BOUSSOLE Monthly Cruise Report

Cruise 231
June 11-12, 2021

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

Science Personnel: Céline Dimier, Melek Golbol and Flavien Petit.

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

A moonfish in the vicinity of the BOUSSOLE buoy (on right) and the R/V *Téthys II* on background (on left)

BOUSSOLE project

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

June 30, 2021

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 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, three 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, an Eco 3X1M sensor that measures multispectral fluorescence (excitation at 440, 470 et 532 nm, emission at 695 nm) and an ECO V2 B206 sensor that measures chlorophyll fluorescence at 470 and 440 nm, CDOM fluorescence and backscattering at 700 nm.

The first day, sea water was sampled for cytometry analyses and two vertical zooplankton nets were performed at the DYFAMED site for the MOOSE program.

Cruise Summary

The first day of the cruise was used for CTD casts with water sampling, for optical profiles, for buoy maintenance on the top of the buoy, for a Secchi disk and for zooplankton nets at the BOUSSOLE site. The ship stayed on the DYFAMED area during the night. The second day was used for CTD casts with water sampling, C-OPS profiles, a Secchi disk and CIMEL measurements at the BOUSSOLE site.

Diving and maintenance operations of the buoy were not carried out because these operations were performed on June 7th with the *Papeete II* ship.

Friday 11 June 2021

The sea state was smooth with a gentle breeze. The sky was cloudy then blue, the visibility was good. Firstly, a CTD cast with water sampling and three C-OPS profiles were performed at the BOUSSOLE site. A second CTD cast was performed with a cap put on the backscattering meter for dark measurements. Then maintenance operations were performed on the top of the buoy: data were downloaded from the surface DL3 (data logger of the buoy radiometers), the buoy battery voltage and internal battery of the surface DL3 were checked. Connections with the 4 and 9 m DL3s were attempted in order to check their functioning but failed. In the meantime, a Secchi disk and two zooplankton nets (MOOSE program) were performed at the BOUSSOLE site. The operations of the day were finished and the ship stayed overnight in the DYFAMED area.

Saturday 12 June 2021

The sea state was smooth with a light breeze to light air. The sky was blue and the visibility was good. Firstly, a CTD cast with water sampling was performed at the BOUSSOLE site. 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. The 60 meter Niskin bottle did not close, so the CTD was deployed again in order to sample water at 60 m for the EFFICACY project. Then four C-OPS profiles were performed. The second profile had to be stopped early because of an unstable irradiance (cloudy sky). Then, a CTD cast with water sampling, 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/8VcmUBT9GcGfvmdK9

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

Cruise Report

Friday 12 June 2021 (UTC)

People on board: Céline Dimier, Melek Golbol and Flavien Petit.

0730 Departure to the BOUSSOLE site.
1115 Arrival at the BOUSSOLE site.
1130 CTD 01, 400 m with water sampling at 400, 200, 150, 80, 70, 60, 50, 40, 30, 20, 10 and 5m for HPLC and a_p (BOUSSOLE program) and for cytometry (MOOSE program).
1230 C-OPS 01, 02, 03.
1340 CTD 02, 300 m with water sampling at 65, 53 and 5m for TSM, O_2, TA/TC and phytoplankton microscopy, cytometry, PIC, POC, HPLC (with cap on the HS6).
1500 Buoy surface maintenance.
1535 Secchi disk, 18 m.
1545 Zooplankton nets, 100 and 200 m (MOOSE program).
1630 End of the operations.

Saturday 12 June 2021 (UTC)

People on board: Céline Dimier, Melek Golbol and Flavien Petit.

0615 CTD 03, 400 m with water sampling at 80, 60, 40 and 5 m for TSM and for metagenomic, cytometry and nutrients analyses (with 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).
0820 CTD 04, 60 m with water sampling at 60 m for metagenomic.
0855 C-OPS 04, 05, 06, 07.
1005 CTD 05, 400 m with water sampling at 400, 200, 150, 80, 70, 60, 50, 40, 30, 20, 10 and 5m for HPLC and $a_{p.}$
1050 Secchi disk 02, 25 m.
1055 CIMEL 01, 02, 03.
1130 Departure to the Nice harbour.
1435 Arrival to the Nice harbour.

Problems identified during the cruise

- A connection to the DL3s at 4 m and 9 m via a cable on the top of the buoy was attempted to check their functioning but nothing happened.

- The second day, the C-OPS 02 profile had to be stopped early because of the unstable irradiance (cloudy sky). So, a fourth profile was performed.

- There was no data from the transmissometer on the CTD package during CTD 01, 02, 03, 04 because the transmissometer was not connected to the CTD. Nevertheless, data were acquired by the transmissometer of the IOP package during all these casts.

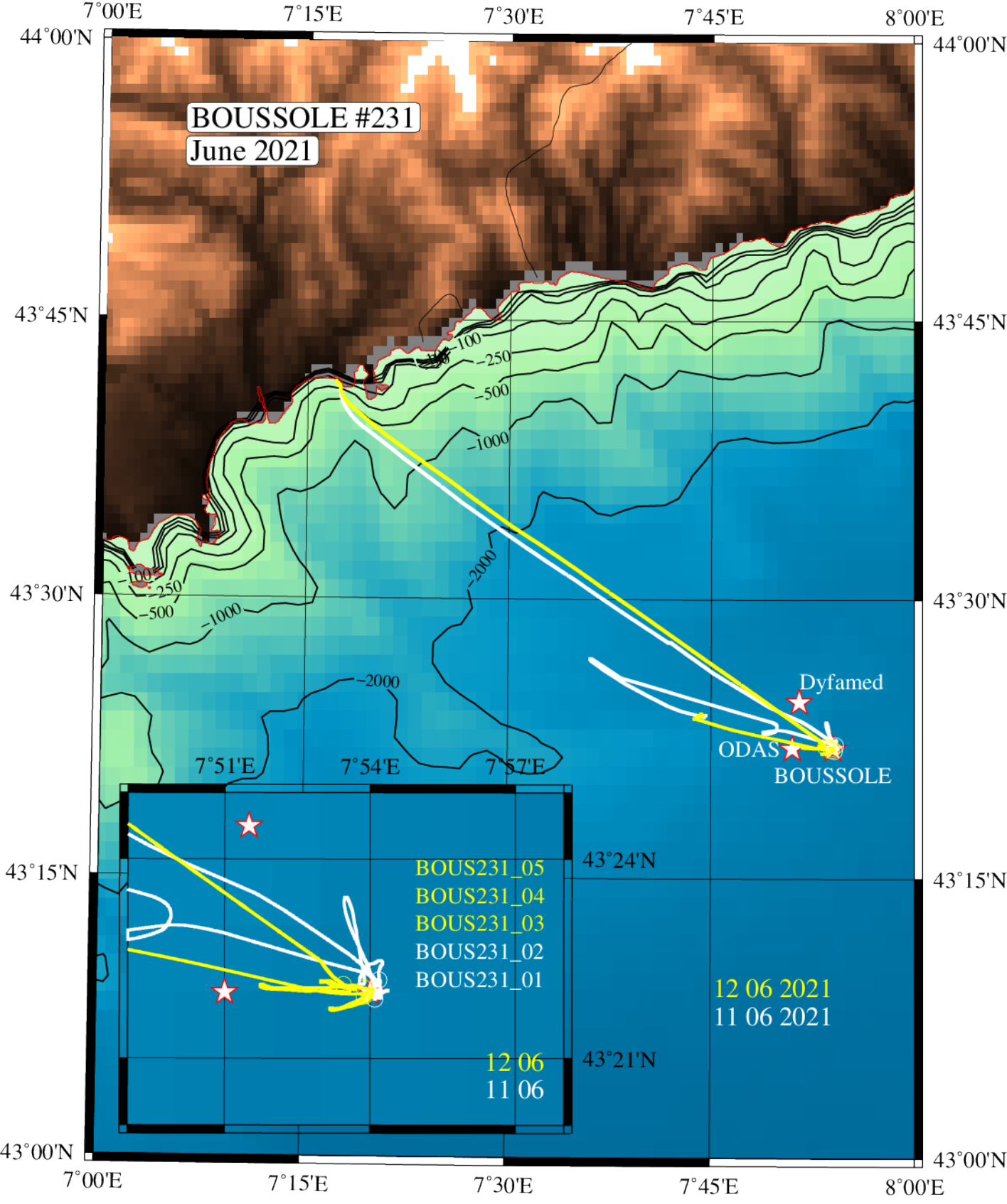
- CTD 03: two Niskin bottles did not close and there was a leak on two others Niskin bottles because their taps were not closed before the deployment. Therefore, there was not enough water sampled at 60 m, so the CTD was deployed again to sample water at 60 m for metagenomic analyses.

