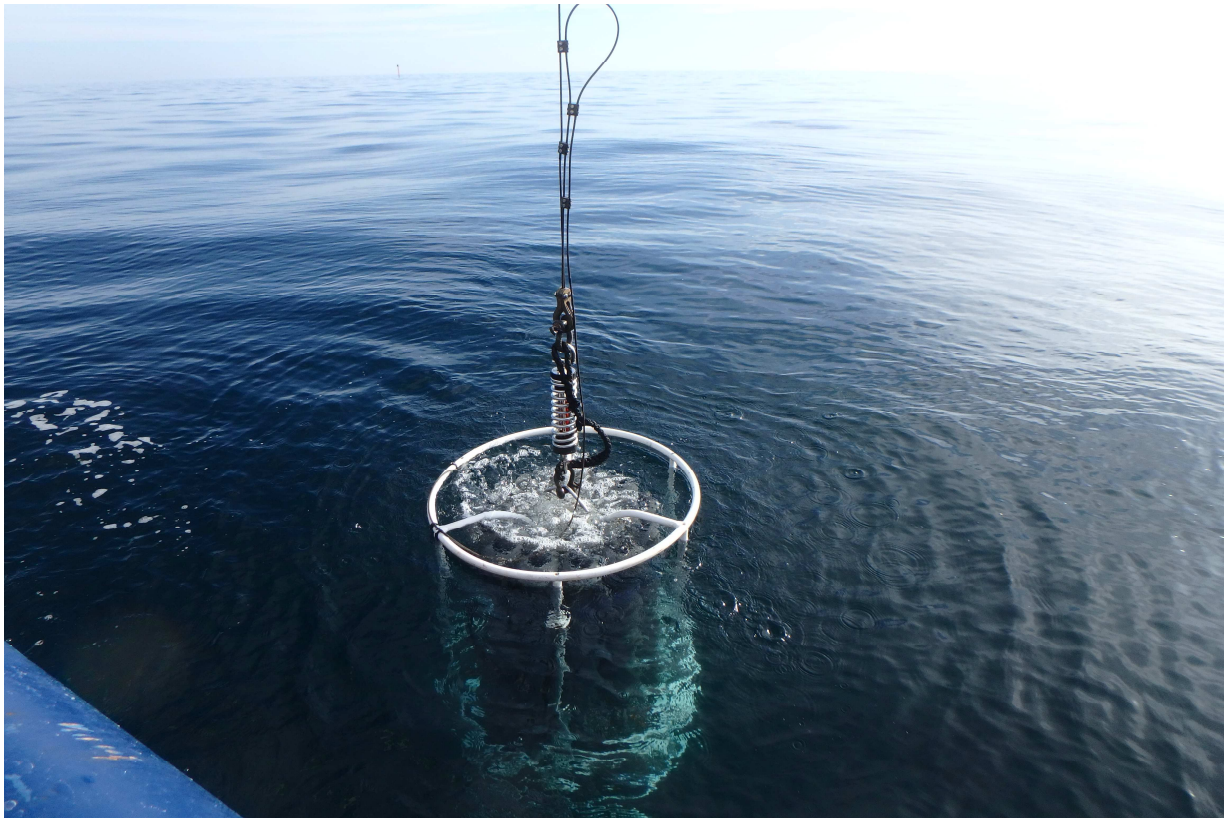
BOUSSOLE Monthly Cruise Report

Cruise 228
March 03-04, 2021

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

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

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



Deployment of the CTD-Rosette from the deck of the R/V *Téthys II* at the BOUSSOLE site.

BOUSSOLE project

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

March 18, 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 second day, two vertical zooplankton nets and a Manta horizontal net were performed at the DYFAMED site for the MOOSE program. The third day scheduled on March 5th was given to MOOSE DYFAMED program because of the bad weather forecasts during the DYFAMED day planned on March 6th.

Cruise Summary

The first day of the cruise was used for optical profiles, for CTD casts with water sampling and for a Secchi disk at the BOUSSOLE site. The ship stayed on the DYFAMED area during the night. The second day was used for two zooplankton nets at the DYFAMED site, for a Manta horizontal net during the way between the DYFAMED and BOUSSOLE sites and for CTD casts with water sampling, C-OPS profiles and Secchi disk at the BOUSSOLE site.

Diving and maintenance operations of the buoy were not carried out because these operations were performed separately with the *Papeete II* ship in the same time during the second day of the *Téthys* cruise for logistical reasons.

Wednesday 3 March 2021

The sea state was smooth with a light breeze to light air. The sky was cloudy yet the visibility was good. When arrived at BOUSSOLE, the CTD cast was deployed but had to be stopped at 50 m depths. Then it was brought back on deck because the electrocarrier cable was not unwinding in the right direction. It was due to the guide of the pulley on the winch not being in the right position. The crew put the guide back in its normal position to permit the electrocarrier cable to be unwounded correctly. Then, two CTD casts with water sampling and three C-OPS profiles were performed at the BOUSSOLE site. A cap was put on the backscattering meter for dark measurements during CTD 03 cast. Then a Secchi disk and another CTD cast were performed at the BOUSSOLE. For this last cast of the day (CTD 04), 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 operations of the day were finished and we went to the DYFAMED site where the ship stayed overnight.

Tuesday 4 March 2021

The sea state was smooth with a light breeze in the morning and a gentle breeze in the afternoon. The sky was cloudy yet the visibility was good. Two vertical zooplankton nets were performed in the morning at the DYFAMED site. Then a Manta horizontal net was deployed at the surface during the way between DYFAMED and BOUSSOLE. When arrived at BOUSSOLE, three CTD casts with water sampling and a Secchi disk were performed. Then six C-OPS profiles were performed but only four of them were kept. The other profiles had to be stopped or were eliminated because of an unstable irradiance (cloudy sky).

Pictures taken during this cruise can be found at:
https://photos.app.goo.gl/2JQFSaM3n4j8v5Go7

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

Cruise Report

Wednesday 3 March 2021 (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 01, 50 m.
1105 Winch of electrocarrier cable maintenance.
1210 CTD 02, 400 m with water sampling at 400, 200, 150, 80, 70, 60, 50, 40, 30, 20, 10 and 5m for HPLC and $a_{p.}$
1235 C-OPS 01, 02, 03.
1335 CTD 03, 300 m with water sampling at 50, 20 and 5m for TSM and phytoplankton microscopy, cytometry, PIC, POC, HPLC (OBOO project) (with cap on the HS6).
1415 Secchi disk, 12 m.
1445 CTD 04, 400 m (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).

1620 End of the operations. Departure to the DYFAMED site.

Tuesday 4 March 2021 (UTC)

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

0625 Zooplankton nets, 100 and 200 m (MOOSE program).
0710 Manta horizontal net (MOOSE program)
0745 Departure to the BOUSSOLE site.
0800 Arrival at the BOUSSOLE site.
0815 CTD 05, 100 m with water sampling at 60, 40, 15 and 5 m for metagenomic, cytometry and nutrients analyses (EFFICACY project).
0900 CTD 06, 10 m for TSM.
0925 CTD 07, 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, 10 m.
1205 C-OPS 04, 05, 06, 07.
1305 Departure to the Nice harbour.
1630 Arrival to the Nice harbour.

Problems identified during the cruise

- The first CTD cast had to be stopped at 50 m because the electrocarrier cable was not unwinding in the right direction. It was due to the guide of the pulley on the winch which was not in the right position. The crew put the guide back in its normal position to permit the electrocarrier cable to be unwounded correctly.

