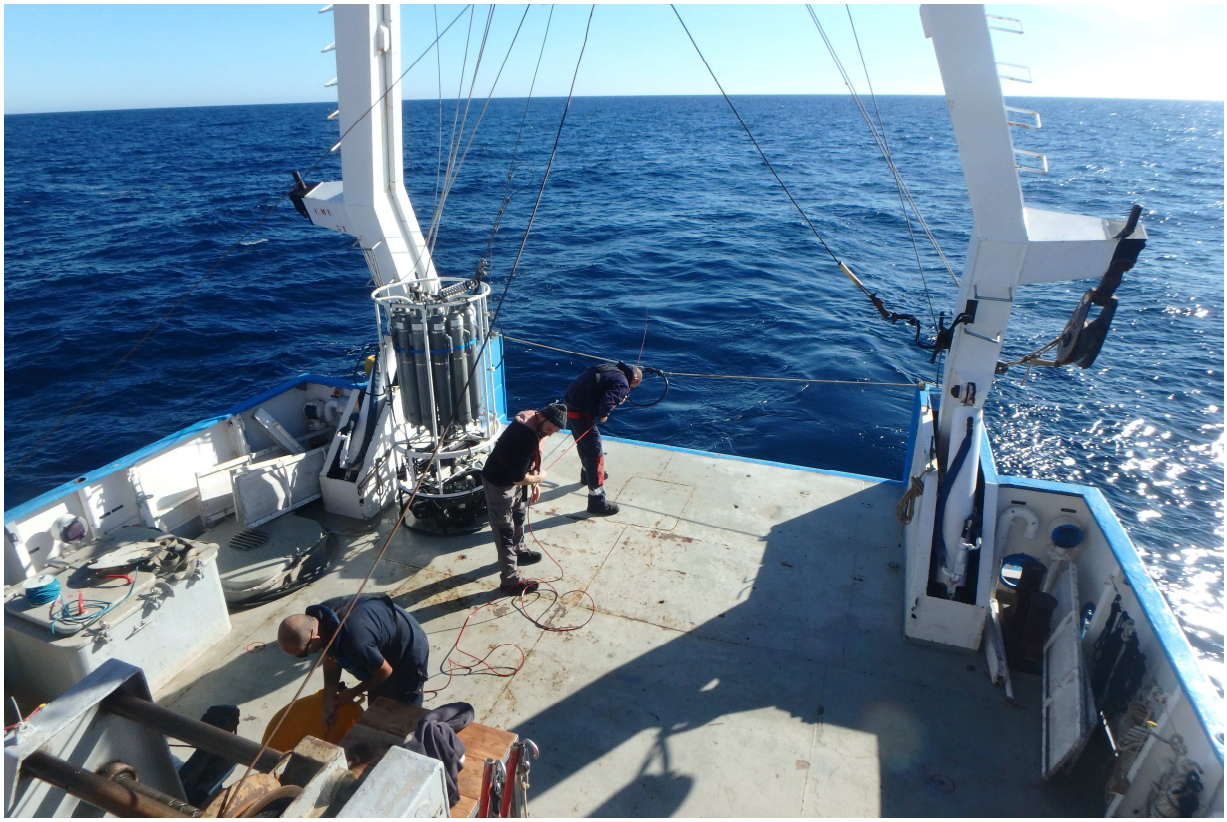
BOUSSOLE Monthly Cruise Report

Cruise 224
November 15-19, 2020

Duty Chief: Melek Golbol (melek.golbol@imev-mer.fr)
Vessel: R/V Téthys II
(Captain: Aurélien Courbe)

Science Personnel: Emilie Diamond Riquier, Melek Golbol, Flavien Petit and Eduardo Soto Garcia.

Institut de la Mer de Villefranche (IMEV), 06230 Villefranche-sur-Mer, France



Recovery of the Biospherical C-OPS free-fall underwater radiometer on the deck of the R/V *Téthys II* after its deployment

BOUSSOLE project

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

November 30, 2020

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). 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.
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 are 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, three sensors were added to the Rosette CTD from September 2020 in the frame of this project: an Eco FLBB2 sensor which measures fluorescence (excitation at 470 nm, emission at 695 nm) and backscattering coefficient at 700 nm, an Eco 3X1M sensor which measures multispectral fluorescence (excitation at 440, 470 et 532 nm, emission at 695 nm) and a C-rover transmissometer which measures attenuation at 650 nm.

Cruise Summary

BOUSSOLE additional operations including sampling in the frame of the OBOO project were performed on November 15th during the DYFAMED cruise day, the day before this BOUSSOLE cruise, for logistical reasons. The first day of BOUSSOLE cruise was cancelled because of bad weather. The two last days were used for optical profiles, CTD casts with water sampling, Secchi disk and CIMEL measurements.

Sunday 15 November 2020 (DYFAMED cruise)

Water sampling and measurements in the frame of the OBOO project were performed during the DYFAMED cruise day for logistical reasons. The sea state was slight with a moderate breeze. The sky was blue. Firstly, a CTD cast with water sampling was performed at the BOUSSOLE site before departure to the DYFAMED site for MOOSE operations (zooplankton nets and deep CTD cast with water sampling).

Tuesday 17 November 2020

Bad weather prevented departure from the Nice harbour.

Wednesday 18 November 2020

The sea state was slight with a moderate to gentle breeze. The sky was blue and the visibility was excellent. Firstly, three C-OPS profiles and two CTD casts with water sampling were performed at the BOUSSOLE site. For this last cast, a cap was put on the backscattering meter for dark measurements and a 0.2µm filter was put on the a-Sphere absorption meter for the dissolved matter absorption measurements. The cast was stopped at 10 depths during the ascent of the CTD. In the meantime, a Secchi disk and 3 CIMEL measurements were performed at the BOUSSOLE site.

Thursday 19 November 2020

The sea state was smooth with a light breeze to light air. The sky was blue and the visibility was excellent. Two CTD casts (400 m and 100 m depths) with water sampling and three C-OPS profiles were performed at the BOUSSOLE site. Then, a Secchi disk and 3 CIMEL measurements were performed at the BOUSSOLE site before returning to the Nice harbour.

Pictures taken during this cruise can be found at:
https://photos.app.goo.gl/VDgHXLBz9o8MHvzp9

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

Cruise Report

Sunday 15 November 2020 (UTC) (DYFAMED cruise)

People on board: Emilie Diamond Riquier, Flavien Petit and Eduardo Soto Garcia.

0730 Departure from the Nice harbour.
1045 Arrival at the BOUSSOLE site.
1050 CTD 01, 200 m with water sampling at 80, 45 and 5m for phytoplankton microscopy, cytometry, PIC, POC and HPLC (OBOO project).
1140 Departure to the DYFAMED site.
1145 Arrival at DYFAMED site.
1145 Zooplankton nets, 100 and 200 m.
1250 Deep CTD cast, MOOSE 146, 2350 m.
1440 Departure to the Nice harbour.
1730 Arrival to the Nice harbour.

Tuesday 17 November 2020 (UTC)

Bad weather prevented departure from the Nice harbour.

Wednesday 18 November 2020 (UTC)

People on board: Melek Golbol and Eduardo Soto Garcia.