- There were some spikes in oxygen data (CTD 01, 02, 03, 05): outliers were removed.

Appendices

Cruise Summary Table for Boussole 231

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
11/06/21			BOUS231_01	HPLC, ap & Cyto	11:31	0:42:00	400	43	22.184	7	54.184	cloudy		4	7	210	1017	83		23	22.87	smooth			
		bou_c-ops_210611_1218_001_data.csv			12:31	0:03:40	92	43	22.301	7	53.862	blue	Ci/Ac/As	3	9.5	231	1016.1	82.9	good	23.2		smooth	0.4		few
		bou_c-ops_210611_1218_002_data.csv			12:45	0:01:43	41	43	22.72	7	53.759	blue	Ci/Ac/As	3	9.5	231	1016.1	82.9	good	23.2		smooth	0.4		few
		bou_c-ops_210611_1218_003_data.csv			12:52	0:05:09	134	43	22.917	7	53.718	blue	Ci/Ac/As	3	9.5	231	1016.1	82.9	good	23.2		smooth	0.4		few
			BOUS231_02	TSM, O_2, TA/TC & Phytofloat (PIC, POC, Cyto, phyto)	13:40	0:27:00	300	43	21.896	7	54.101	blue		3	7.4	240	1016.6	85.6		22.8	23.23	smooth			
				Secchi 01	15:35	0:04:00	18	43	22	7	54	blue		3					good			smooth			
12/06/21			BOUS231_03	TSM, Metagenomics, Cyto, Nutrients & filter a-Sphere	6:16	1:35:00	400	43	21.936	7	53.882	blue		1	4	348	1017.9	81.6		22.8	22.067	smooth			
			BOUS231_04	Metagenomics	8:20	0:07:00	60	43	22.055	7	53.88	blue		1	2.3	222	1018.3	79.9		22.7	21.574	smooth			
		bou_c-ops_210612_0848_001_data.csv			8:53	0:04:10	105	43	22.08	7	53.54	blue	Ci	1	1.7	242	1018.6	80.9	good	22.7		smooth	0.2		no
		bou_c-ops_210612_0848_002_data.csv			9:06	0:01:08	25	43	22.06	7	53.037	blue	Ci	1	1.7	242	1018.6	80.9	good	22.7		smooth	0.2		no
		bou_c-ops_210612_0848_003_data.csv			9:09	0:04:28	114	43	22.056	7	52.905	blue	Ci	1	1.7	242	1018.6	80.9	good	22.7		smooth	0.2		no
		bou_c-ops_210612_0848_004_data.csv			9:20	0:03:58	100	43	22.06	7	52.424	blue	Ci	1	1.7	242	1018.6	80.9	good	22.7		smooth	0.2		no
			BOUS231_05	HPLC & ap	10:02	0:41:00	400	43	22.11	7	53.454	blue		1	1.5	197	1018.9	78		23.6	20.8	calm			
				Secchi 01	10:50	0:04:00	25	43	22	7	54	blue		1					good			calm			
				CIMEL01	11:00	0:03:00		43	22.307	7	53.141	blue		1			1018.9								
				CIMEL02	11:04	0:03:00		43	22.307	7	53.141	blue		1			1018.9								
				CIMEL03	11:07	0:0400		43	22.307	7	53.141	blue		1			1018.9								



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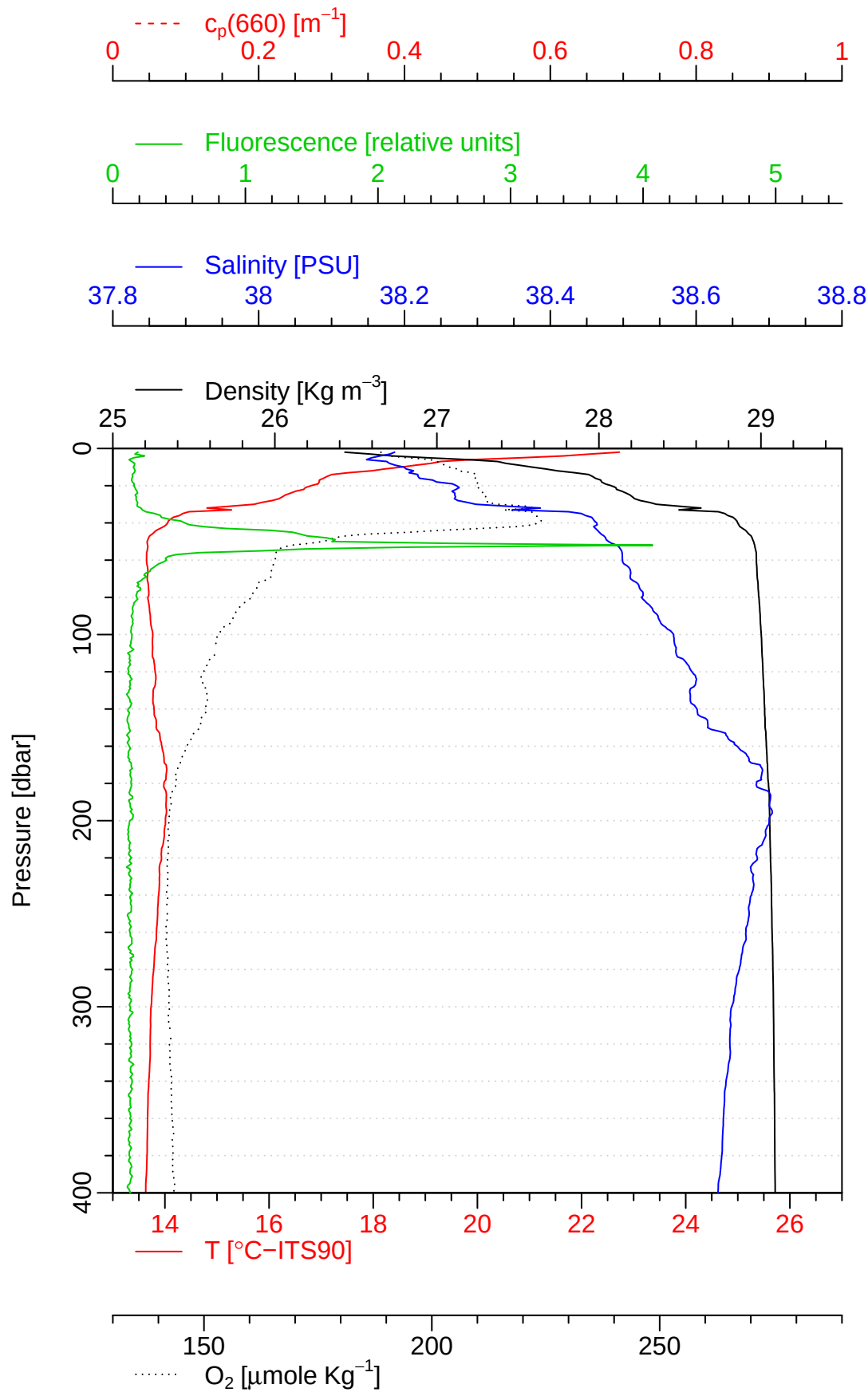

