BOUSSOLE Monthly Cruise Report

Cruise 234
September 13-14, 2021

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

Science Personnel: Céline Dimier, Melek Golbol, Flavien Petit, Thomas Pavy et Isabelle Simonnet.

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Autonomous CTD beacons to be later on deployed on Weddell seals in the Southern Ocean were affixed on the CTD Rosette for testing and for data intercomparison with the main CTD.

BOUSSOLE project

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

September 22, 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), 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).

Several CTD beacons equipped with fluorometers that are planned to be deployed on Weddell seals in the Southern Ocean by the *Laboratoire d'Océanographie et du Climat* (LOCEAN) and the *Centre d'Etudes Biologiques de Chizé* (CEBC) were tested during this cruise. They were installed on the CTD Rosette for comparison with the BOUSSOLE main CTD.

The buoy is currently not working. All the instruments of the BOUSSOLE buoy except the autonomous ones were recovered the first day in order to perform work and tests on them in the lab.

The last day, a Manta net was performed at the DYFAMED site in the way back to Nice harbour because the weather conditions were better than those of the day after, which was planned for DYFAMED cruise (MOOSE program).

Cruise Summary

The first day was used for diving operations, for a Secchi disk, for CTD casts with water sampling and for optical profiles at the BOUSSOLE site. The second day was used for optical profiles, for CTD casts with water sampling, for a Secchi disk at the BOUSSOLE site and for a Manta net at the DYFAMED site.

Monday 13 September 2021

The sea state was firstly smooth and then slight, with a moderate breeze. The sky was blue and the visibility was good. Firstly, divers went at sea to remove the instruments from the buoy: DL3 (data loggers) at 4 and 9 m, CTD at 9 m, radiometers at 4 and 9 m, transmissometers at 4 and 9 m, fluorimeters at 4 and 9 m, backscattering meter at 9 m and the CLC (charge controller) at 6 m. All the cables were also recovered. In the meantime, the junction box, the surface radiometer, the surface DL3 and the cables were recovered from the top of the buoy. These operations were performed because the recent multiple faults of the system now require full testing in the lab to identify the problems and redeploy a functional system.
In the meantime, a Secchi disk was performed. Then, two CTD casts with water sampling and two C-OPS profiles were performed at the BOUSSOLE site. For the second CTD cast (CTD #002), a cap was put on the backscattering meter for dark measurements.

Tuesday 14 September 2021

The sea state was smooth with a light breeze. The sky was overcast and the visibility was medium. Firstly, three C-OPS profiles were performed at the BOUSSOLE site. Then two CTD casts with water sampling and a Secchi disk were performed at the BOUSSOLE site. For the first CTD cast (CTD #003), 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. Finally, we went at the DYFAMED site to deploy the Manta net in the way back to Nice harbour.

Pictures taken during this cruise can be found at:
https://photos.app.goo.gl/BuxmsSbTQSppvP198

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 13 September 2021(UTC)

People on bord: Céline Dimier, Melek Golbol, Flavien Petit, Thomas Pavy et Isabelle Simonnet (divers).

0600 Departure to the BOUSSOLE site.
0930 Arrival at the BOUSSOLE site.
0945 Diving operations: recovery of buoy instruments.
1025 Secchi 01, 21 m.
1130 End of diving operations.
1205 CTD 01, 400 m with water sampling at 400, 200, 150, 80, 70, 60, 50, 40, 30, 20, 10 and 5 m for HPLC and $a_{p.}$
1300 C-OPS 01, 02.
1350 CTD 02, 300 m with water sampling at 60, 40 and 5 m for TSM, and phytoplankton microscopy, cytometry, PIC, POC, HPLC (with cap on the HS6).

1415 Departure to the Nice harbour.
1730 Arrival to the Nice harbour.

Tuesday 14 September 2021 (UTC)

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

0445 Departure to the BOUSSOLE site.
0750 Arrival at the BOUSSOLE site.
0810 C-OPS 03, 04, 05.
0905 CTD 03, 400 m with water sampling at 60, 40, 20 and 5 m 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).
1050 Secchi 02, 24 m.
1115 CTD 04, 400 m with water sampling at 400, 200, 150, 80, 70, 60, 50, 40, 30, 20, 10 and 5 m for HPLC, $a_{p,}$ O_2 and TA/TC.
1155 Departure to the DYFAMED station.
1225 Arrival to the DYFAMED station.
Surface Manta net
1255 End of Surface Manta net
Departure to the Nice harbour.
1600 Arrival to the Nice harbour.