0730 Departure from the Nice harbour.
1040 Arrival at the BOUSSOLE site.
1100 C-OPS 01, 02, 03.
1306 CTD 02, 400 m with water sampling at 400, 200, 150, 80, 70, 60, 50, 40, 30, 20, 10 and 5m for HPLC and $a_{p.}$
1305 CTD 03, 400 m with water sampling at 10 and 5 m for O_2, TA/TC and TSM (with cap on the HS6, a 0.2 µm filter on a-Sphere and with 2 minutes stop at 400, 150 m and 7 minutes stop at 80, 60, 50, 40, 30, 20, 10 and 5 m).
1405 Secchi disk 01, 26 m.
1410 CIMEL 01, 02, 03.
1440 Departure to the Nice harbour.
1740 Arrival to the Nice harbour.

Thursday 19 November 2020 (UTC)

People on board: Melek Golbol, Flavien Petit and Eduardo Soto Garcia.

0730 Departure from the Nice harbour.
1040 Arrival at the BOUSSOLE site.
1100 CTD 04, 100 m with water sampling at 60, 40, 20 and 5 m for metagenomic, cytometry and nutrients analyses (EFFICACY project)
1115 C-OPS 04, 05, 06.
1215 CTD 05, 400 m with water sampling at 400, 150, 80, 70, 60, 50, 40, 30, 20, 10 and 5m for HPLC, a_p and TSM.
1225 CIMEL 04, 05, 06.
1250 Secchi disk 02, 21 m.
1300 Departure to the Nice harbour.
1700 Arrival to the Nice harbour.

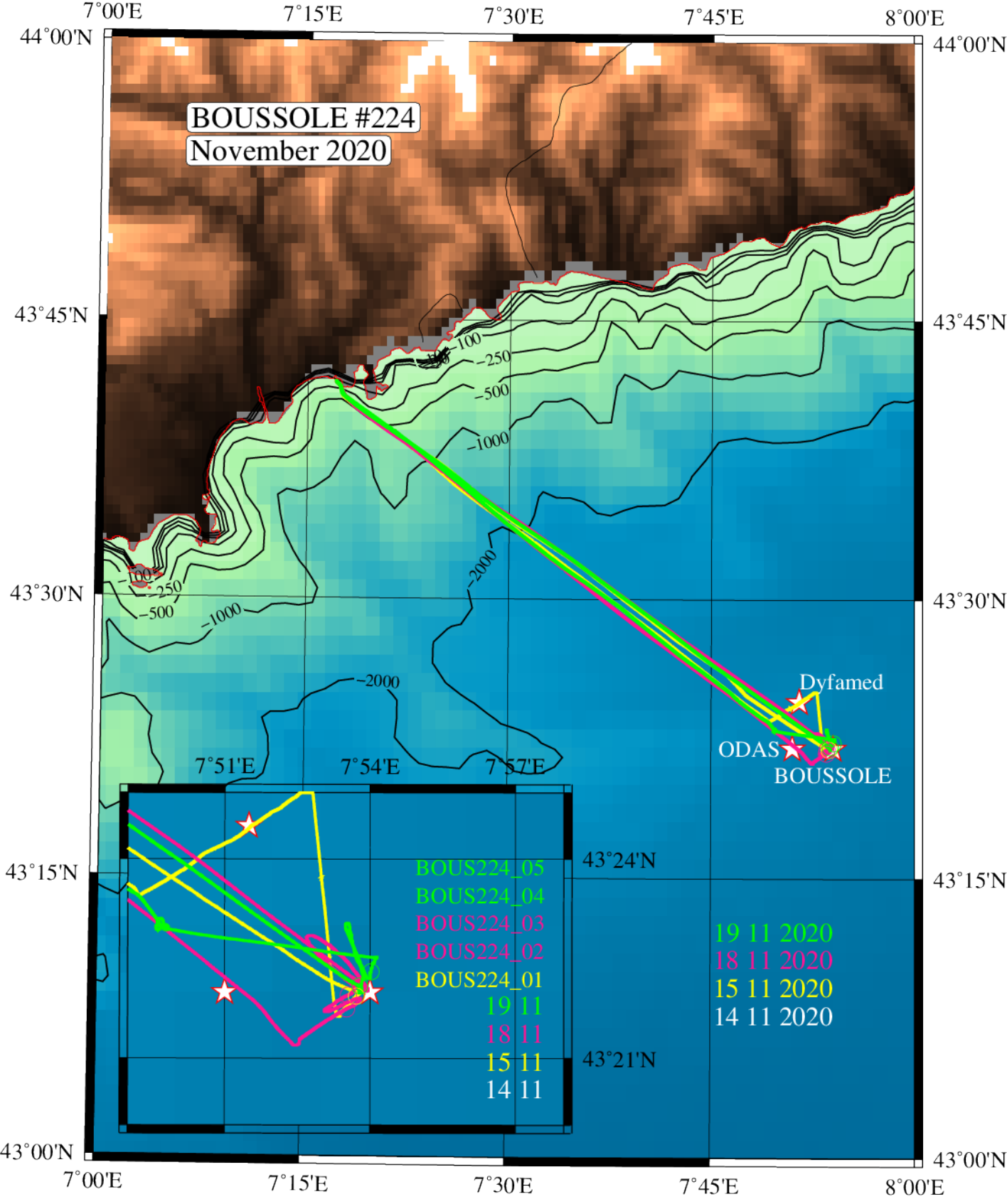
Problems identified during the cruise

- Diving and maintenance operations of the buoy were not carried out because the buoy currently does not function.

Appendices

Cruise Summary Table for Boussole 224

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
15/11/2020 (DYFAMED cruise)			BOUS224_01	Phytofloat (HPLC, PIC, POC, Cyto, phyto)	10:56	15:00	400	43	21.938	7	53.72	blue		2	15	50	1021.2	79		16.2	16.74	slight			
17/11/20	Bad weather																							
18/11/20		bou_c-ops_201118_1044_002_data.csv			10:56	4:21	78	43	22.411	7	53.058	blue	None	0	12	62	1028.5	62	excellent	16.8		slight	0.8		Yes
		bou_c-ops_201118_1044_003_data.csv			11:10	3:07	74	43	22.603	7	53.302	blue	None	0	12	62	1028.5	62	excellent	16.8		slight	0.8		Yes
		bou_c-ops_201118_1044_004_data.csv			11:21	3:25	76	43	22.751	7	53.049	blue	None	0	12	62	1028.5	62	excellent	16.8		slight	0.8		Yes
			BOUS224_02	HPLC & ap	11:54	37:00	400	43	21.955	7	53.556	blue		1	12	65	1027.9	62		16.5	16.688	slight			
			BOUS224_03	TA/TC, O2 & TSM	13:07	1:25:00	400	43	21.744	7	53.518	blue		1	8	8	1027.6	66		16.6	16.655	slight			
				Secchi 01	14:05	4:00	26	43	22	7	54	blue							excellent			slight			
				CIMEL01	14:10	5:00		43	21.412	7	52.792	blue	Ci	1			1027.5								
				CIMEL02	14:15	3:00		43	21.412	7	52.792	blue	Ci	1			1027.5								
				CIMEL03	14:19	4:00		43	21.412	7	52.792	blue	Ci	1			1027.5								
19/11/20			BOUS224_04	Metagenomics, Cyto & Nutrients	10:50	12:00	60	43	22.09	7	53.79	blue		1	5	243	1022.9	71		16.3	16.369	smooth			
		bou_c-ops_201119_1054_001_data.csv			11:14	3:44	89	43	22.354	7	53.818	blue	None	0	3	318	1022.4	73	excellent	16.1		smooth	0.5		No
		bou_c-ops_201119_1054_002_data.csv			11:26	4:14	104	43	22.605	7	53.677	blue	None	0	3	318	1022.4	73	excellent	16.1		smooth	0.5		No
		bou_c-ops_201119_1054_003_data.csv			11:39	4:57	124	43	22.827	7	53.617	blue	None	0	3	318	1022.4	73	excellent	16.1		smooth	0.5		No
			BOUS224_05	HPLC, ap & TSM	12:13	33:00	400	43	22.3	7	54.022	blue		1	2	228	1021.7	72		16.8	16.419	smooth			
				CIMEL04	12:23	3:00		43	22.382	7	54.022	blue	Cu	1			1021.5								
				CIMEL05	12:27	3:00		43	22.382	7	54.022	blue		0			1021.5								
				CIMEL06	12:31	3:00		43	22.382	7	54.022	blue		0			1021.5								
				Secchi 02	12:50	4:00	21	43	22	7	54	blue							excellent			smooth			