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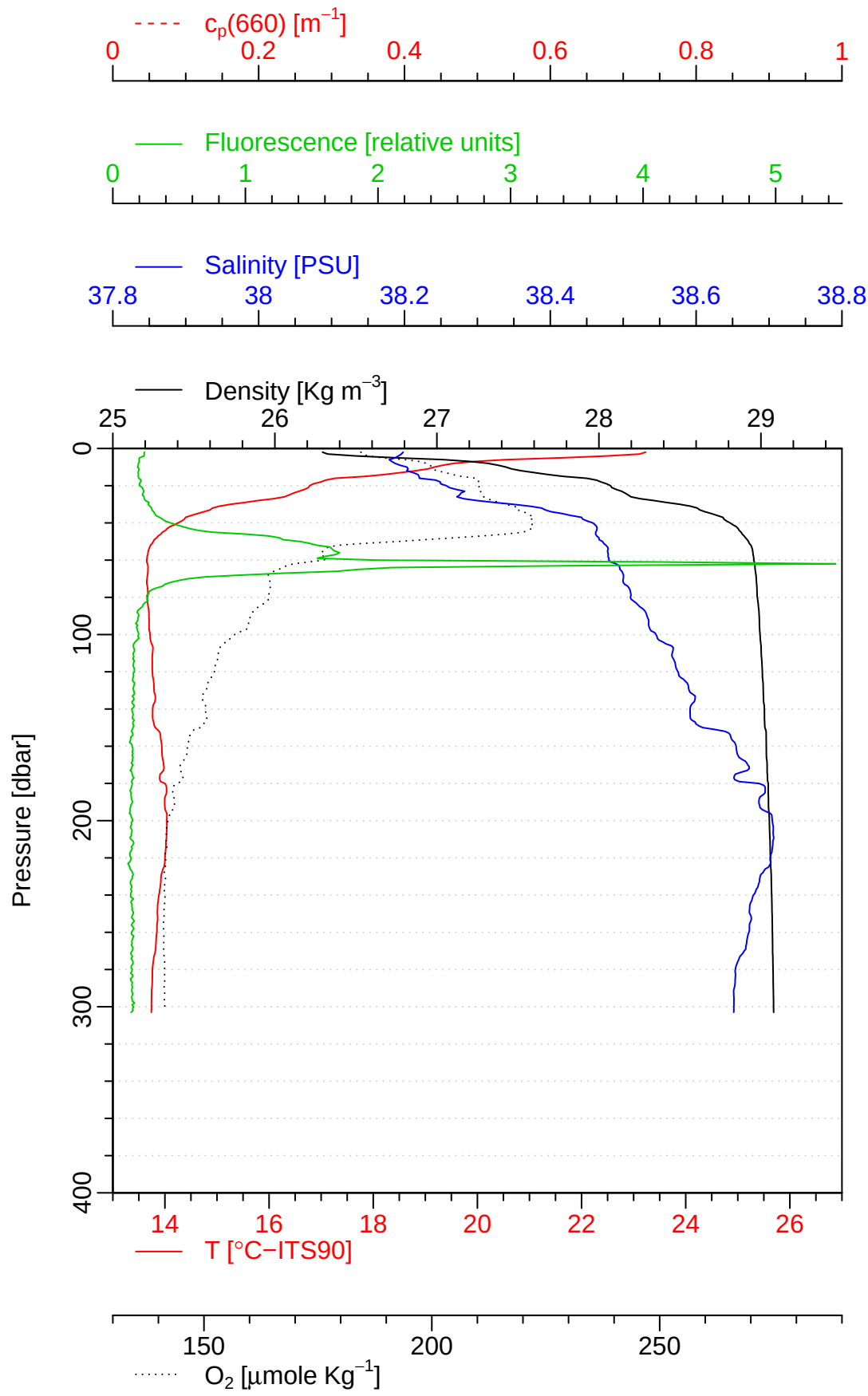

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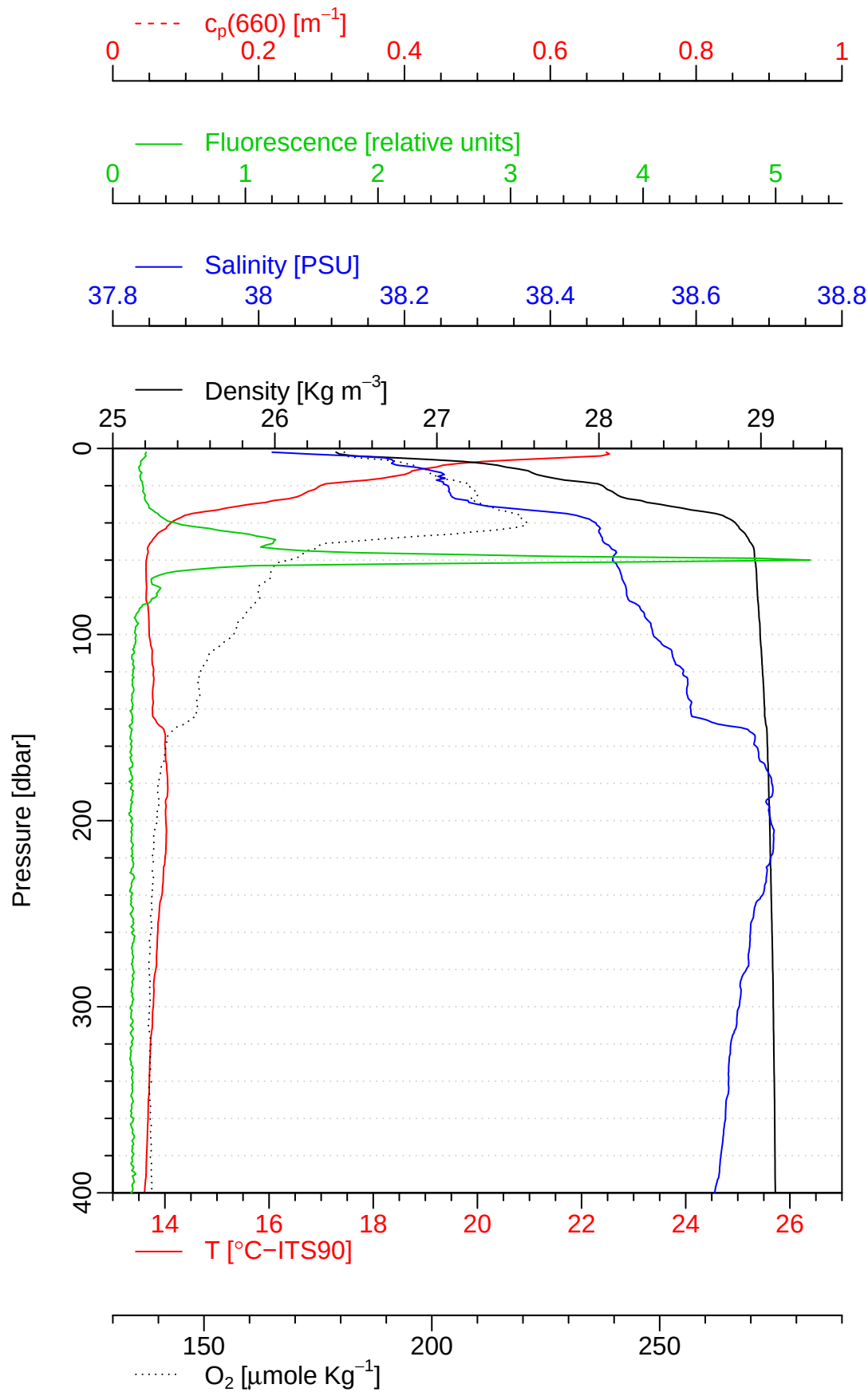