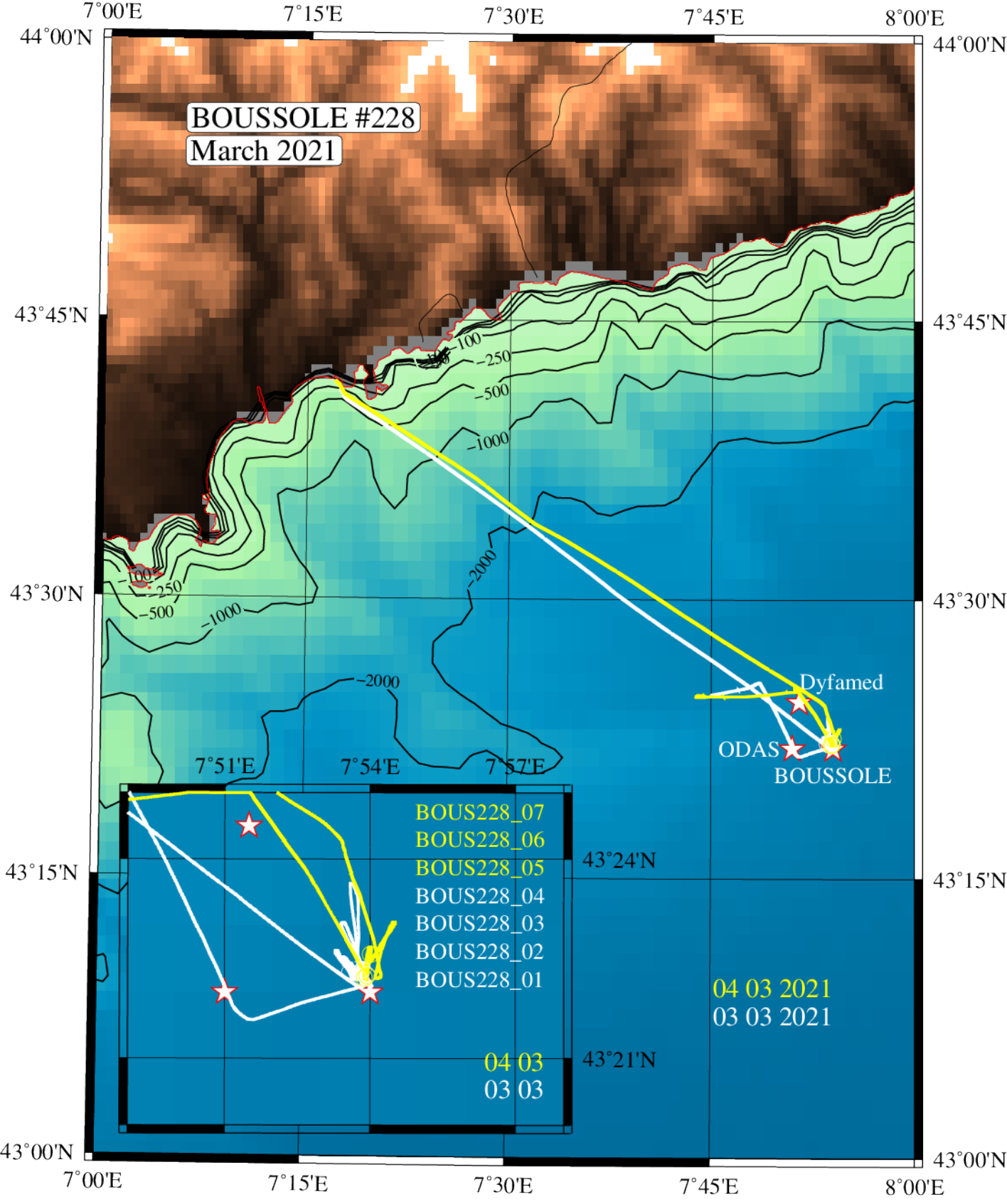
- The second day, the C-OPS measurements were not optimal because of the bad sky conditions during the acquisition: the sky was cloudy with unstable irradiance. Some profiles had to be stopped early during the acquisition.

- The CTD of the IOP package could not be installed on the package with the other instruments because it was still under calibrations at SeaBird. Therefore, the IOP data will have to be synchronized in time with the main CTD for the data processing.

Appendices

Cruise Summary Table for Boussole 228

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
03/03/21			BOUS228_01		10:56	0:08:00	50	43	22.225	7	53.452	overcast		7	5.4	100	1031.3	78		14.2	13.517	smooth			
			BOUS228_02	HPLC & ap	11:41	0:33:00	400	43	22.294	7	53.581	cloudy		6	5.1	100	1031.1	77		14.1	13.573	smooth			
		bou_c-ops_210303_1209_001_data.csv			12:34	0:03:14	79	43	22.562	7	53.751	cloudy	Cs	6	3.5	140	1030.4	77	good	14.4		smooth	0.3		no
		bou_c-ops_210303_1209_002_data.csv			12:48	0:05:09	135	43	22.996	7	53.759	cloudy	Cs	6	3.5	140	1030.4	77	good	14.4		smooth	0.3		no
		bou_c-ops_210303_1209_003_data.csv			13:01	0:03:28	88	43	23.309	7	53.757	cloudy	Cs	6	3.5	140	1030.4	77	good	14.4		smooth	0.3		no
			BOUS228_03	TSM & Phytofloat (HPLC, PIC, POC, Cyto, phyto) & dark HS6	13:34	0:20:00	300	43	22.34	7	53.849	cloudy		5	2.1	100	1029.7	77		14.5	13.609	smooth			
				Secchi 01	14:15	0:04:00	12	43	22	7	54	cloudy		7	1.3	247	1029.5	76	good	14.5		smooth			
			BOUS228_04	a-Sphere filter	14:44	1:32:00	400	43	22.252	7	53.935	cloudy		5	1	160	1029.3	75		15.2	13.641	smooth			
04/03/21			BOUS228_05	Metagenomics, Cyto, Nutrients	8:13	0:12:00	100	43	22.241	7	53.942	cloudy		4	4.5	260	1024.5	76		12.4	13.486	smooth			
			BOUS228_06	TSM	8:58	0:02:00	10	43	22.566	7	54.01	cloudy		4	4.7	250	1024.5	76		12.6	13.514	smooth			
			BOUS228_07	HPLC,ap, TA/TC & O_2	9:23	0:29:00	400	43	22.212	7	53.881	cloudy		3	4.9	240	1024.2	76		12.5	13.55	smooth			
				Secchi 02	10:50	0:04:00	10	43	22	7	54	cloudy							good			smooth			
		bou_c-ops_210304_1144_002_data.csv			12:15	0:04:58	128	43	22.845	7	54.048	cloudy	Sc	6	8.9	221	1022.4	76.8	good	13.4		smooth	0.5		no
		bou_c-ops_210304_1144_004_data.csv			12:32	0:04:23	112	43	23.313	7	53.844	cloudy	Sc	6	8.9	221	1022.4	76.8	good	13.4		smooth	0.5		no
		bou_c-ops_210304_1144_005_data.csv			12:43	0:00:47	25	43	23.583	7	53.713	cloudy	Sc	4	10.7	214	1021.8	77.5	good	13.4		smooth	0.4		no
		bou_c-ops_210304_1144_006_data.csv			12:53	0:04:27	115	43	23.923	7	53.55	cloudy	Sc	4	10.7	214	1021.8	77.5	good	13.4		smooth	0.4		no
05/03/21	DYFAMED cruise																							



GMT 2021 Mar 24 09:18:51

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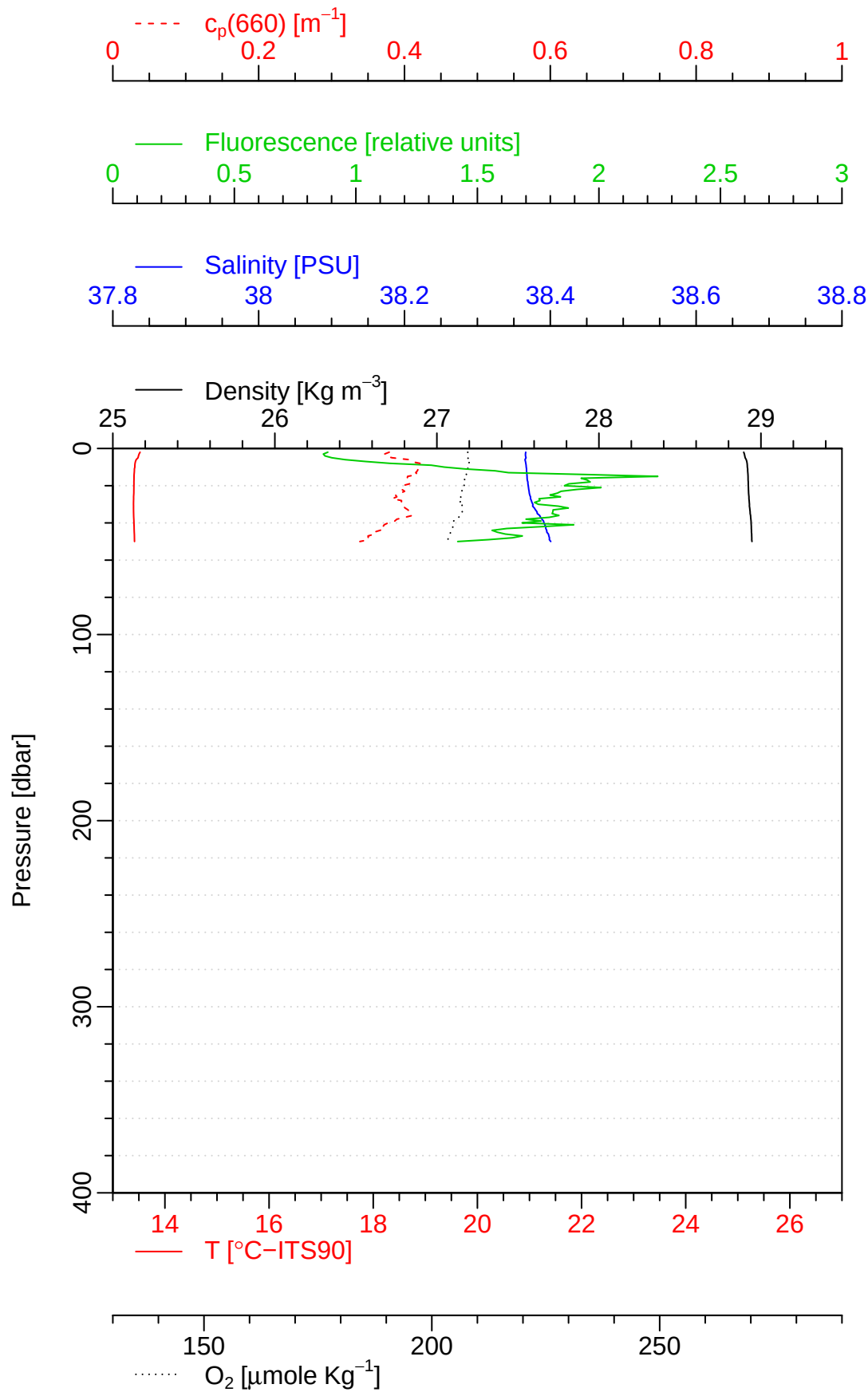