GMT 2021 Jan 29 17:12:08

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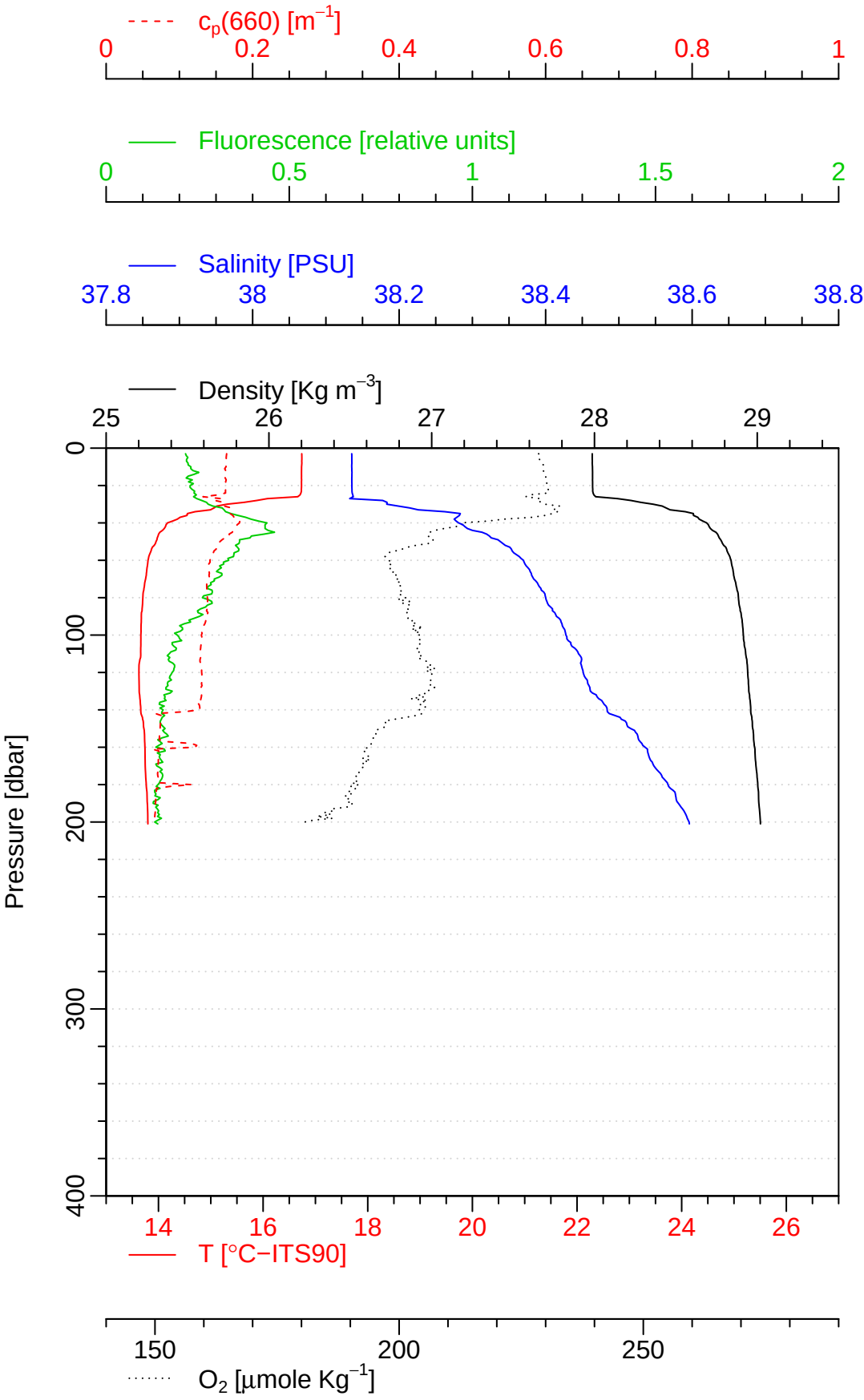
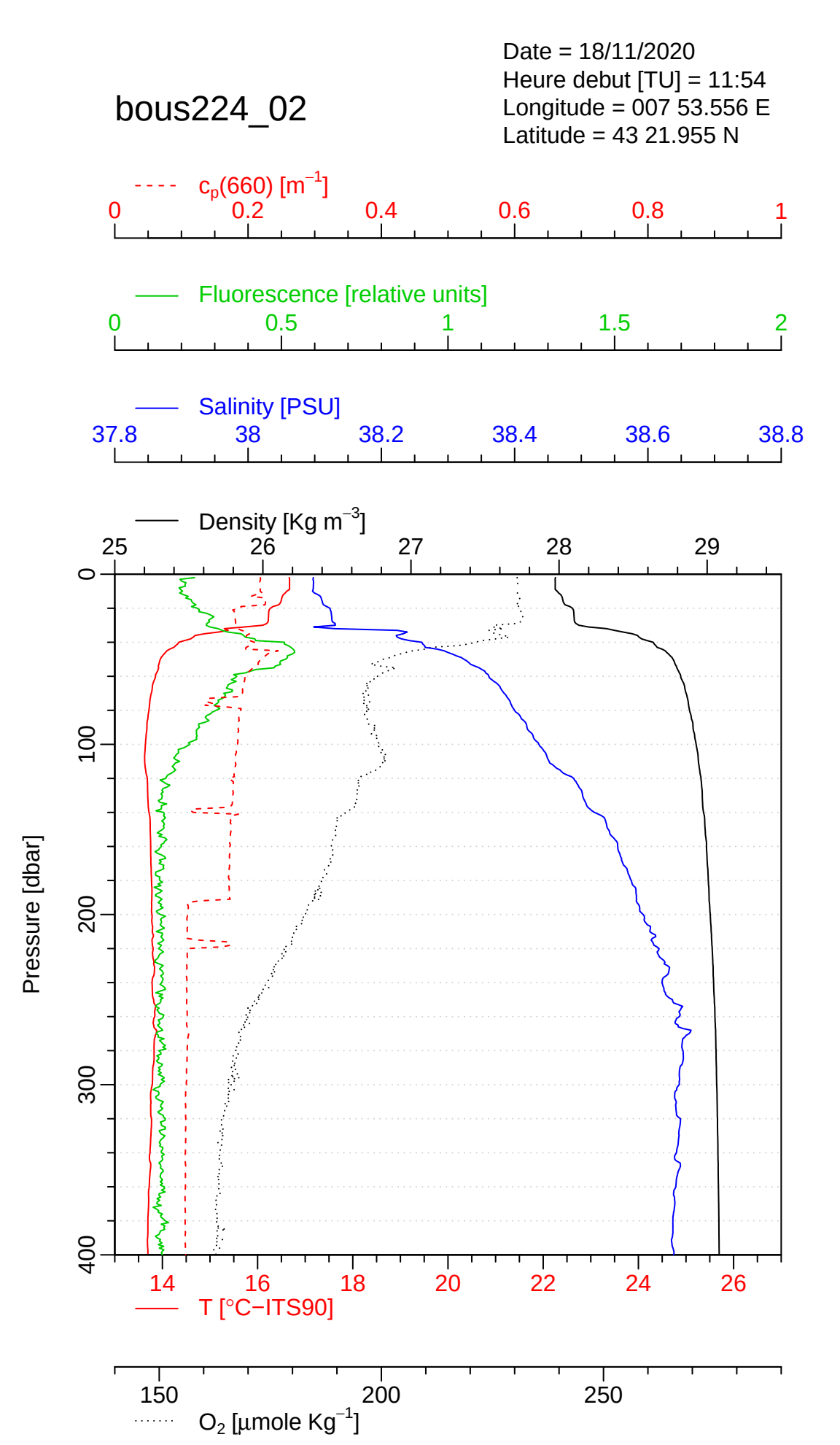
Latitude = 43 21.938 N