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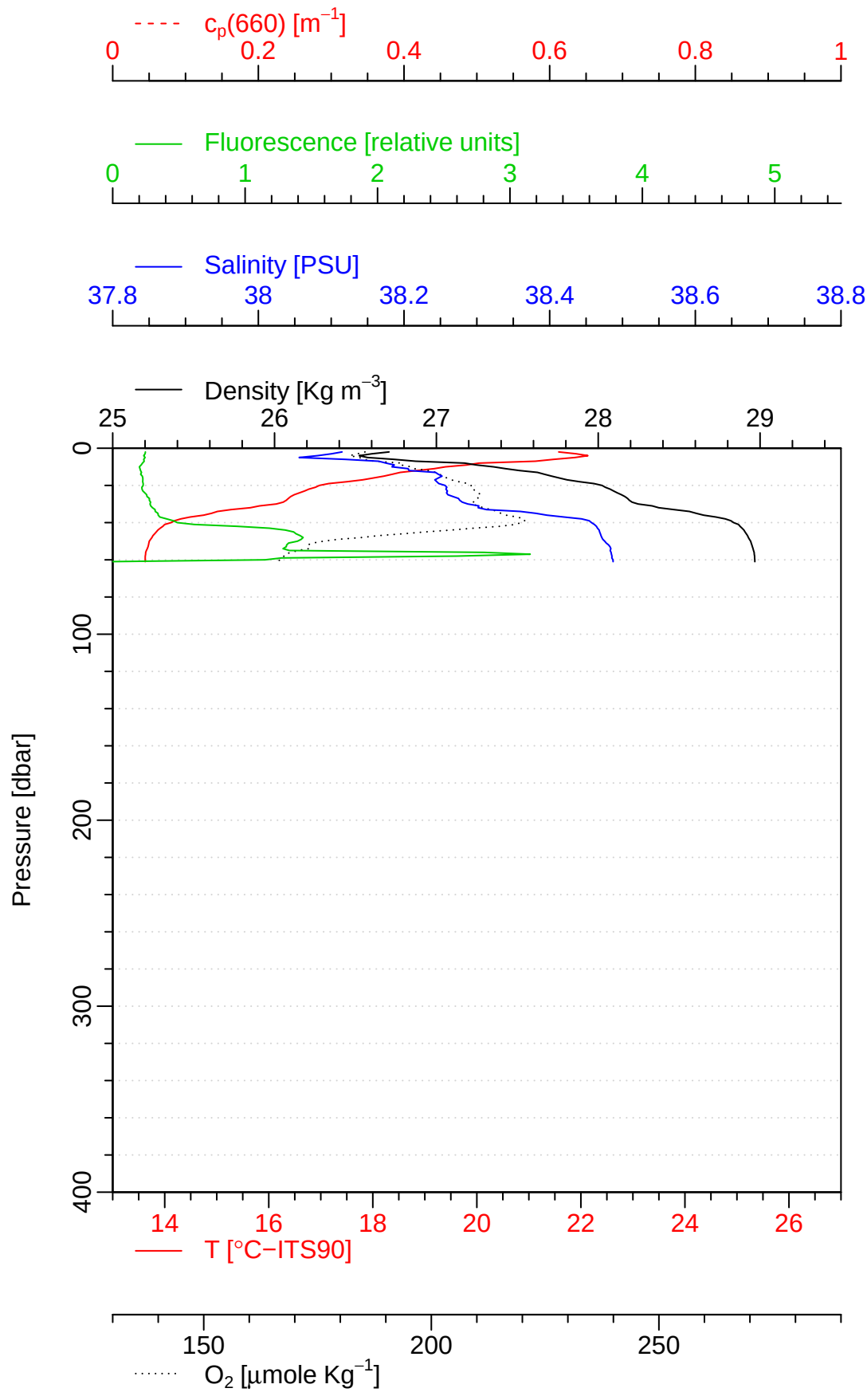

