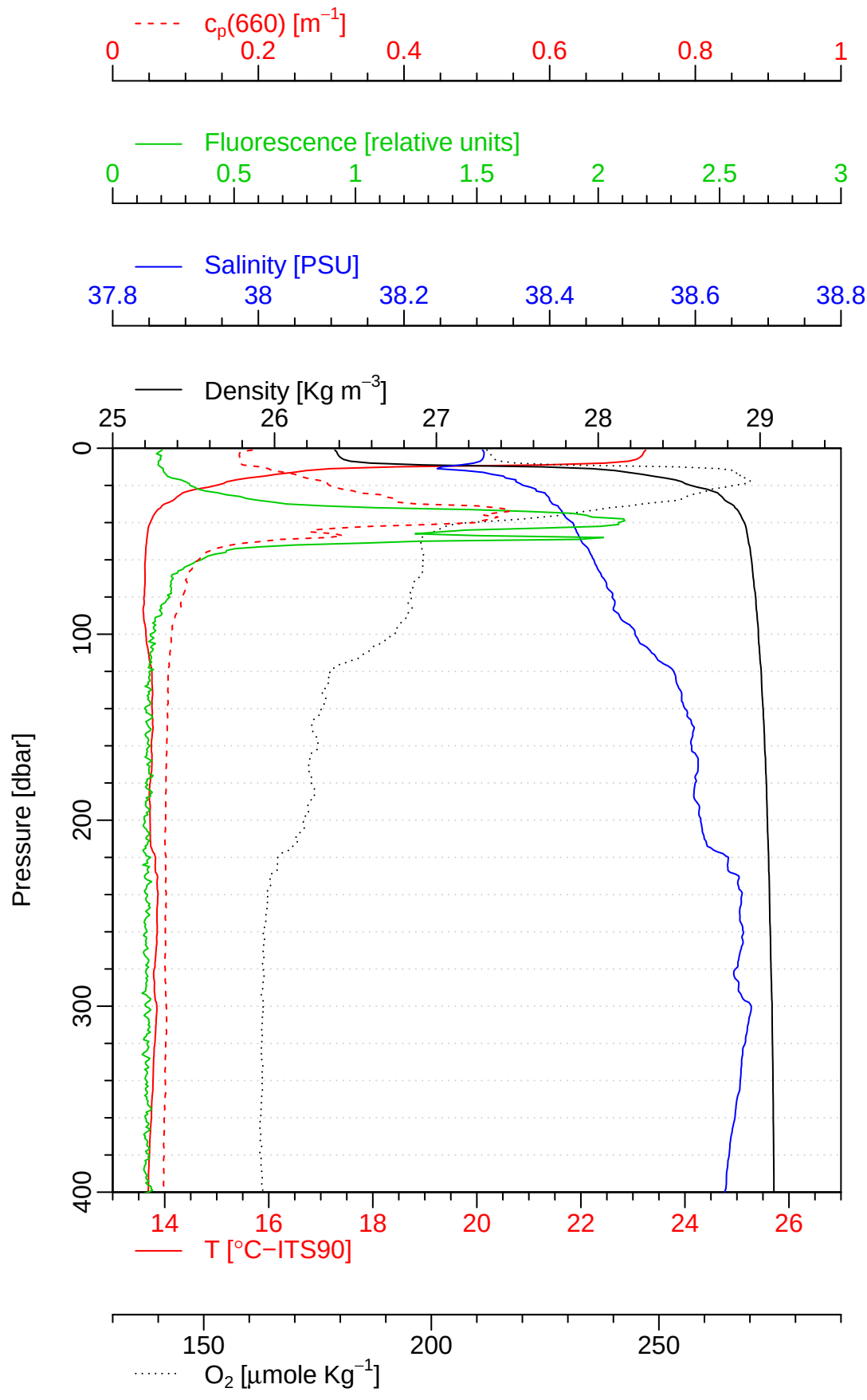


GMT 2021 Sep 24 09:39:57


bous232_01
Date = 12/07/2021
Heure debut [TU] = 11:01
Longitude = 007 53.921 E
Latitude = 43 21.957 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
2.5
3
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]

bous232_02

Date = 12/07/2021
Heure debut [TU] = 12:46