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Latitude = 43 21.955 N
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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]

bous224_03

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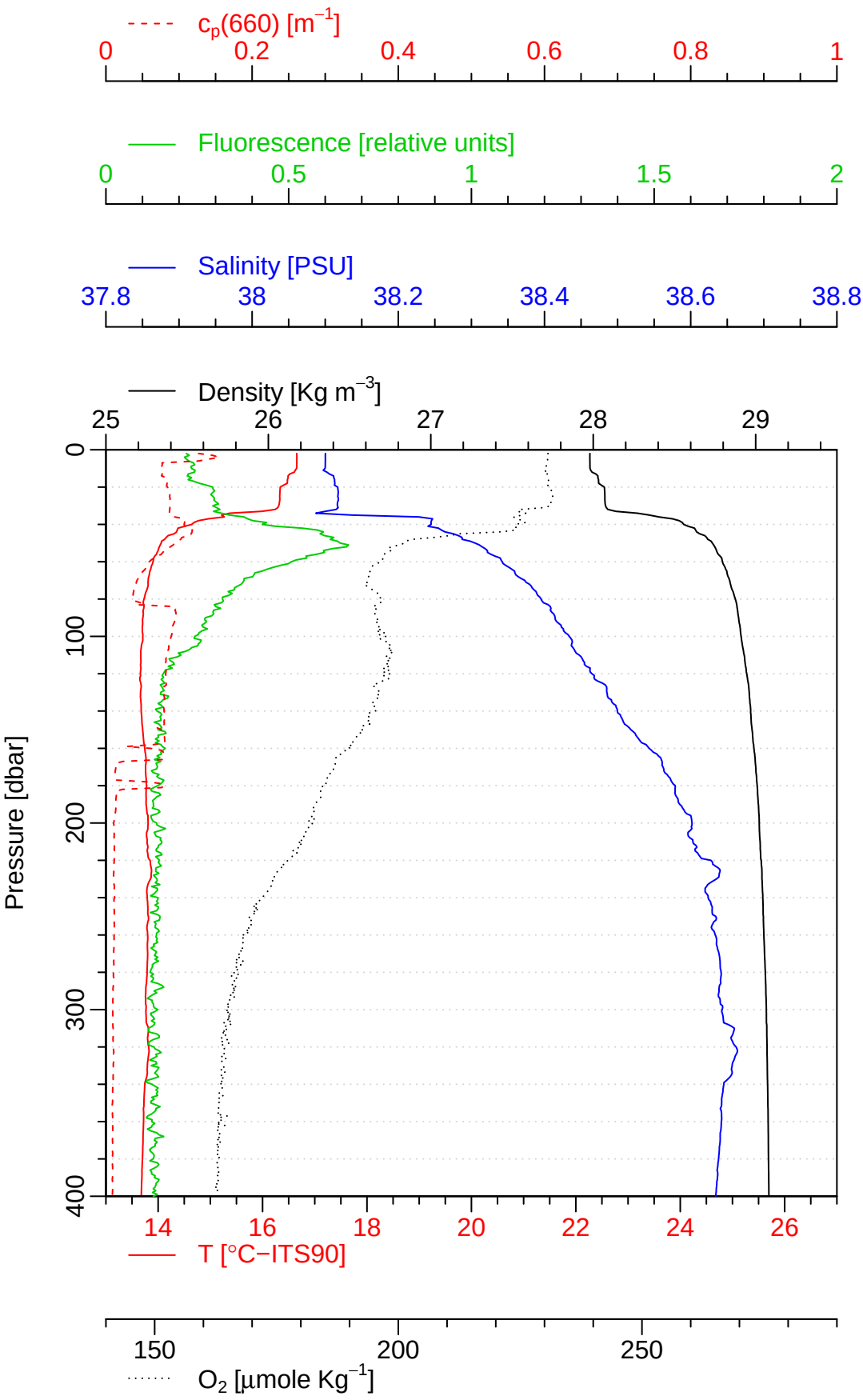
Longitude = 007 53.518 E
Latitude = 43 21.744 N