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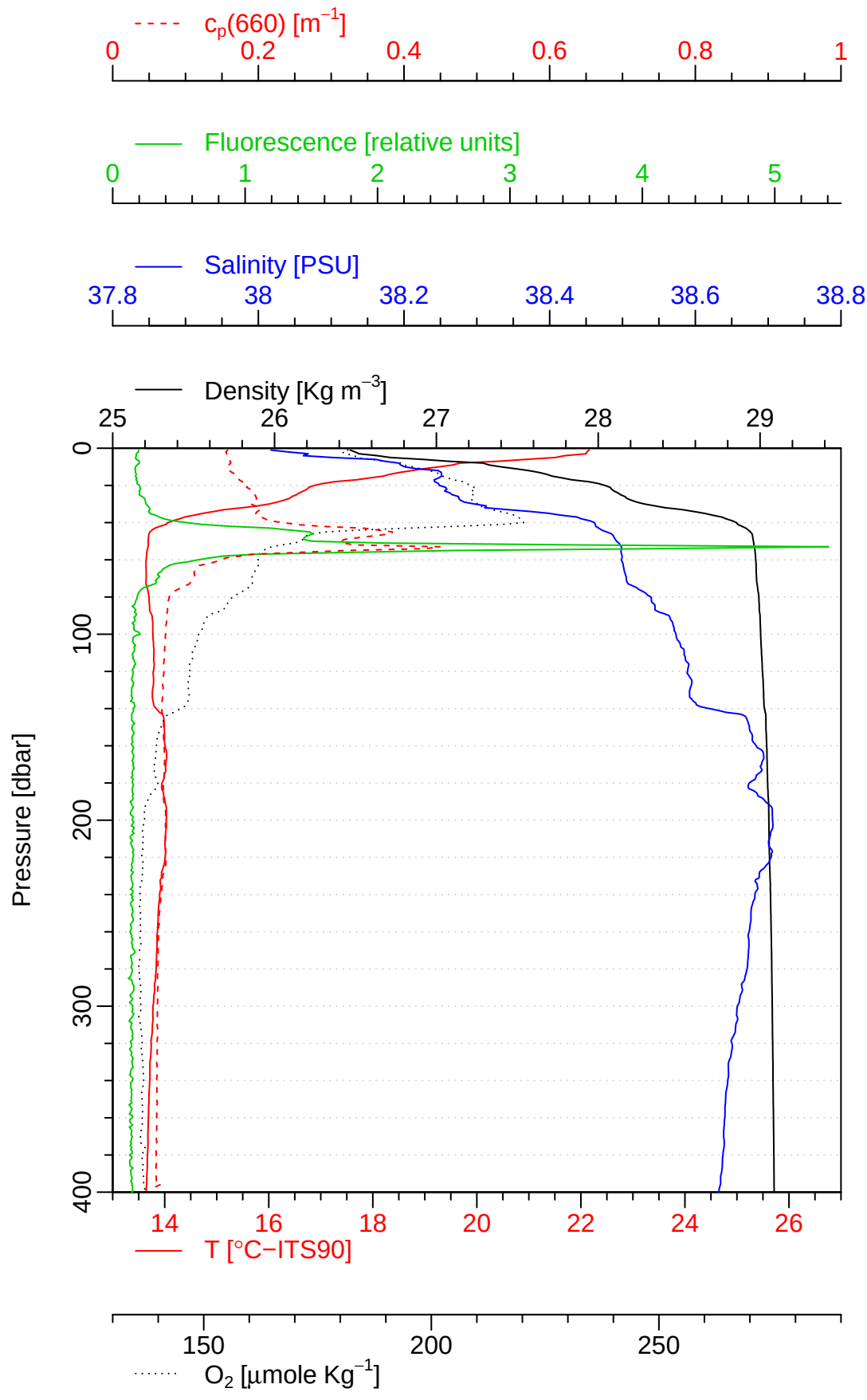