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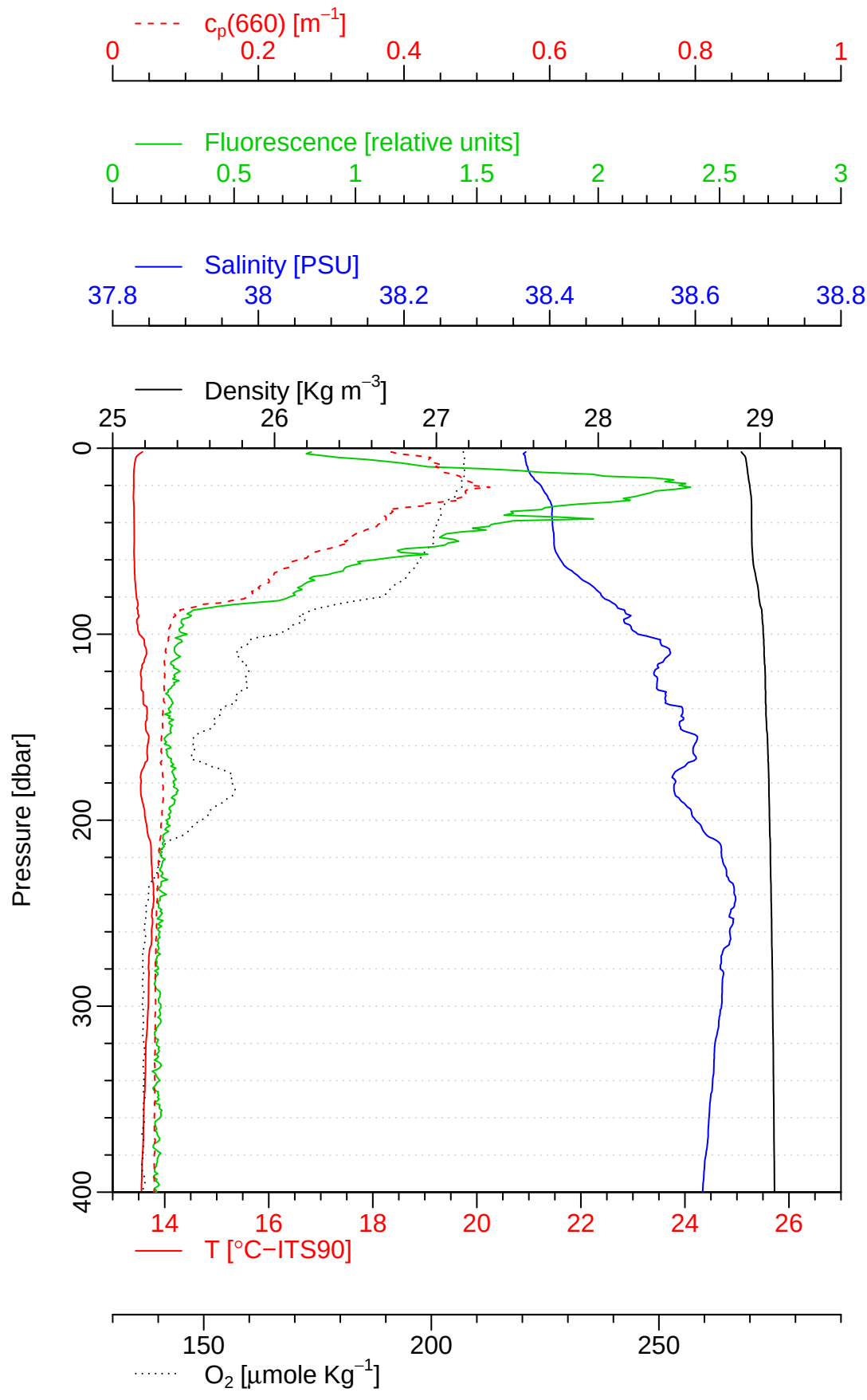

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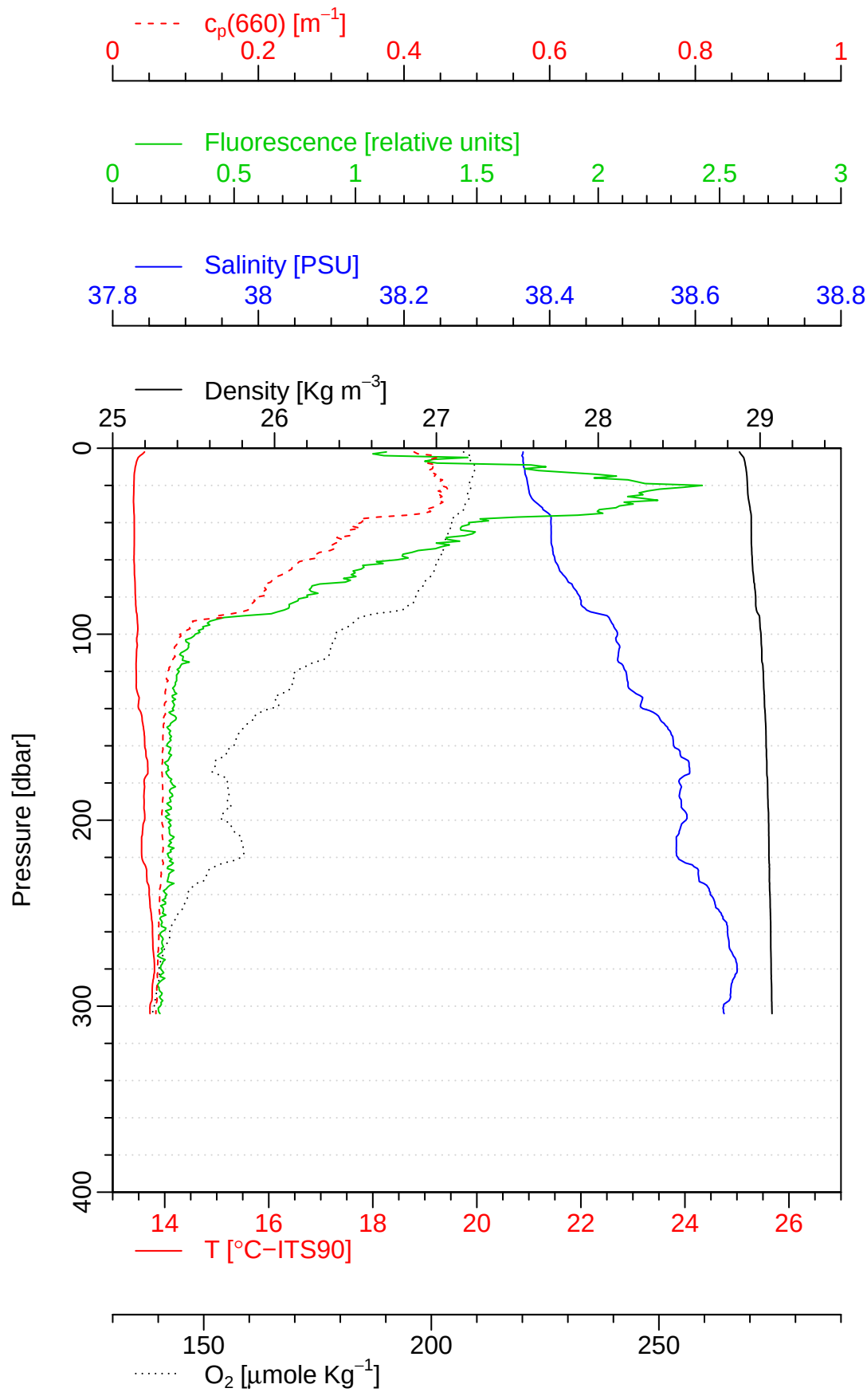