Problems identified during the cruise

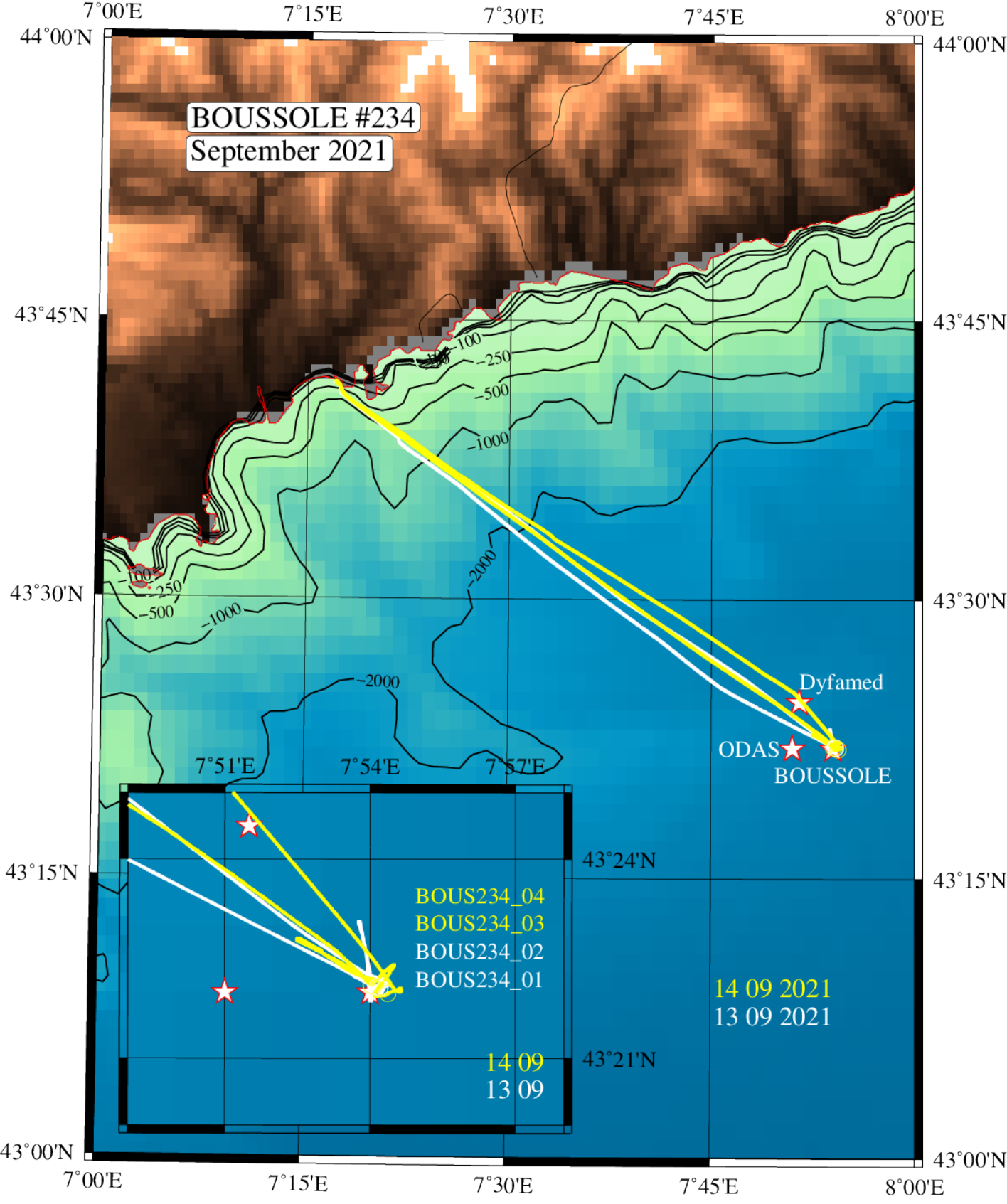
- The first day, it was not possible to perform a third C-OPS profile because the sky became cloudy with unstable irradiance.

- CTD #04: the Niskin bottle #12 (5 m) was leaking.