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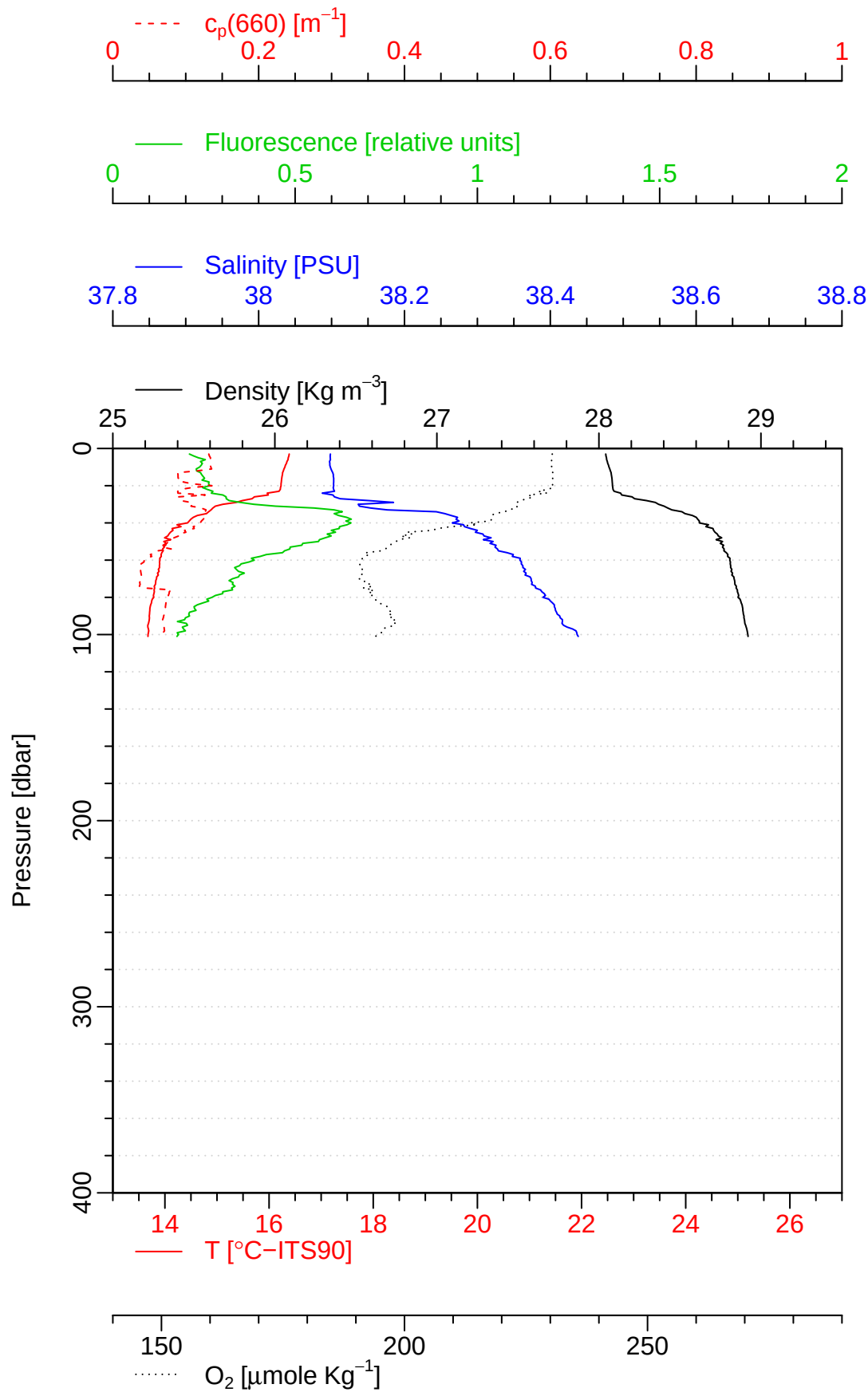

bous224_05

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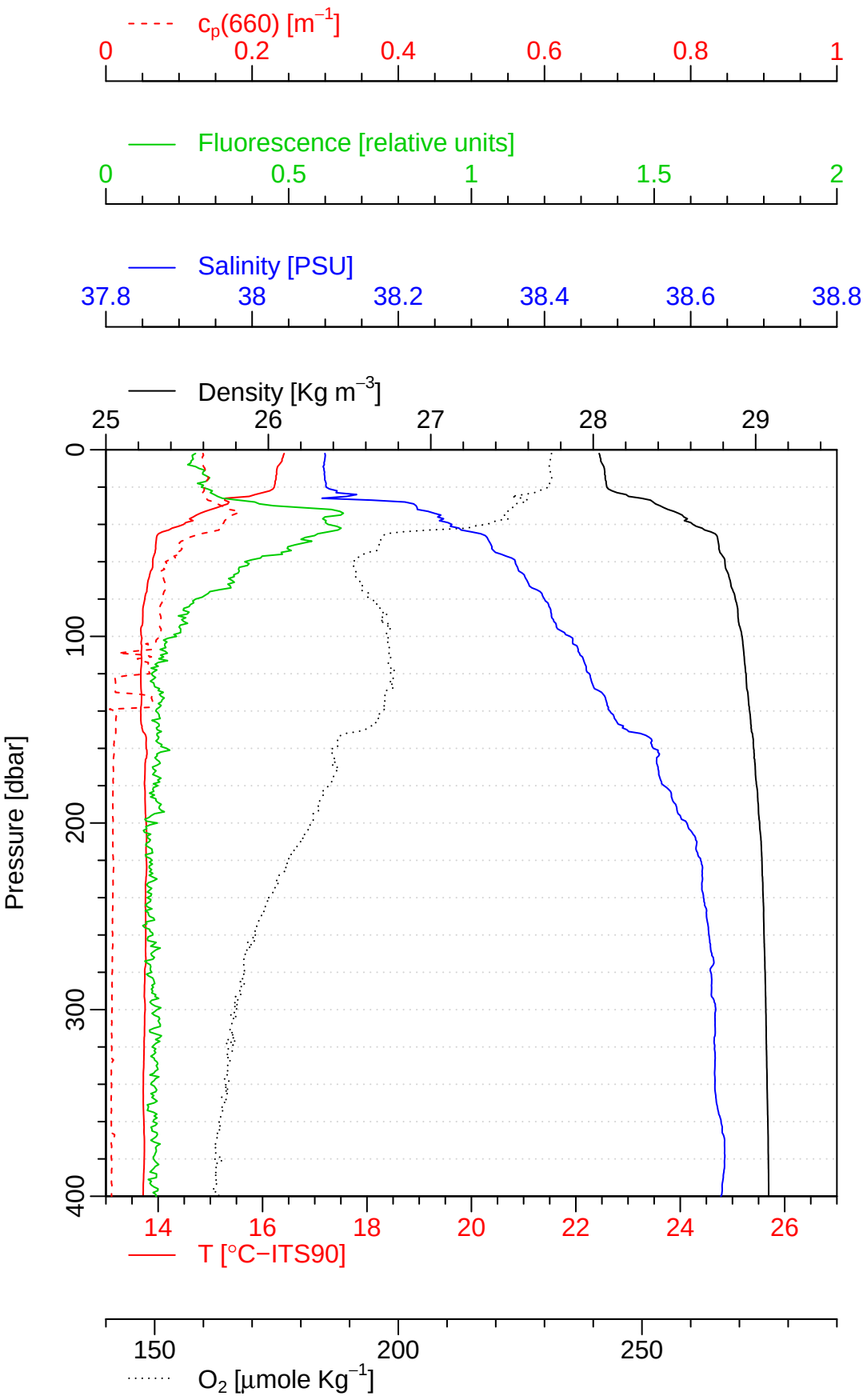