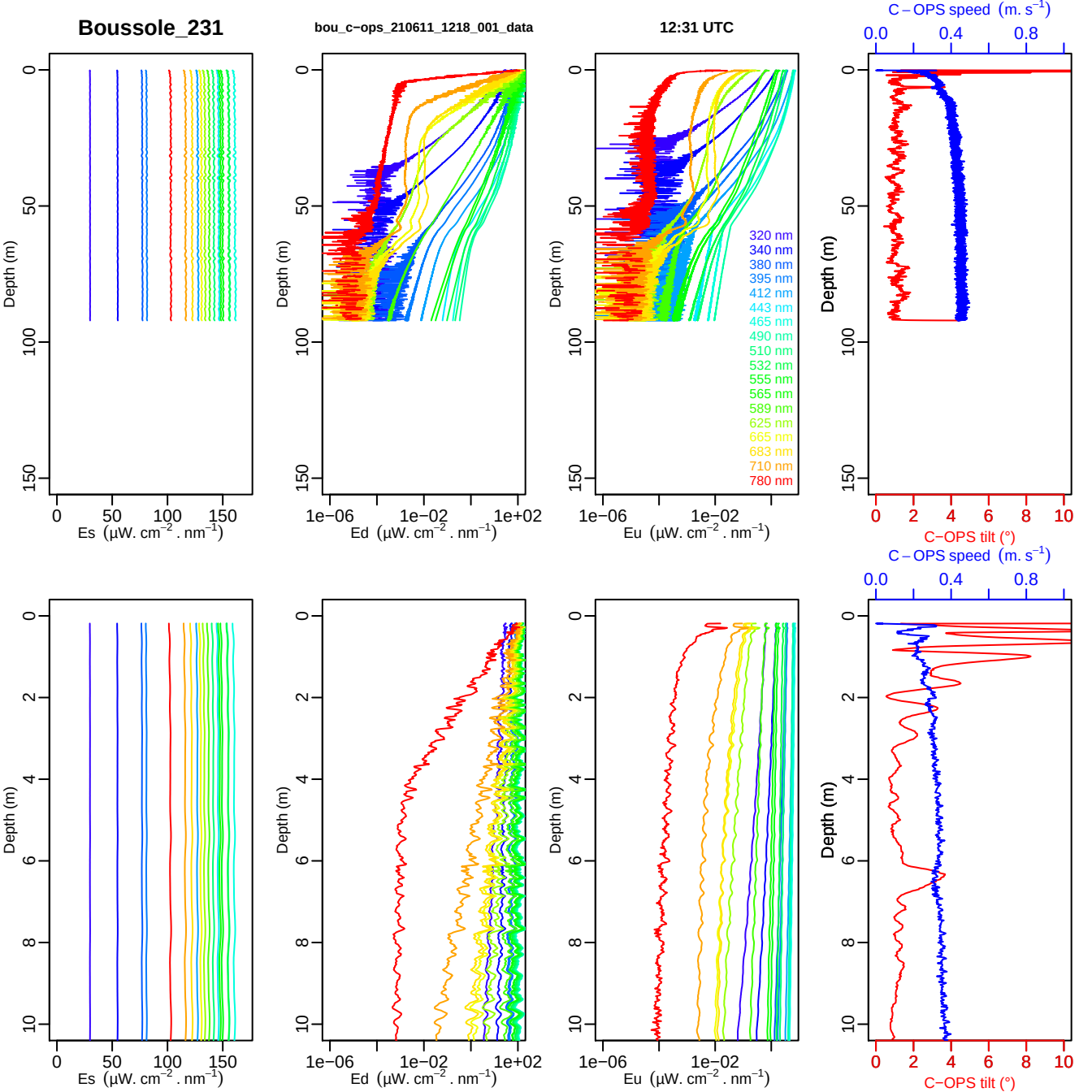
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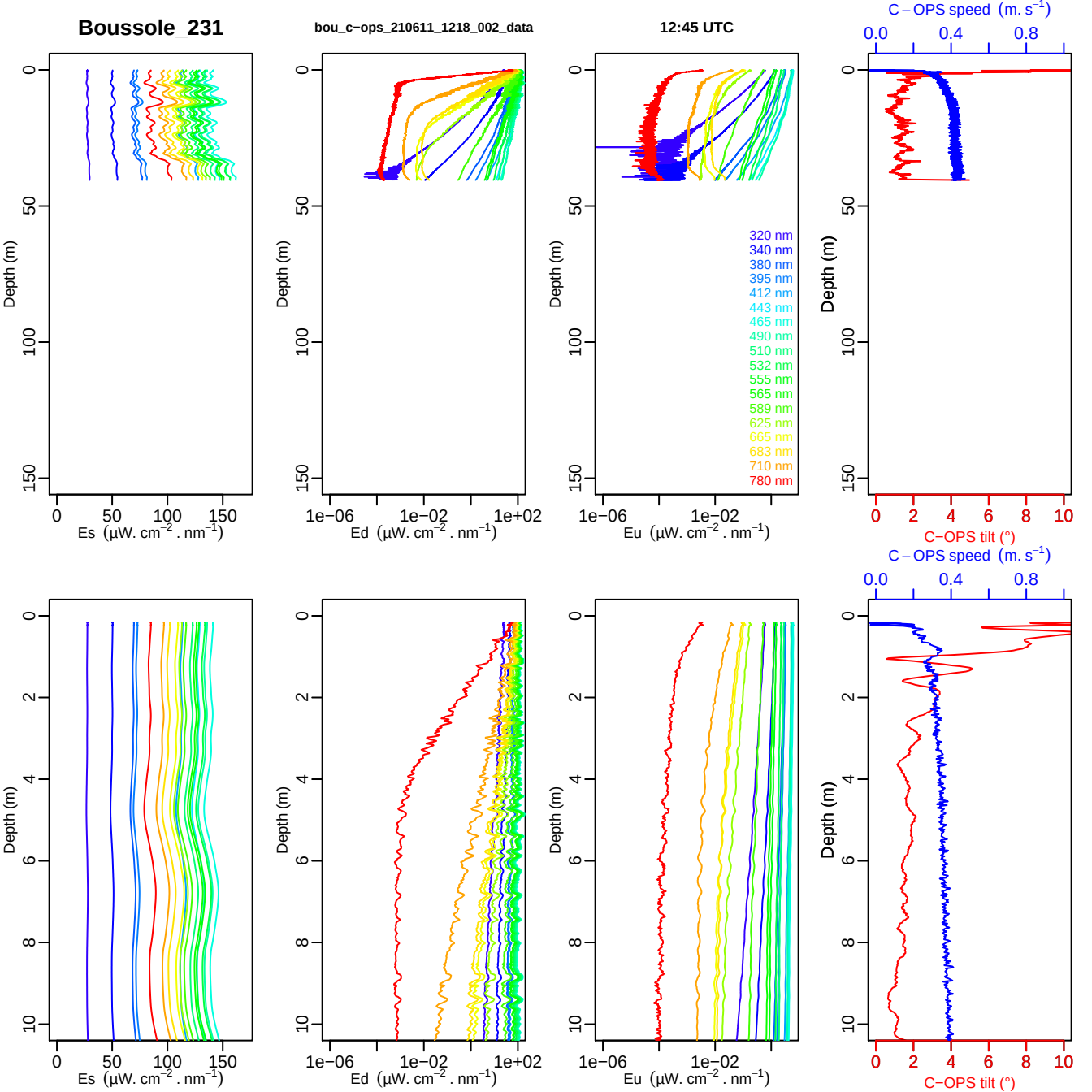
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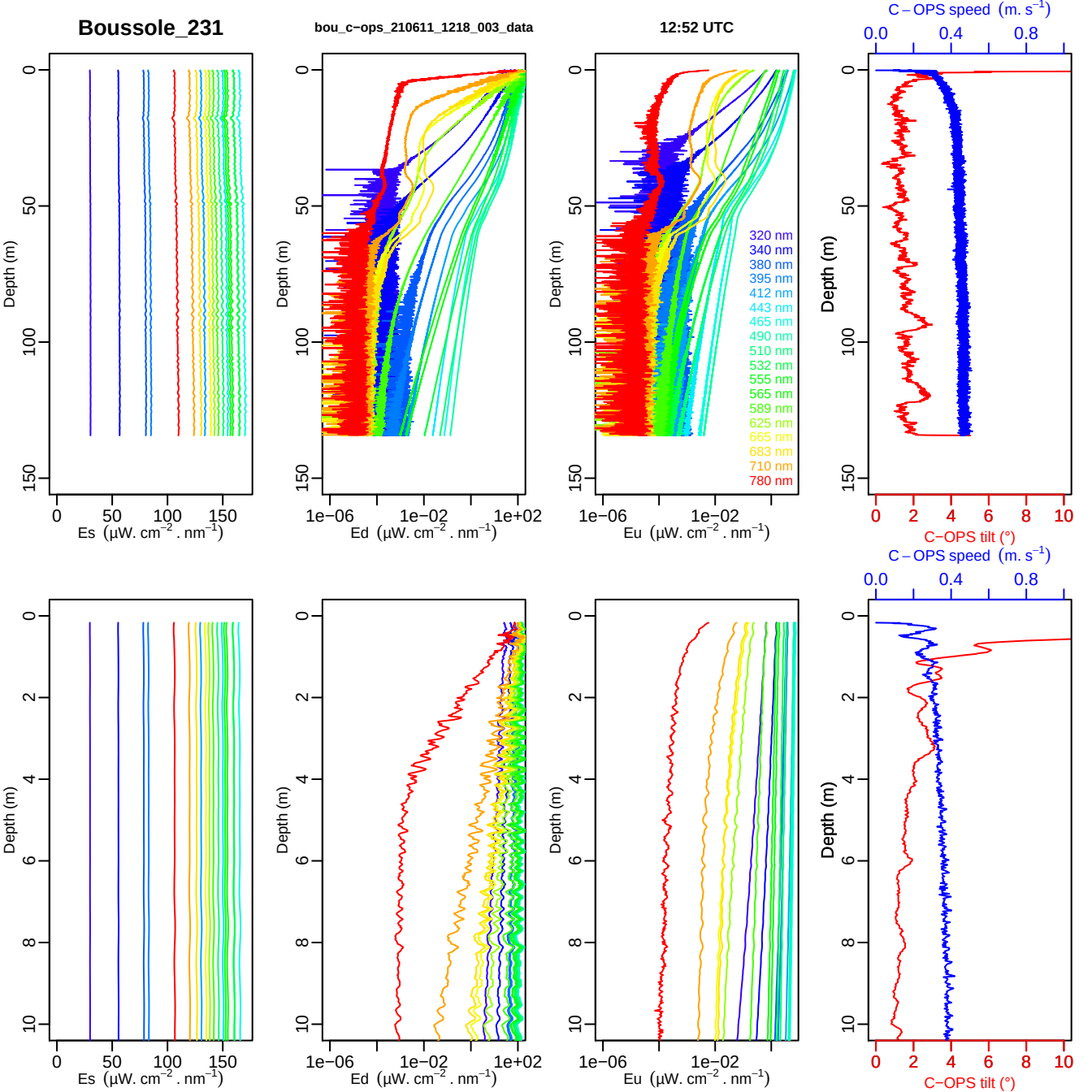