Longitude = 007 53.810 E
Latitude = 43 22.068 N



bous232_03

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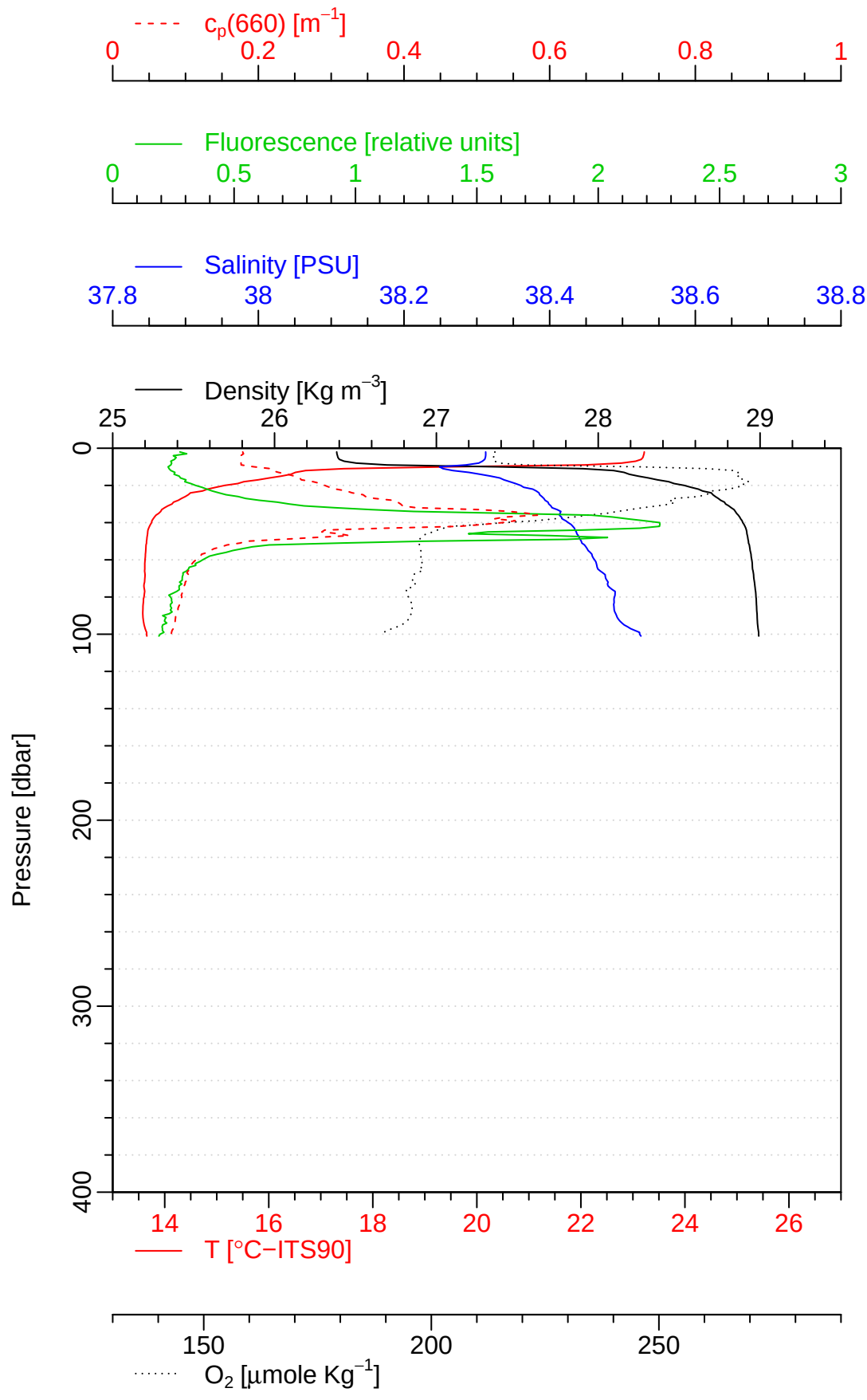
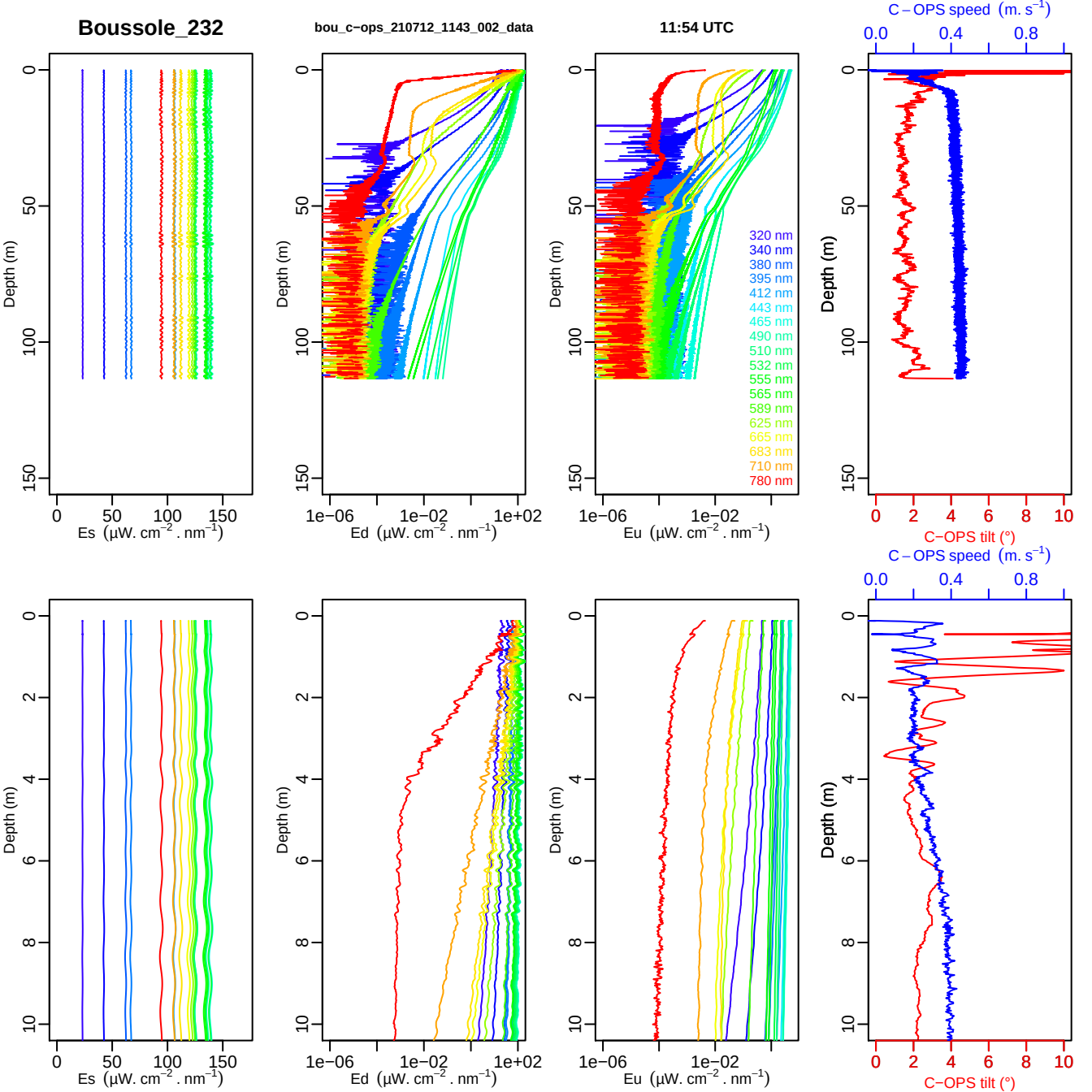
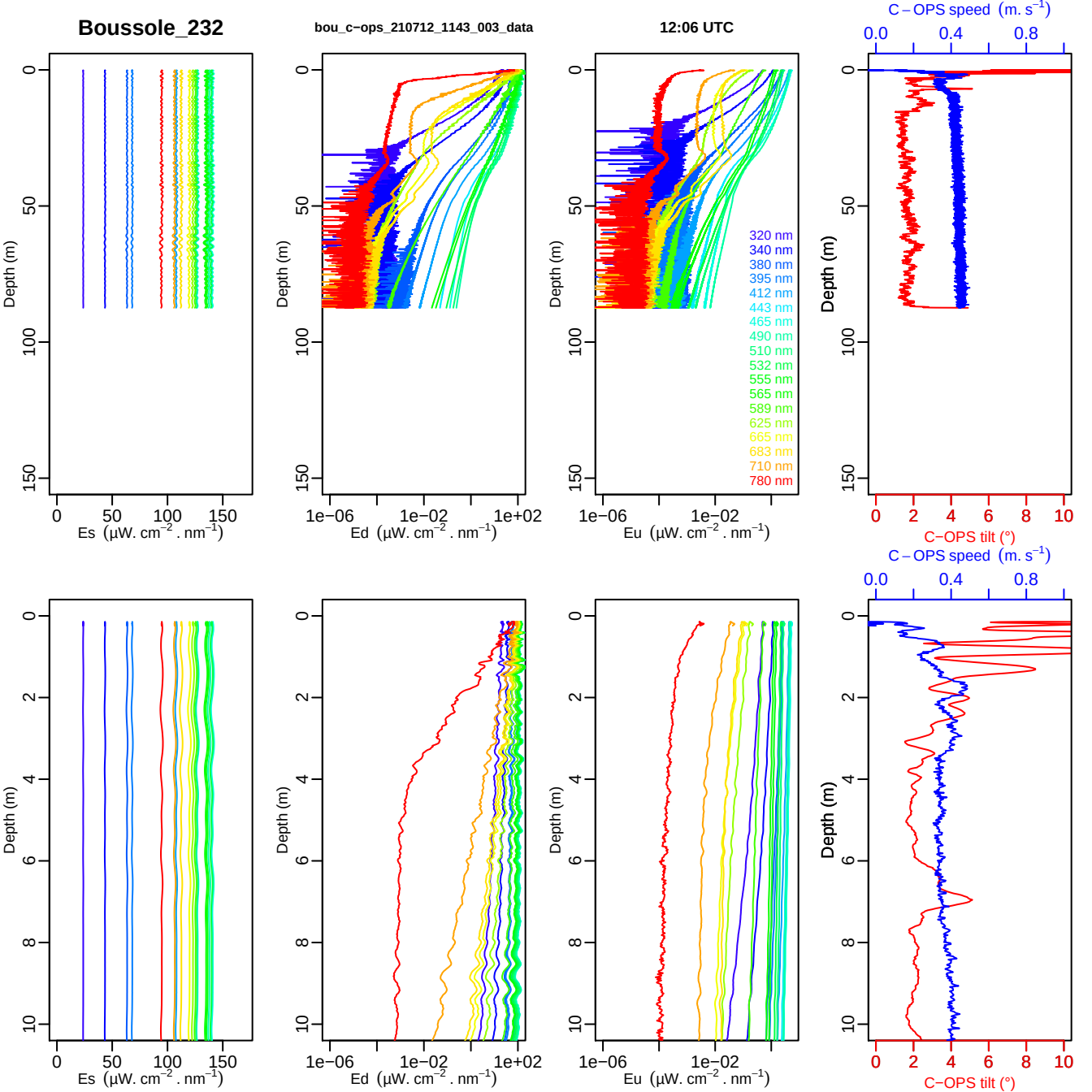
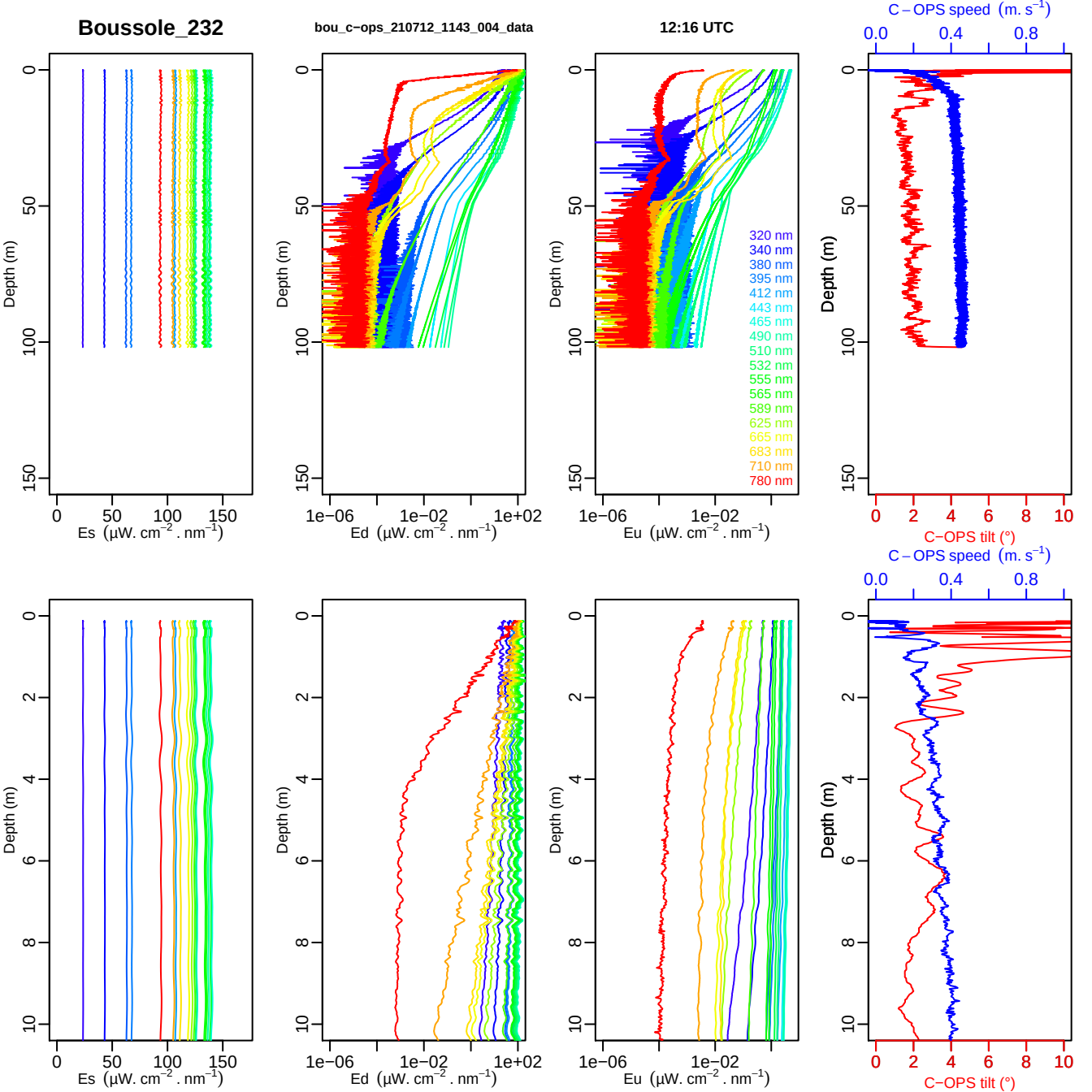
Latitude = 43 21.969 N




Boussole_232