Appendices

Cruise Summary Table for Boussole 234

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
13/09/21				Secchi 01	10:25	0:04:00	21	43	22	7	54	blue		0					good			smooth			
			BOUS234_01	HPLC & ap	12:07	0:28:00	400	43	22.057	7	54.203	blue		1	12.2	214	1016.6	82		23.9	23.86	smooth			
		bou_c-ops_210913_1250_001_data.csv			13:01	0:03:41	89	43	22.015	7	53.095	blue	Ci	2	13.2	232	1016.2	79	good	24.1		slight	0.6		yes
		bou_c-ops_210913_1250_003_data.csv			13:18	0:05:28	141	43	22.07	7	53.088	blue	Ci	2	13.2	232	1016.2	79	good	24.1		slight	0.6		yes
			BOUS234_02	TSM & Phytofloat (PIC, POC, Cyto, phyto)	13:51	0:19:00	300	43	22.081	7	54.154	blue		2	13	246	1016.1	83.8		24	23.88	slight			
14/09/21		bou_c-ops_210914_0756_001_data.csv			8:09	0:04:07	106	43	22.023	7	53.085	overcast	As	8	4.4	209	1017.6	87.9	medium	23.6		smooth	0.4		no
		bou_c-ops_210914_0756_002_data.csv			8:21	0:04:29	115	43	22.038	7	53.043	overcast	As	8	4.4	209	1017.6	87.9	medium	23.6		smooth	0.4		no
		bou_c-ops_210914_0756_003_data.csv			8:33	0:05:28	144	43	22.577	7	53.034	overcast	As	8	4.4	209	1017.6	87.9	medium	23.6		smooth	0.4		no
			BOUS234_03	TSM, Metagenomics, Cyto & Nutrients	9:06	1:24:00	400	43	22.097	7	54.03	overcast		7	3.3	222	1017.9	87.5		23.7	23.68	smooth			
				Secchi 02	10:50	0:04:00	24	43	22	7	54	overcast		8					medium			smooth			
			BOUS234_04	HPLC, ap, O_2 & TA/TC	11:13	0:30:00	400	43	21.975	7	54.367	overcast		8	5.8	235	1017.7	87.6		23.7	23.73	smooth			



GMT 2021 Sep 24 09:40:03

bous234_01

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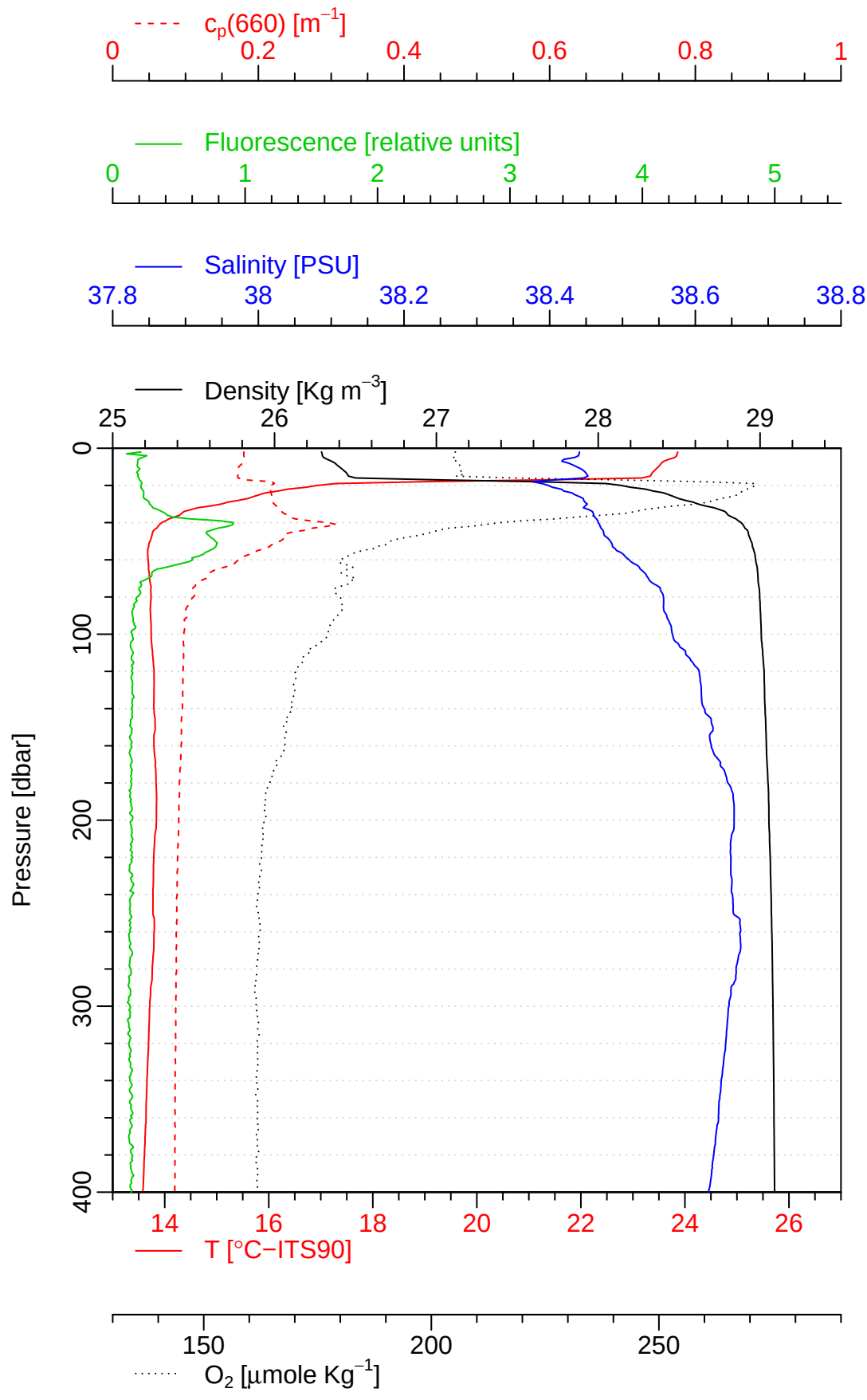
Latitude = 43 22.057 N