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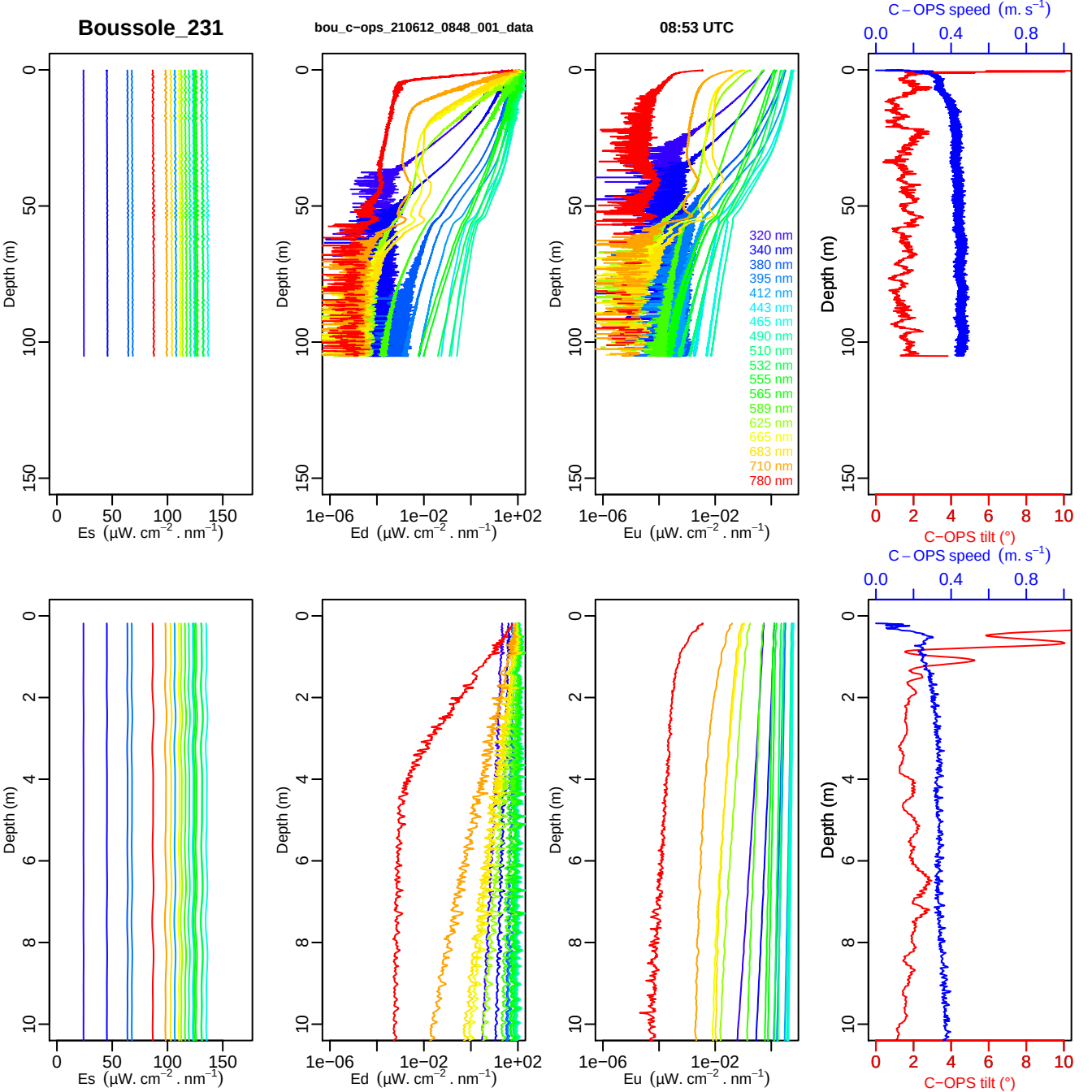
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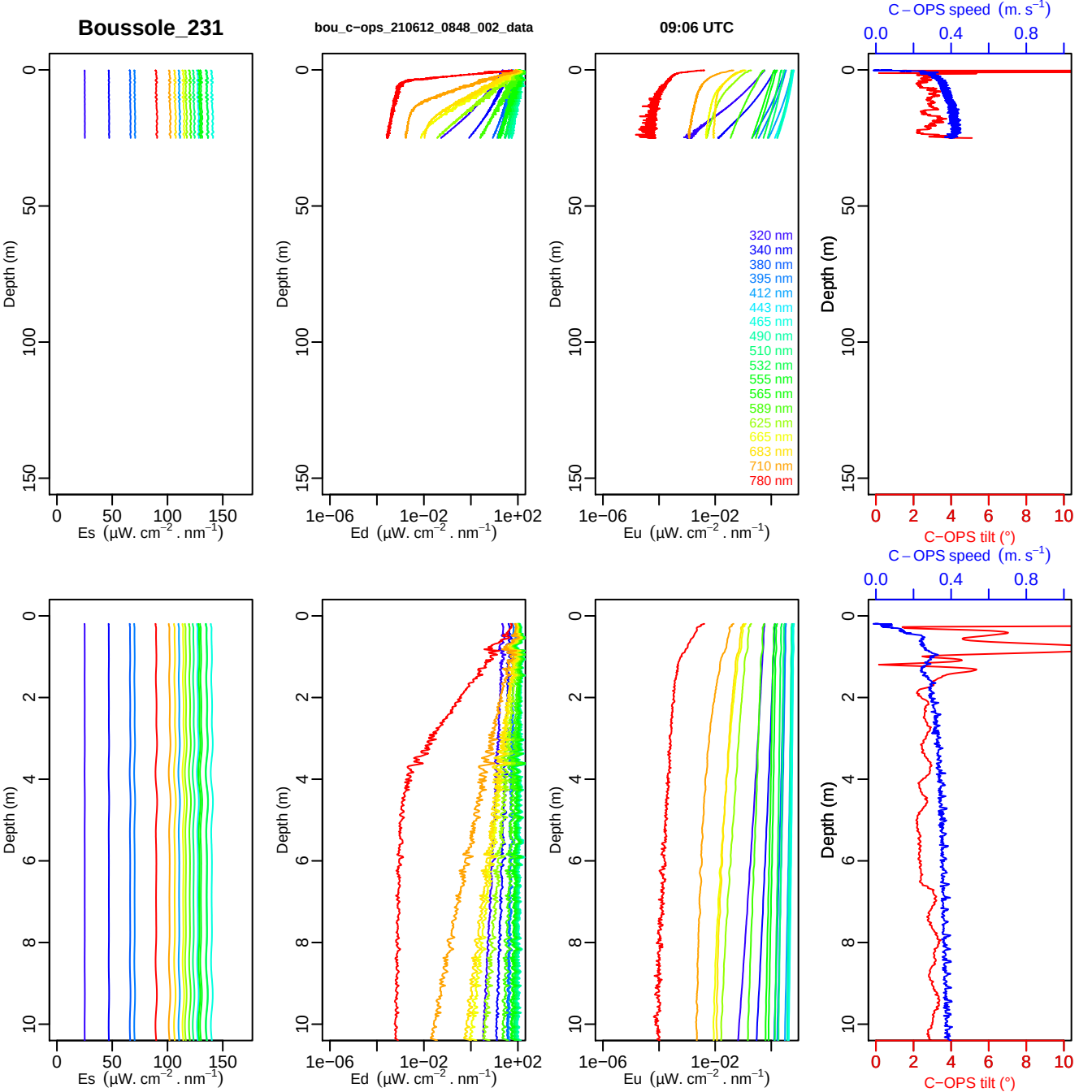