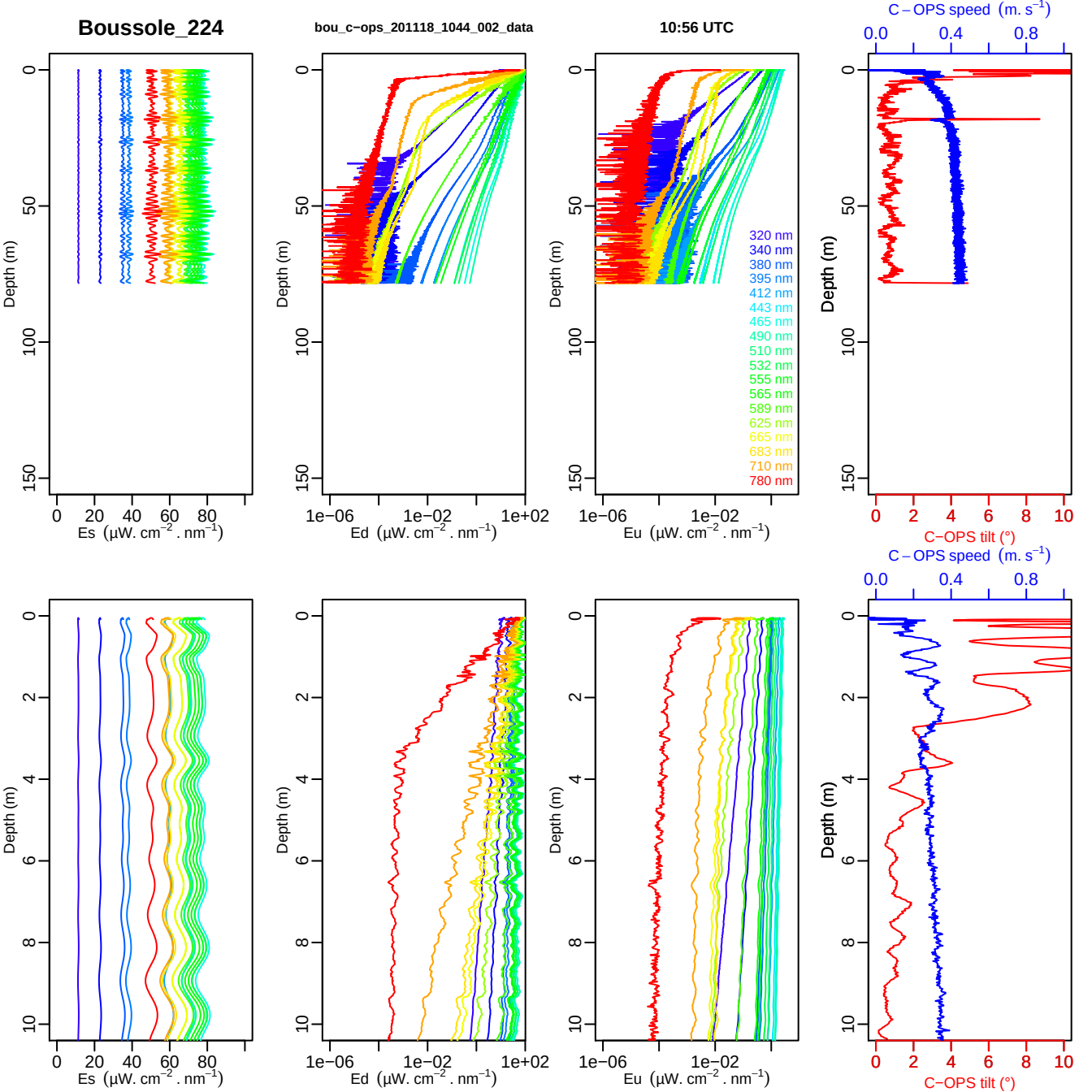
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C-OPS speed (m. s⁻¹)
C-OPS tilt (°)
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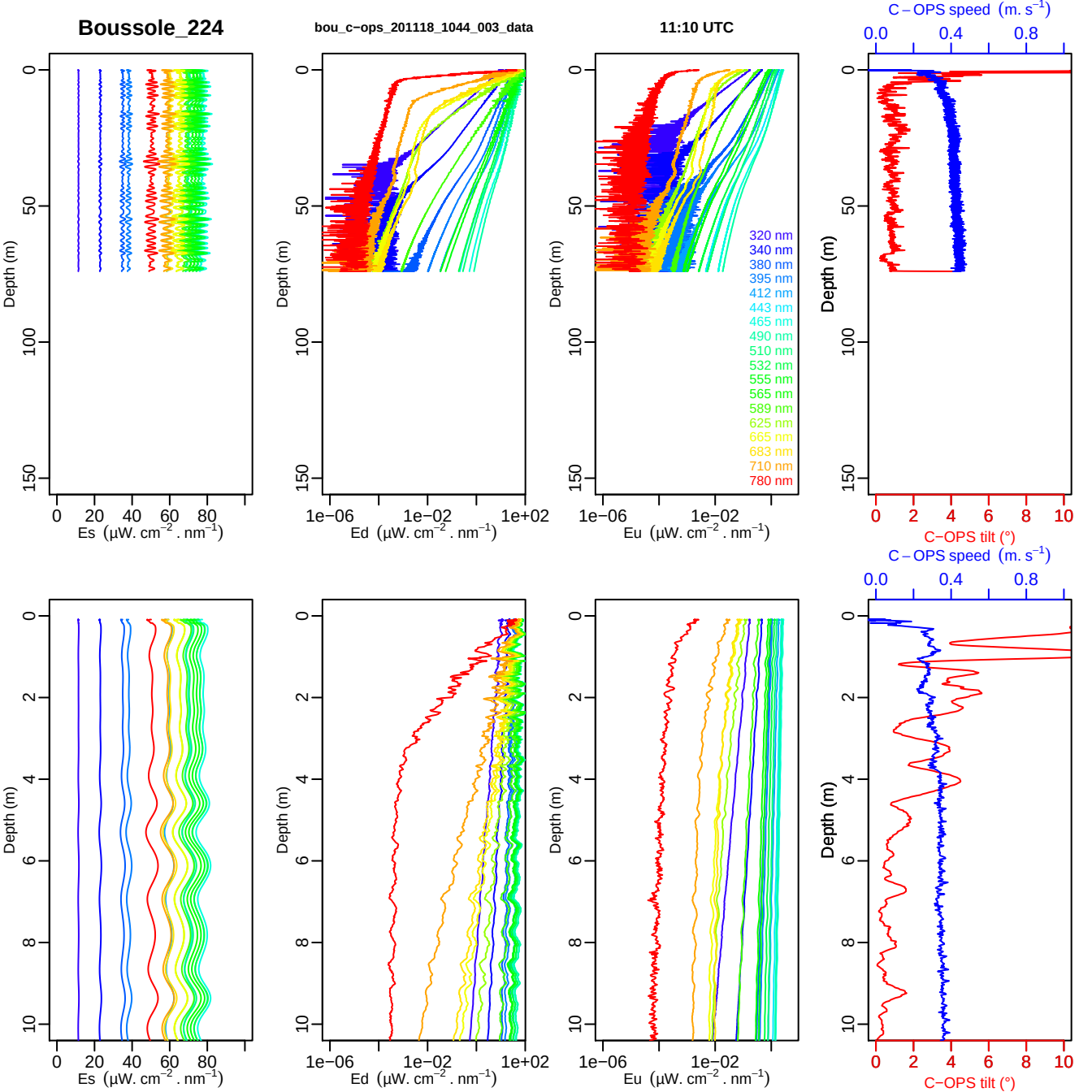