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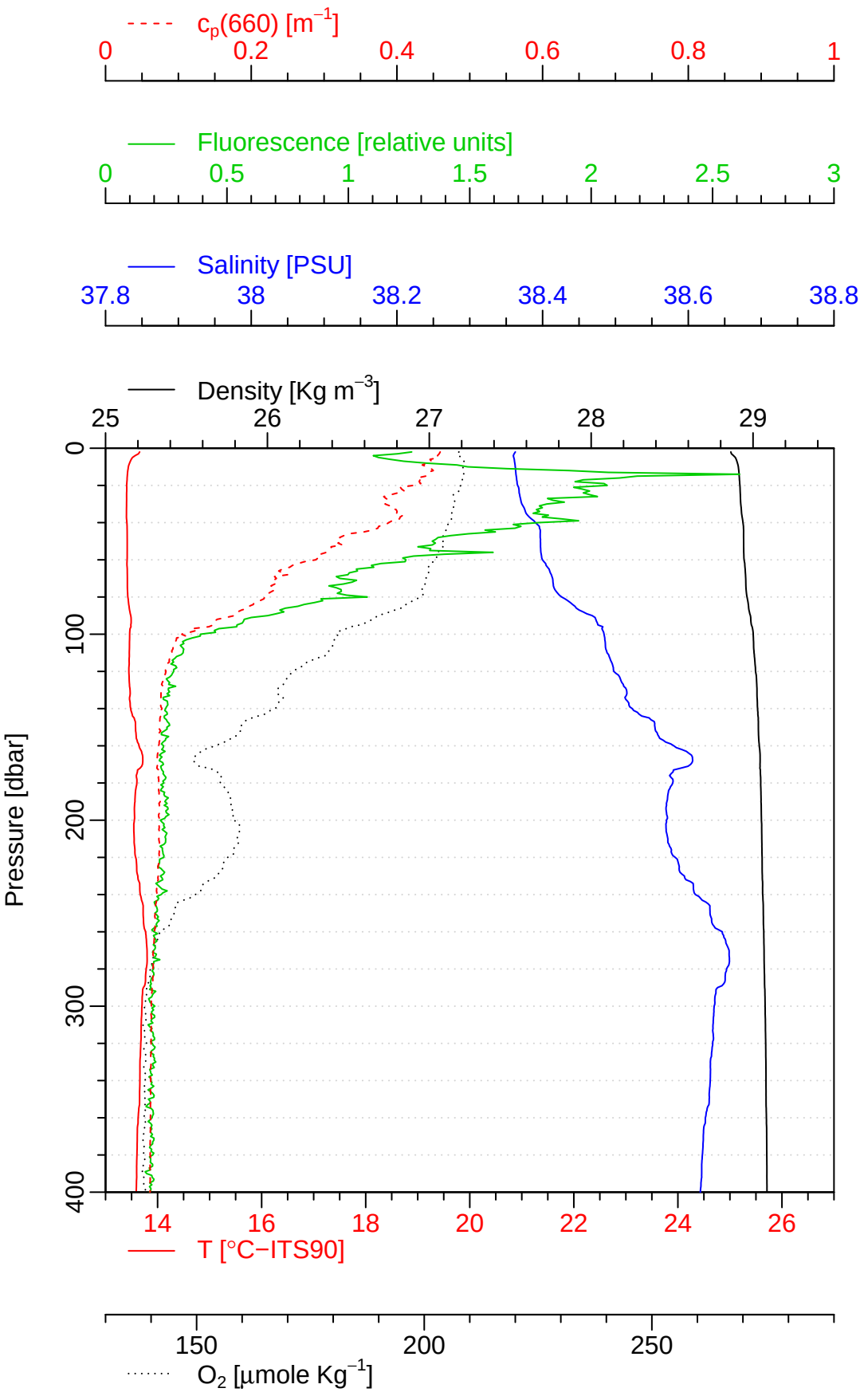

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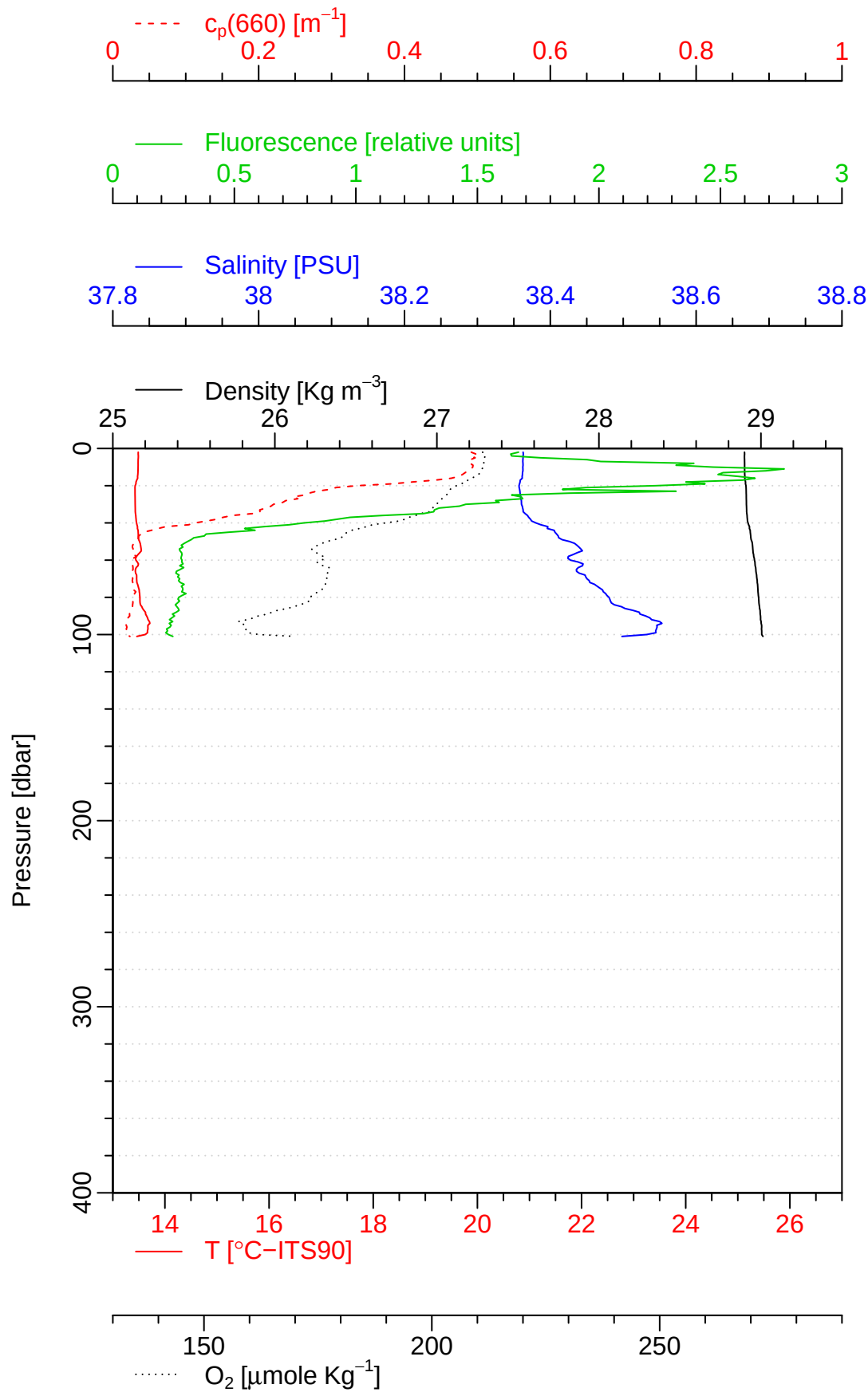