bou_c-ops_210712_1143_002_data
11:54 UTC
C – OPS speed (m. s^{-1})
0.0
0.4
0.8
Depth (m)
0
50
100
150
Es (µW. cm^{-2}. nm^{-1})
Ed (µW. cm^{-2}. nm^{-1})
Eu (µW. cm^{-2}. nm^{-1})
1e−06
1e−02
1e+02
320 nm
340 nm
380 nm
395 nm
412 nm
443 nm
465 nm
490 nm
510 nm
532 nm
555 nm
565 nm
589 nm
625 nm
665 nm
683 nm
710 nm
780 nm
C−OPS tilt (°)
0
2
4
6
8
10


Boussole_232
bou_c−ops_210712_1143_003_data
12:06 UTC
C − OPS speed (m. s−1)
0.0
0.4
0.8
Depth (m)
0
50
100
150
0
50
100
150
Es (µW. cm−2 . nm−1)
1e−06
1e−02
1e+02
Ed (µW. cm−2 . nm−1)
Eu (µW. cm−2 . nm−1)
320 nm
340 nm
380 nm
395 nm
412 nm
443 nm
465 nm
490 nm
510 nm
532 nm
555 nm
565 nm
589 nm
625 nm
665 nm
683 nm
710 nm
780 nm
0
2
4
6
8
10
C−OPS tilt (°)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Es (µW. cm−2 . nm−1)
Ed (µW. cm−2 . nm−1)
Eu (µW. cm−2 . nm−1)
C − OPS speed (m. s−1)
C−OPS tilt (°)
320 nm
340 nm
380 nm
395 nm
412 nm
443 nm
465 nm
490 nm
510 nm
532 nm
555 nm
565 nm
589 nm
625 nm
665 nm
683 nm
710 nm
780 nm