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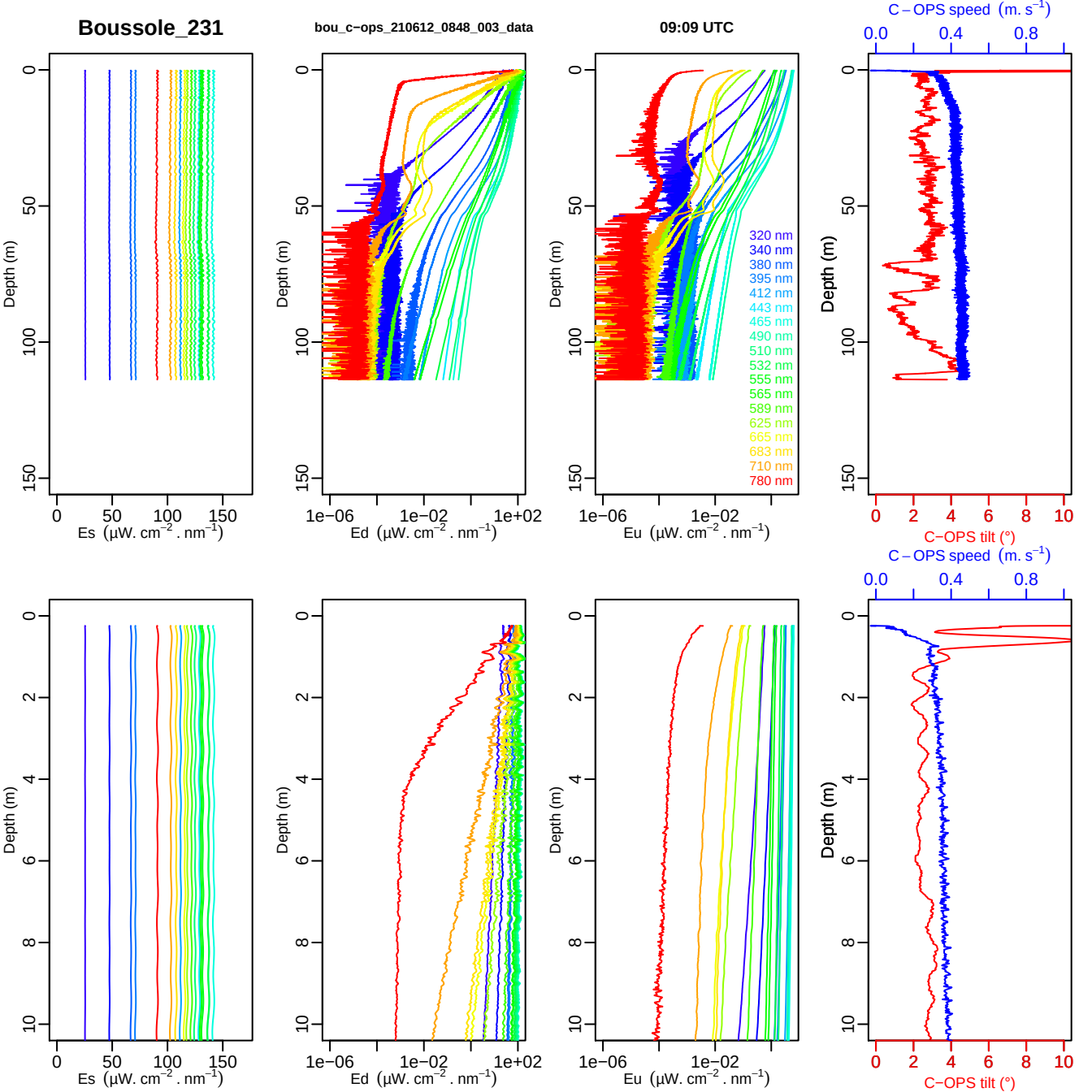
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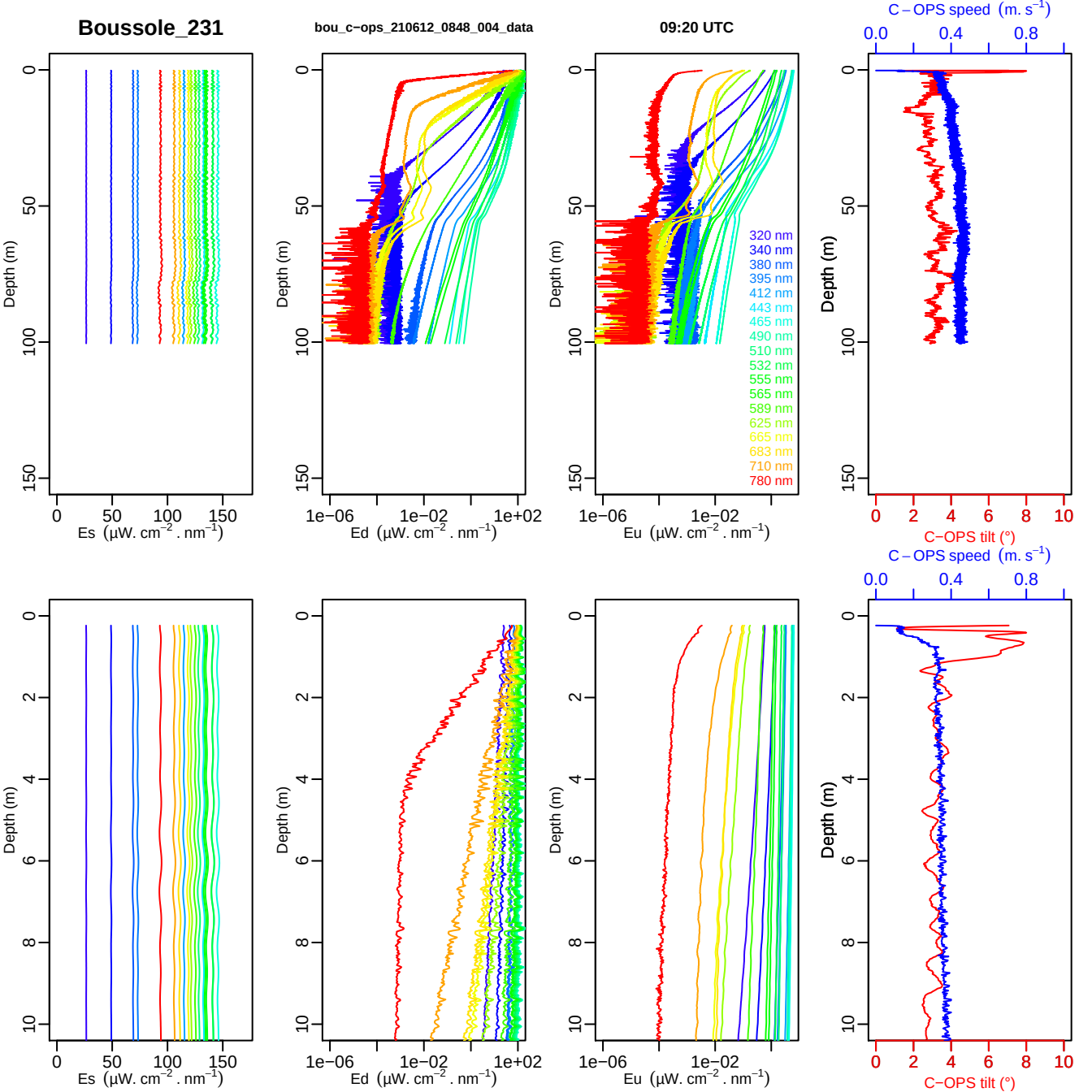
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