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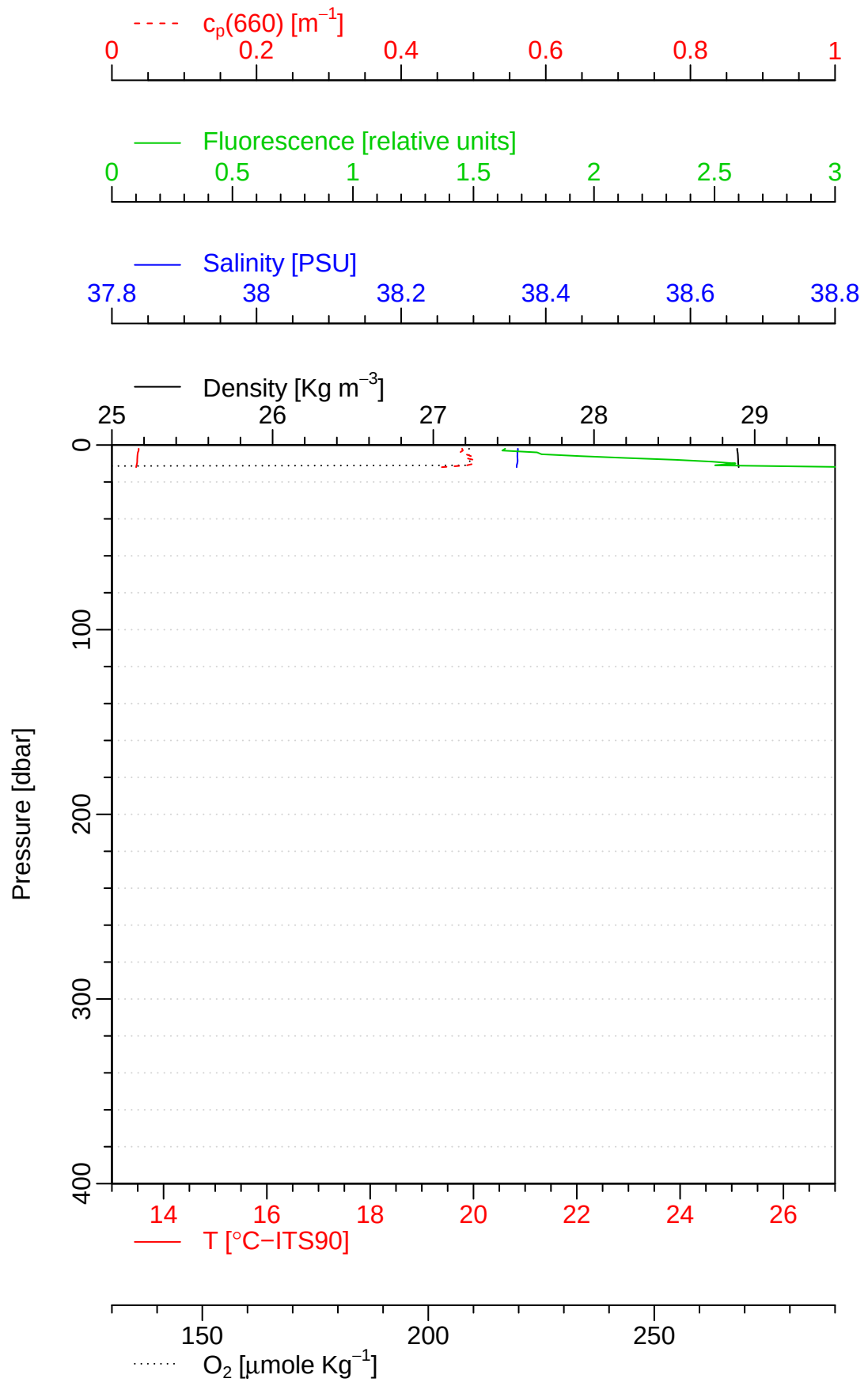

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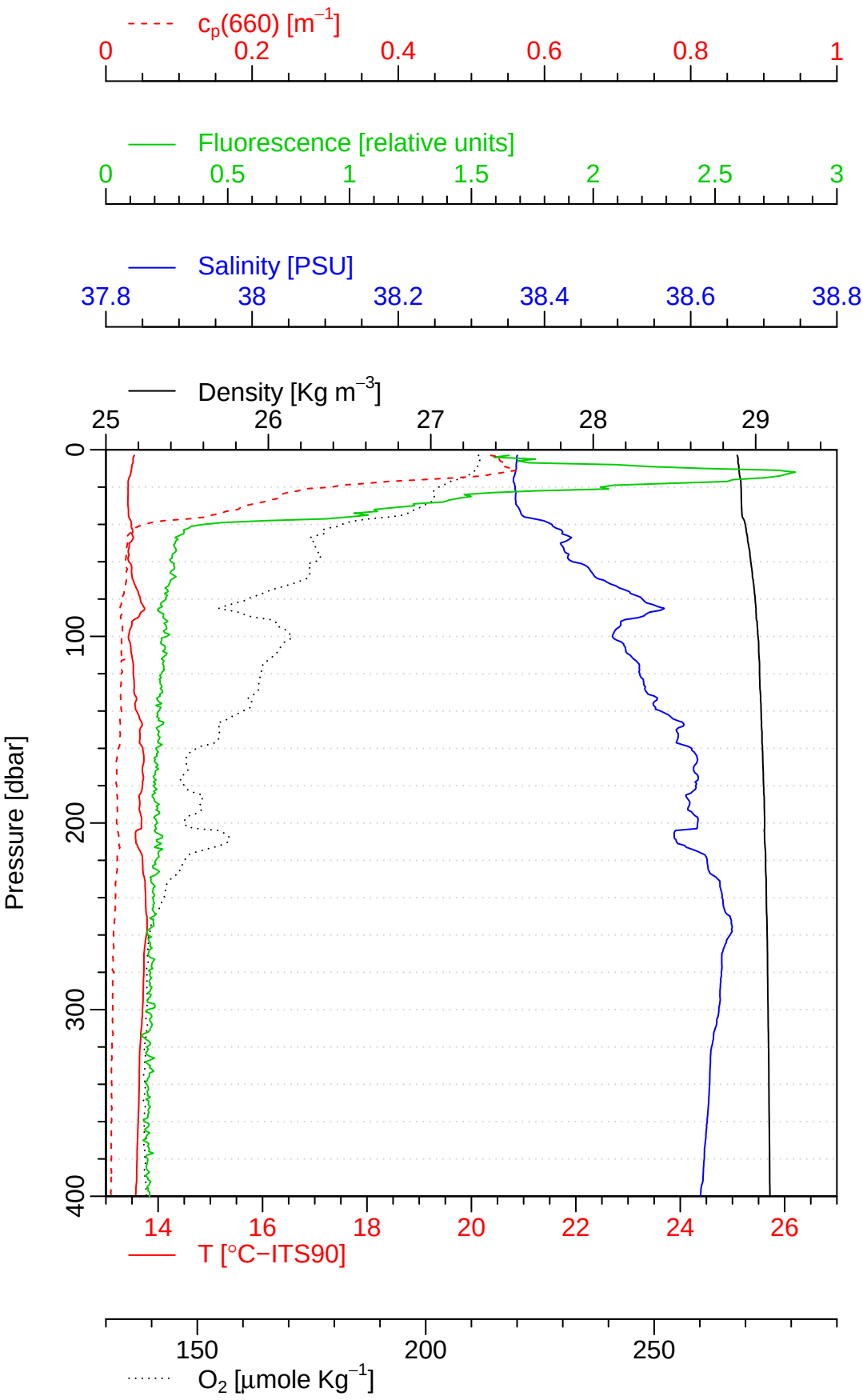