665 nm
683 nm
710 nm
780 nm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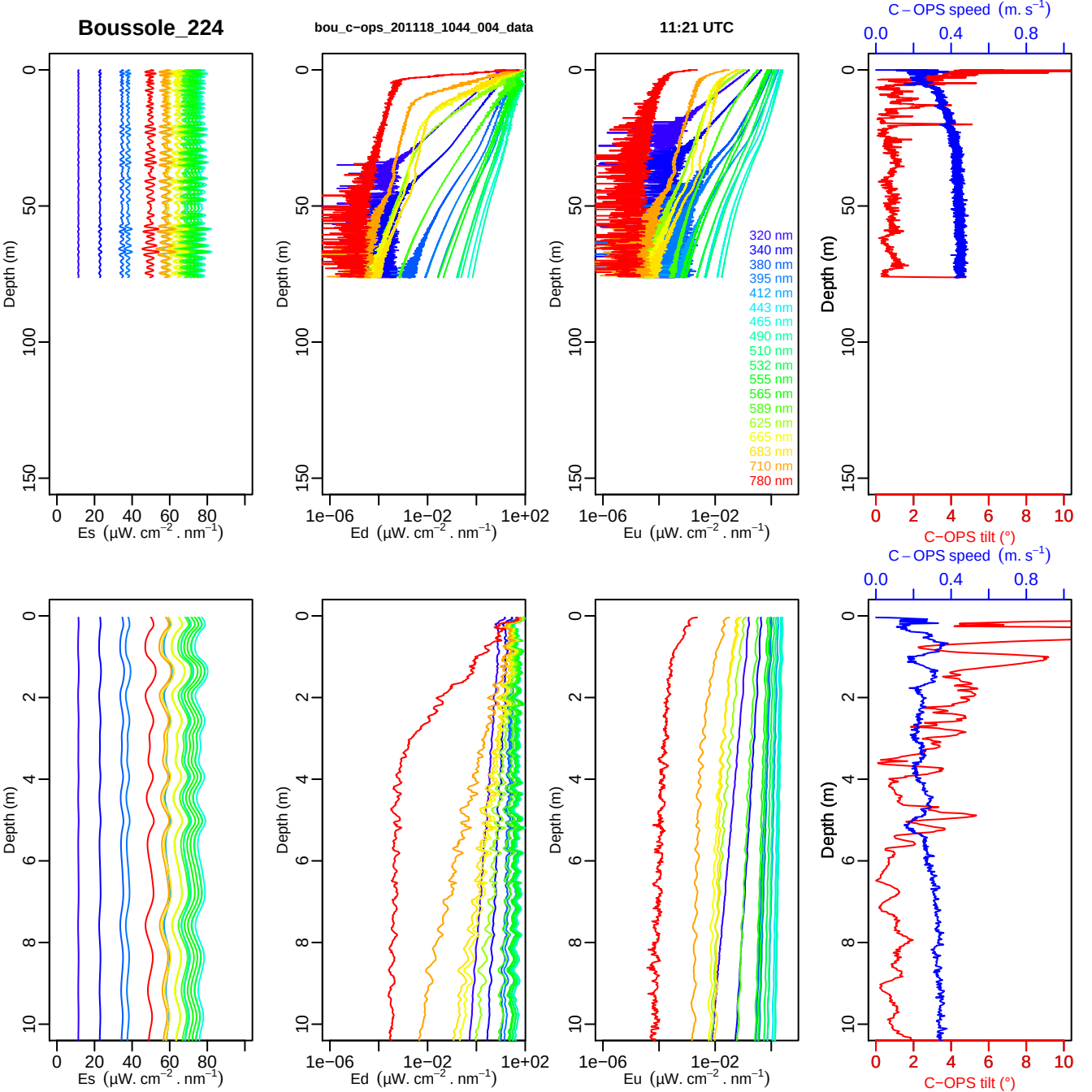
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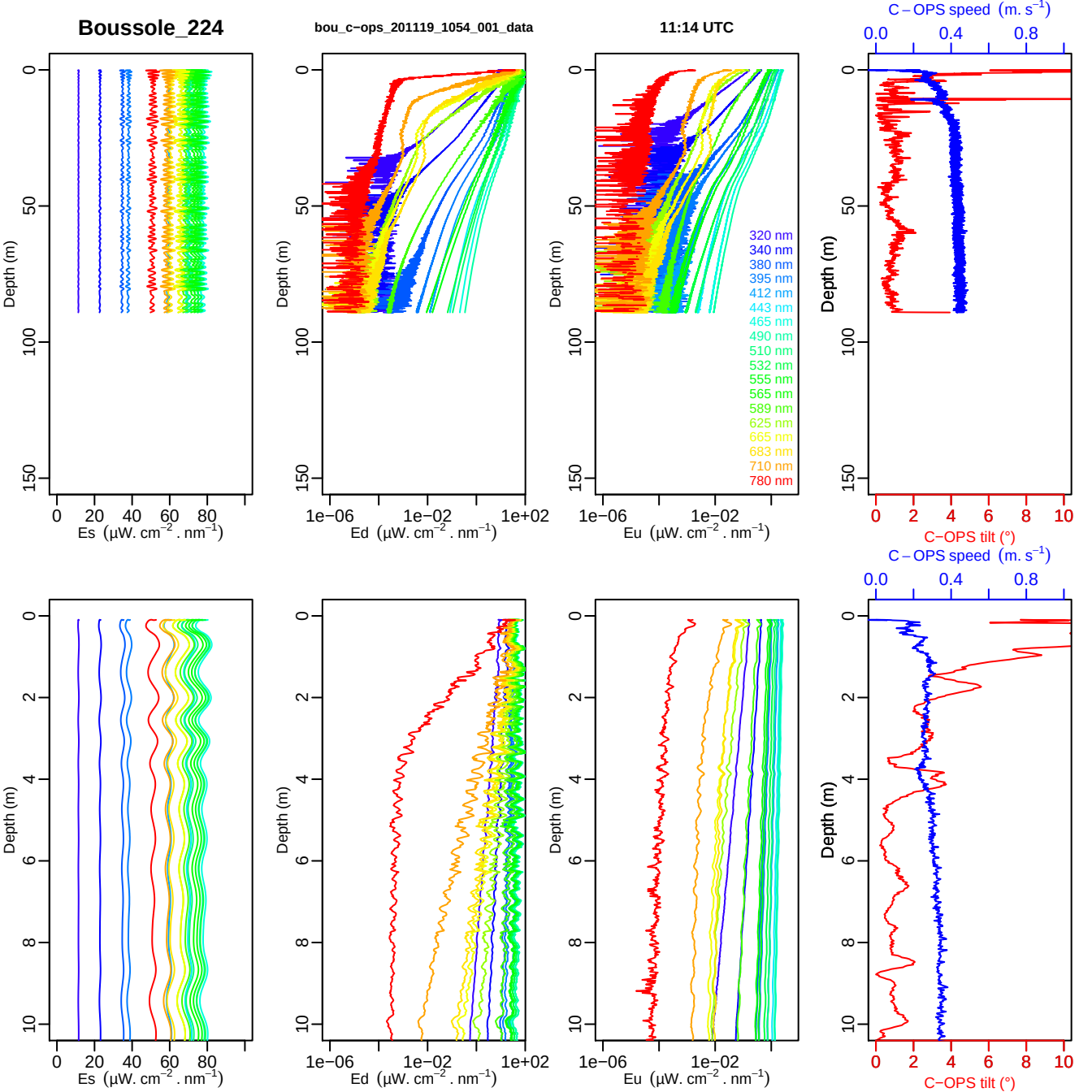