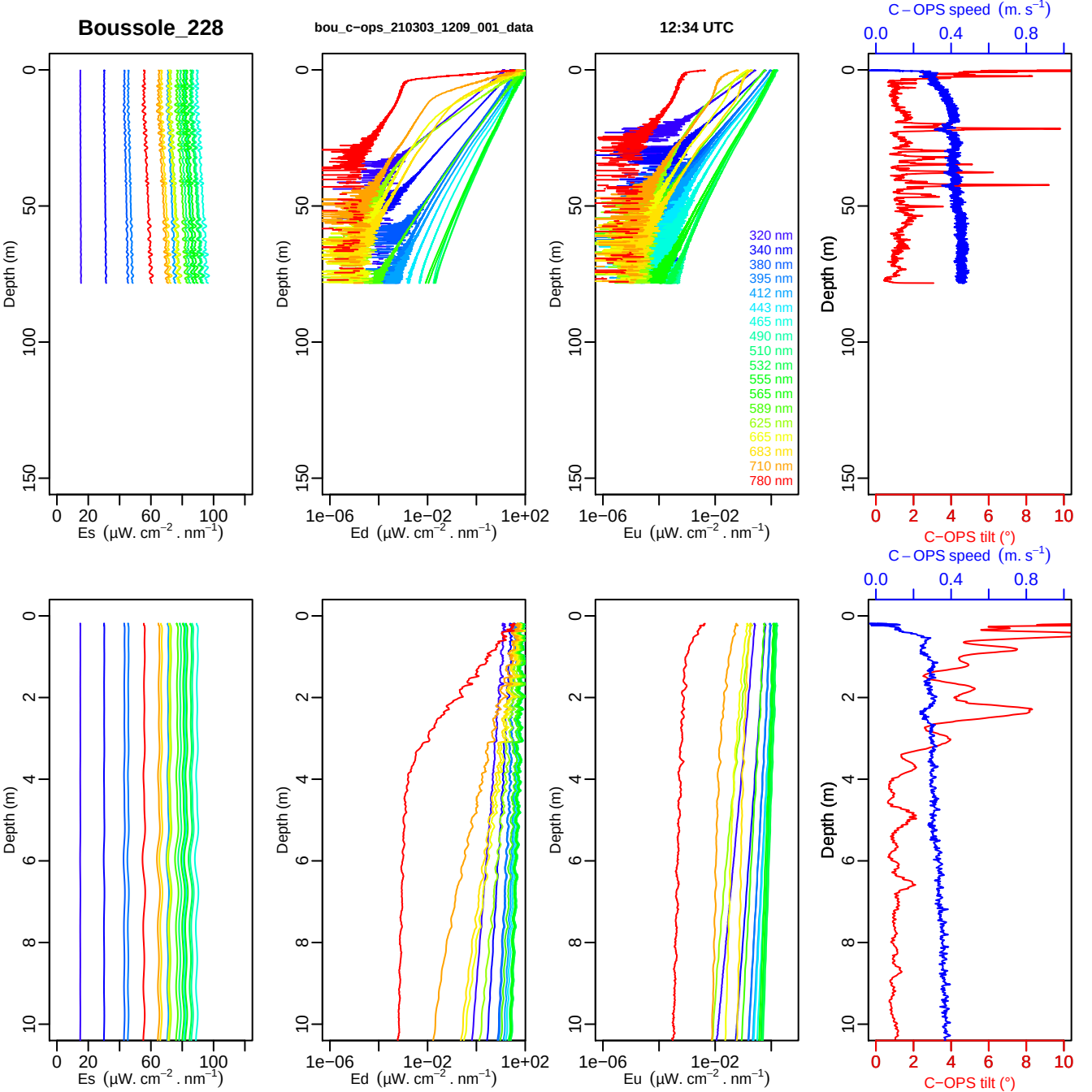
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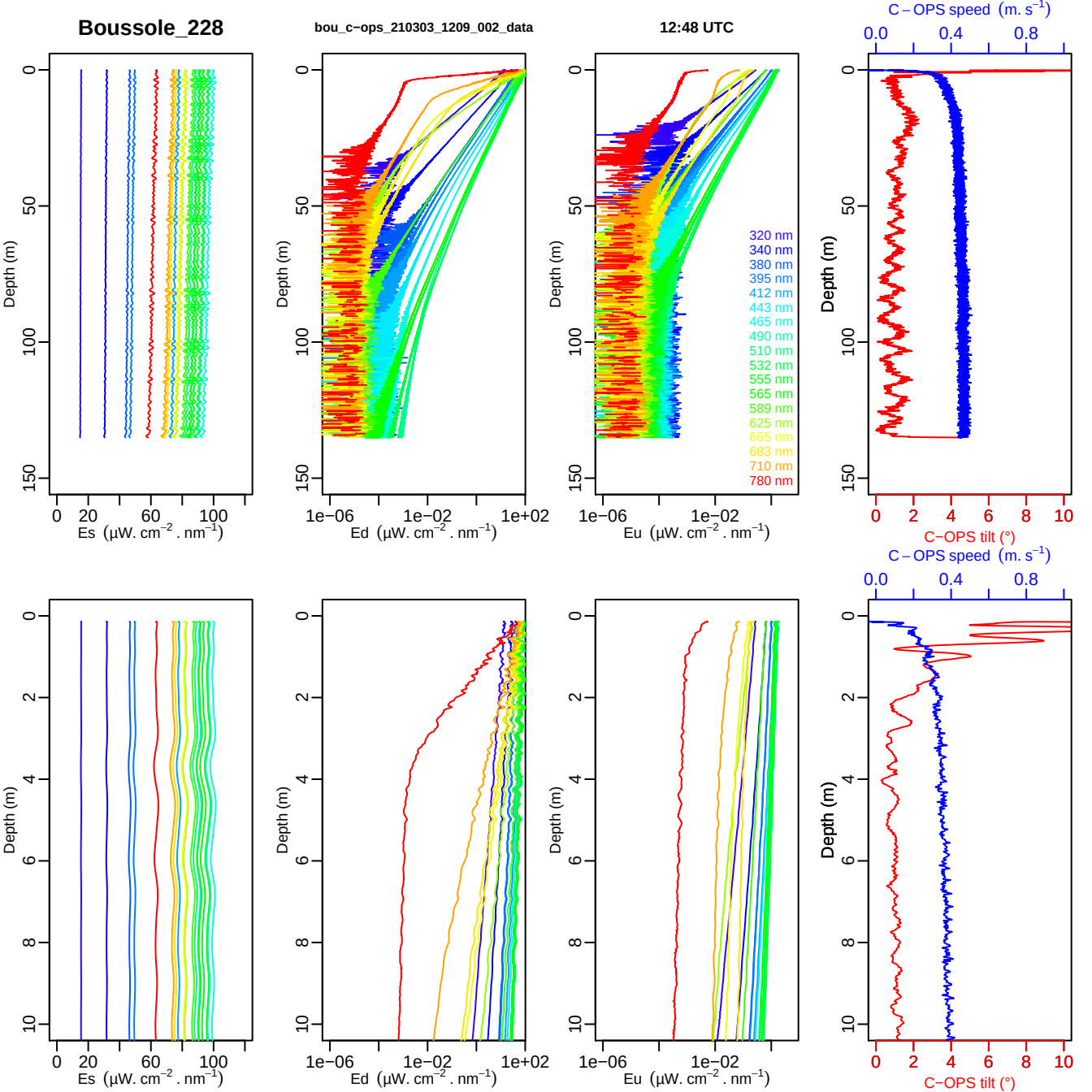
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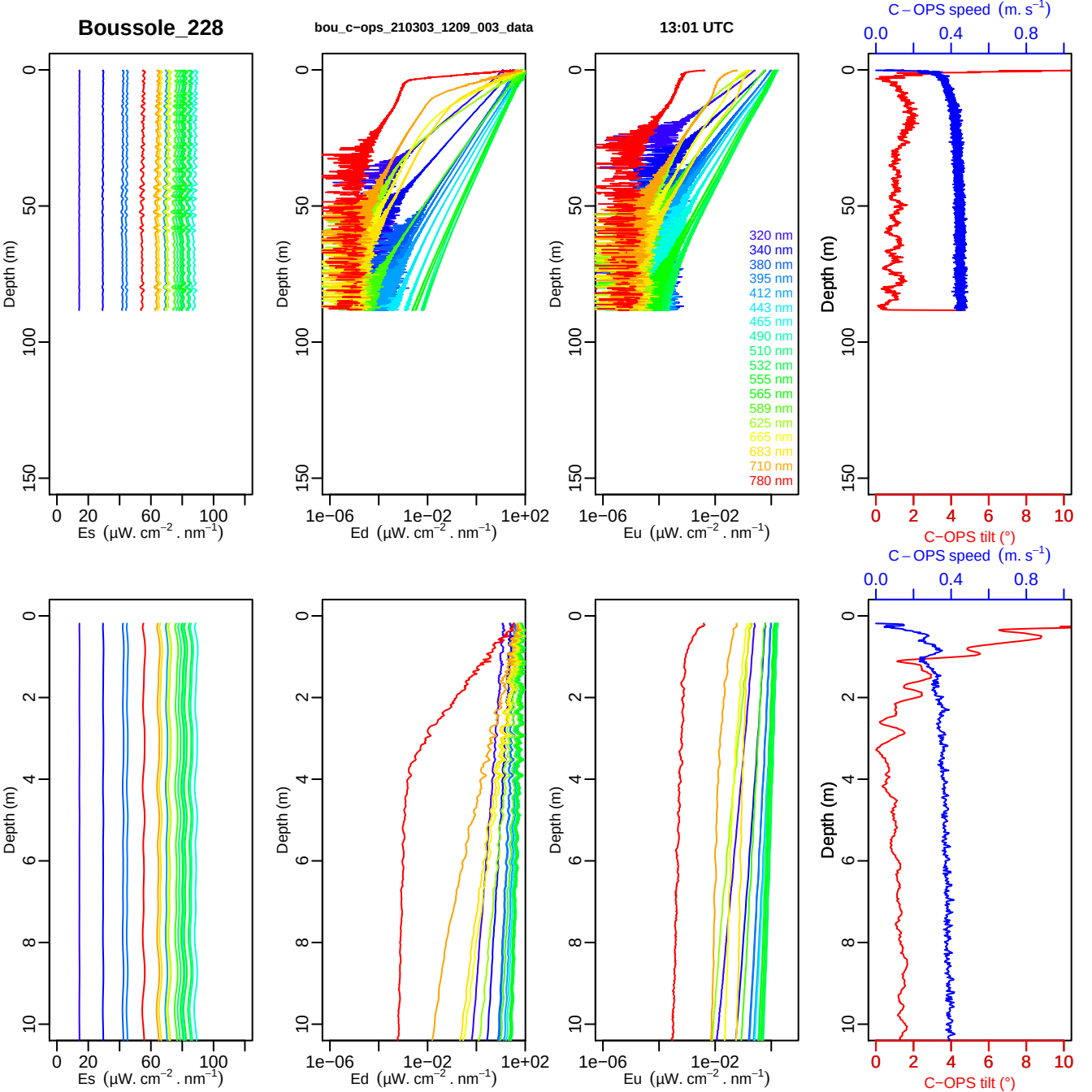
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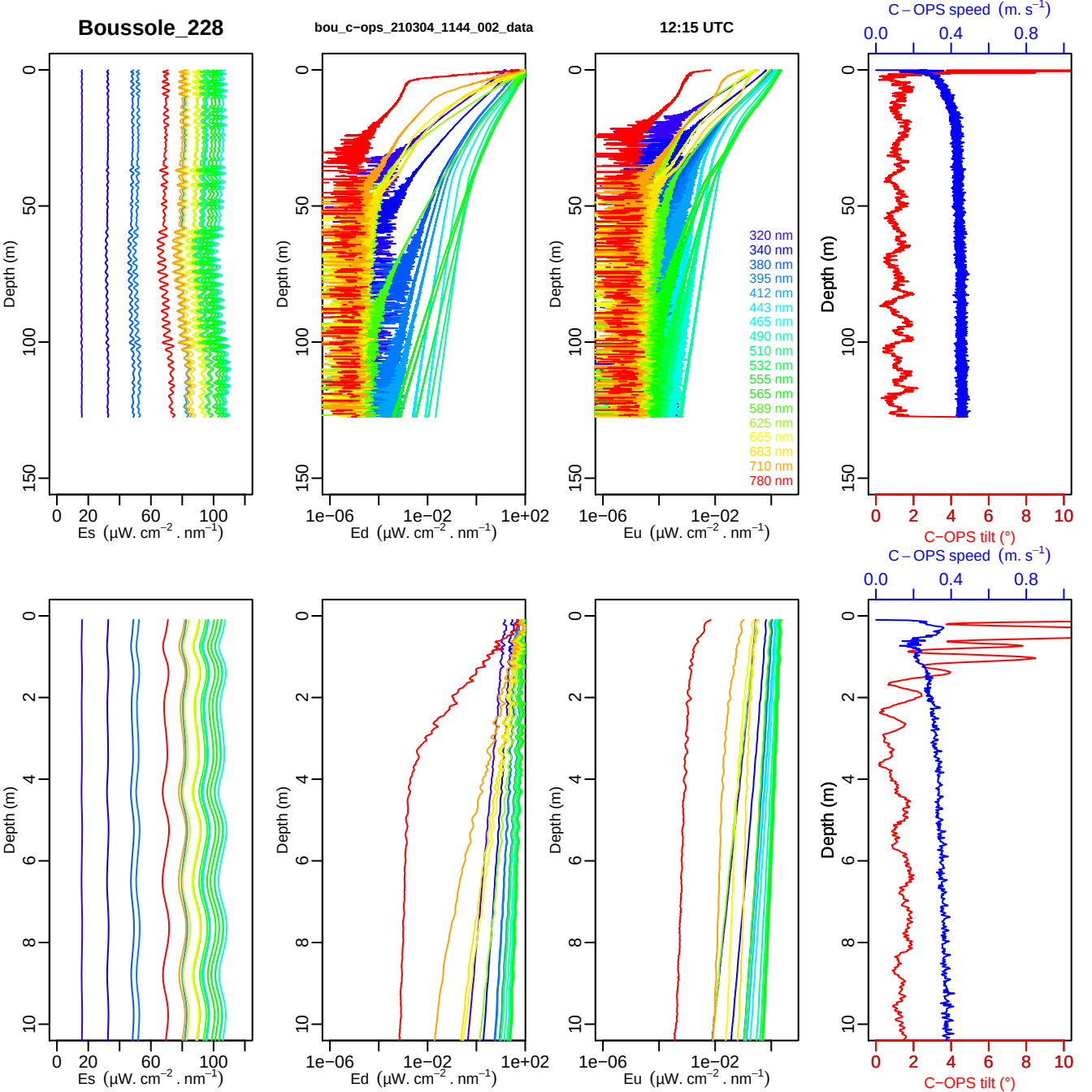
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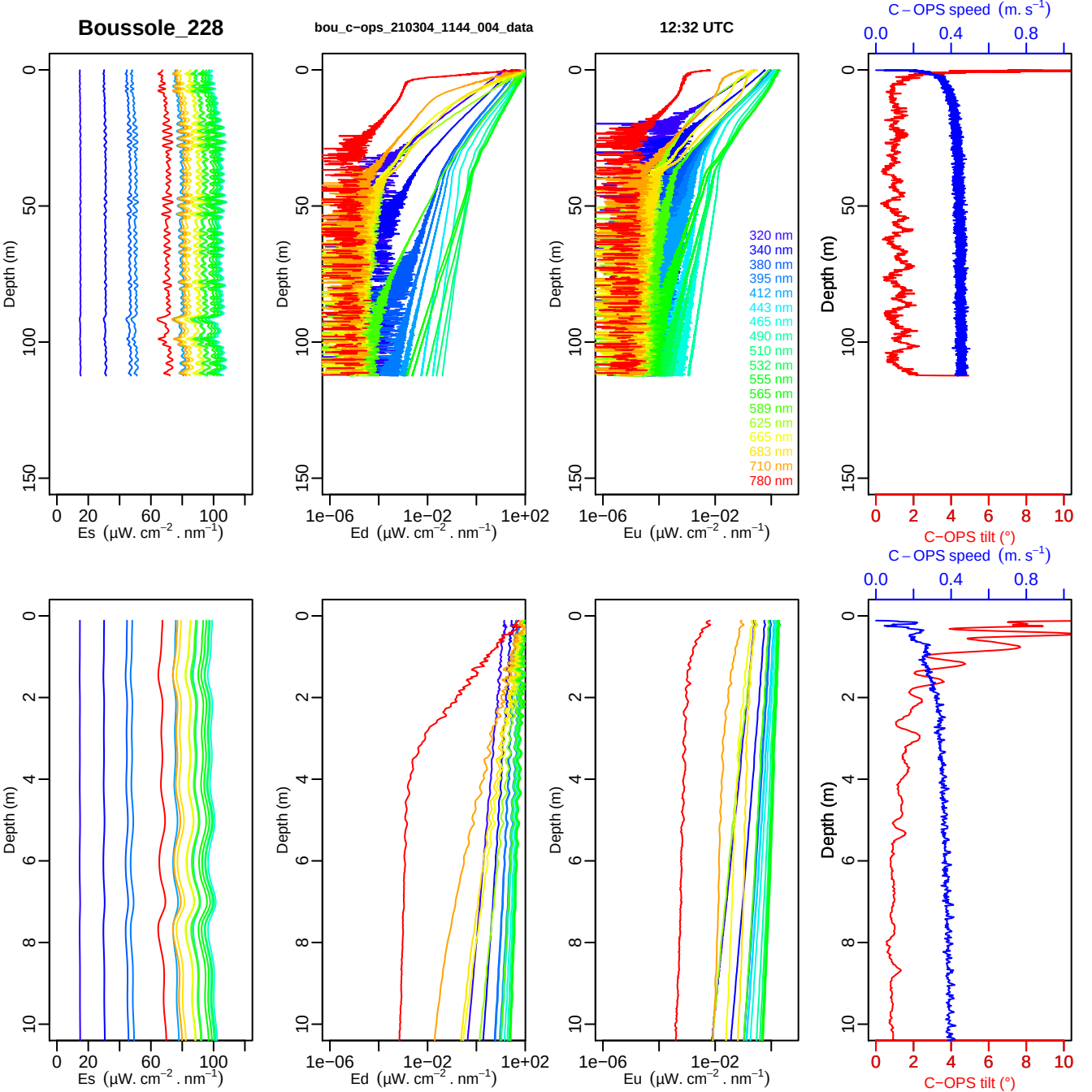
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20
60
100
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Ed (µW. cm^{-2}. nm^{-1})
Eu (µW. cm^{-2}. nm^{-1})
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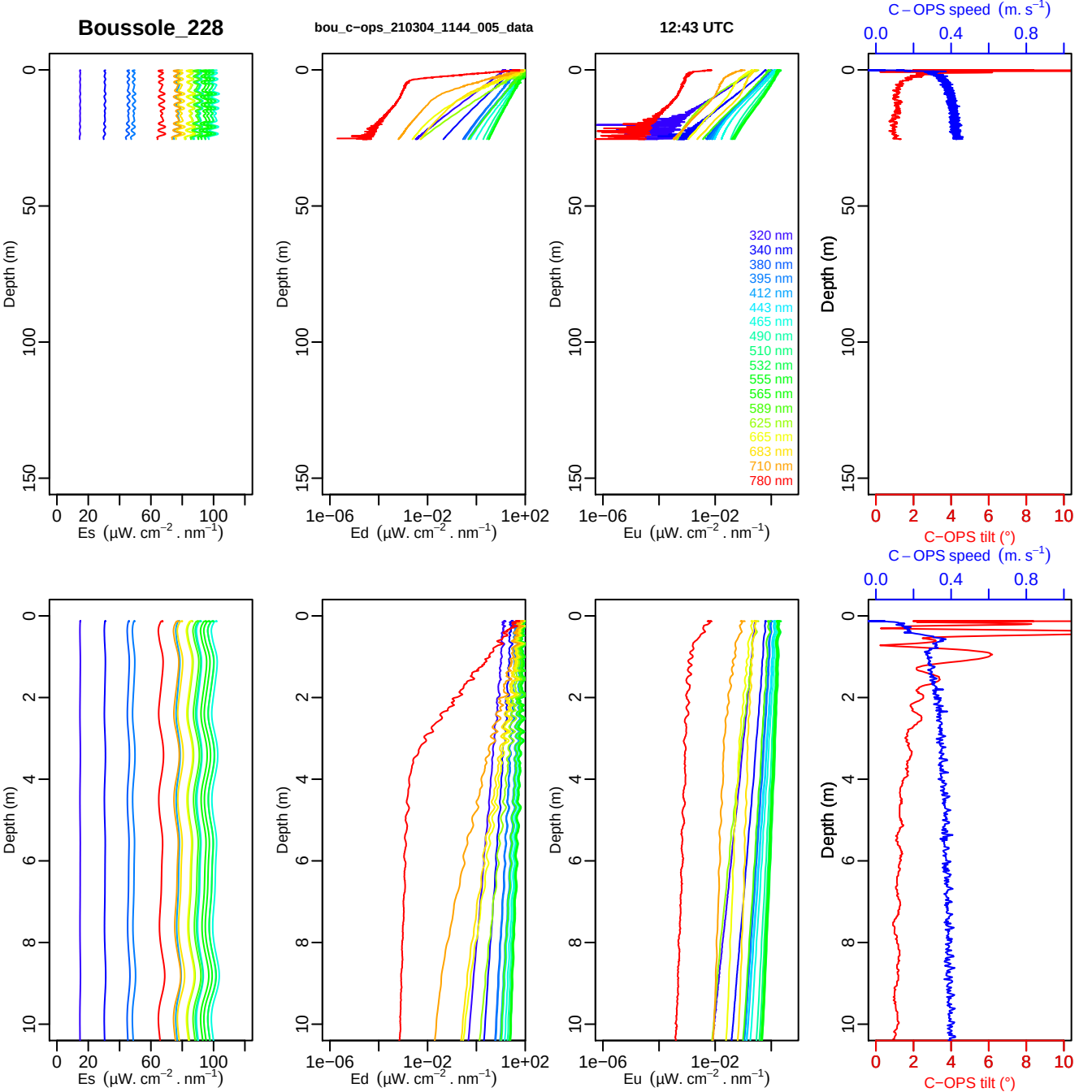