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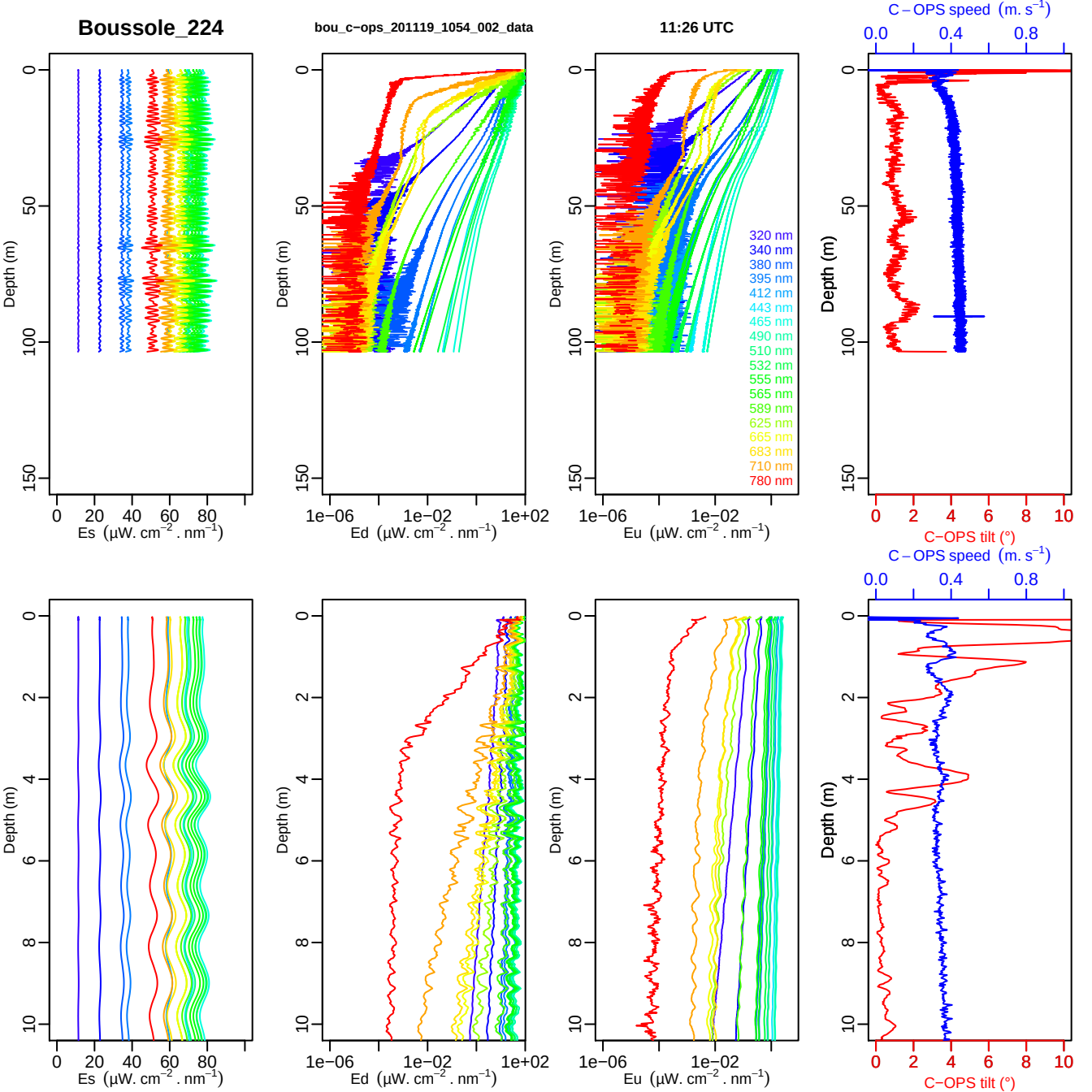
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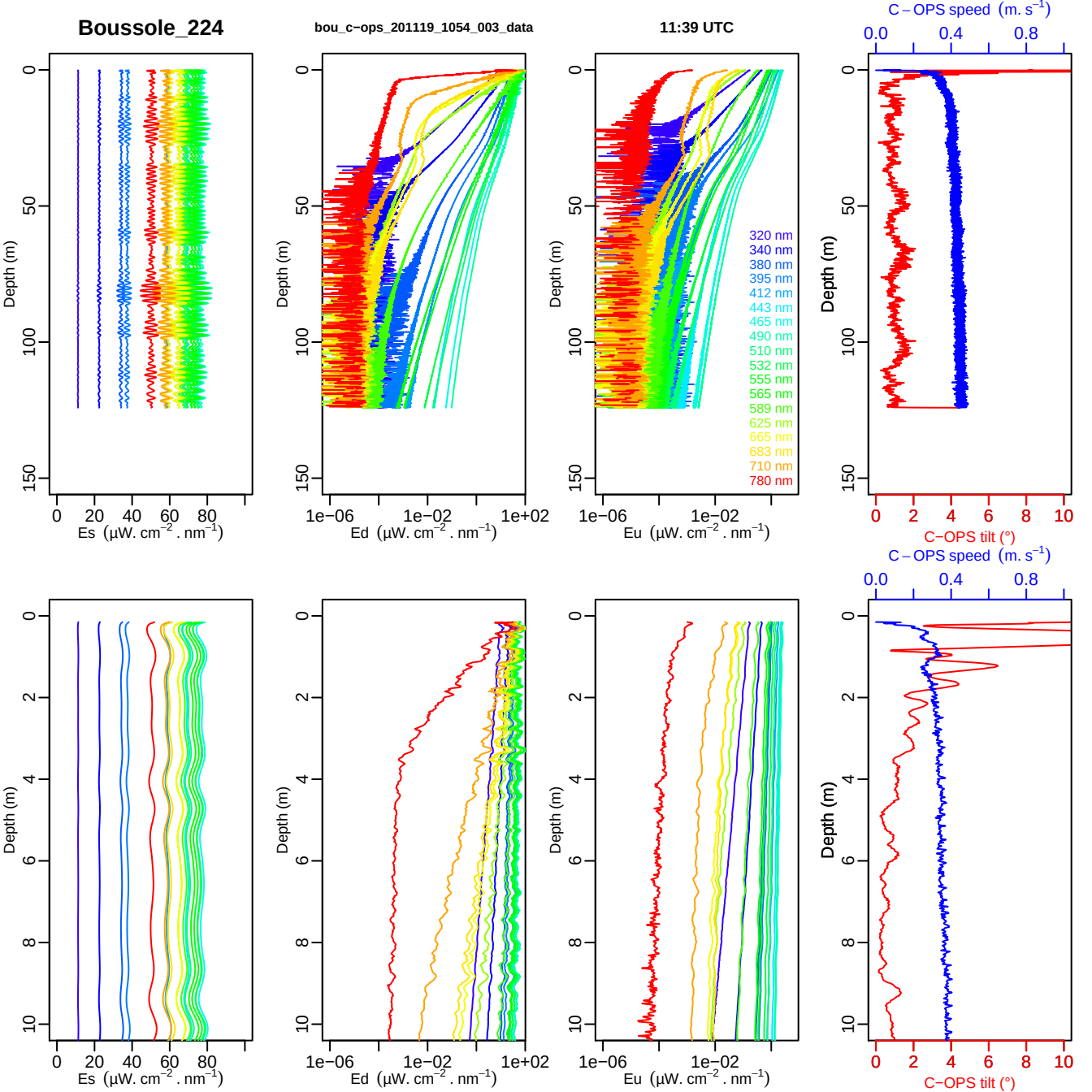
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