C−OPS tilt (°)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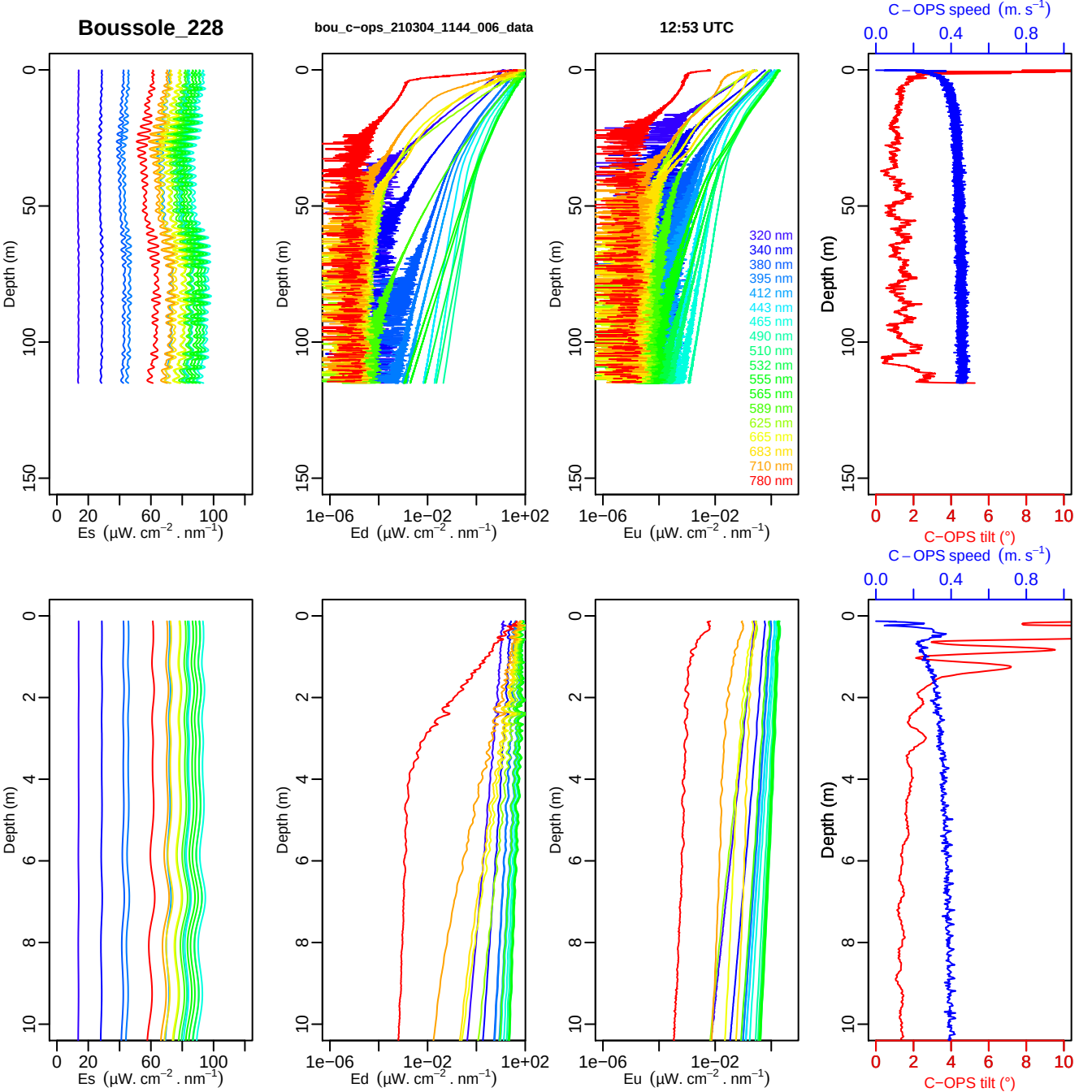
C−OPS tilt (°)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C-OPS tilt (°)
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565 nm
589 nm
625 nm
665 nm
683 nm
710 nm
780 nm