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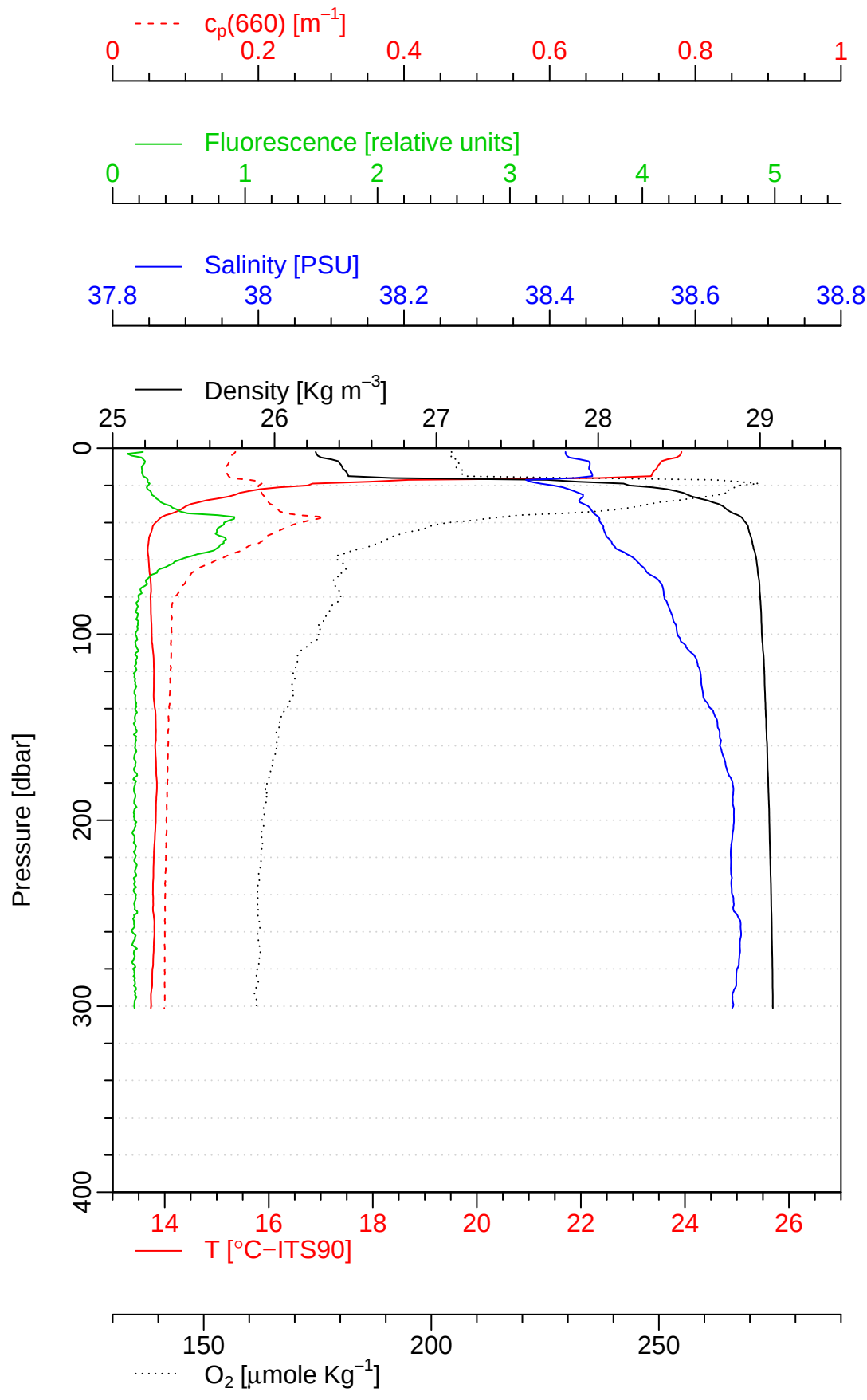

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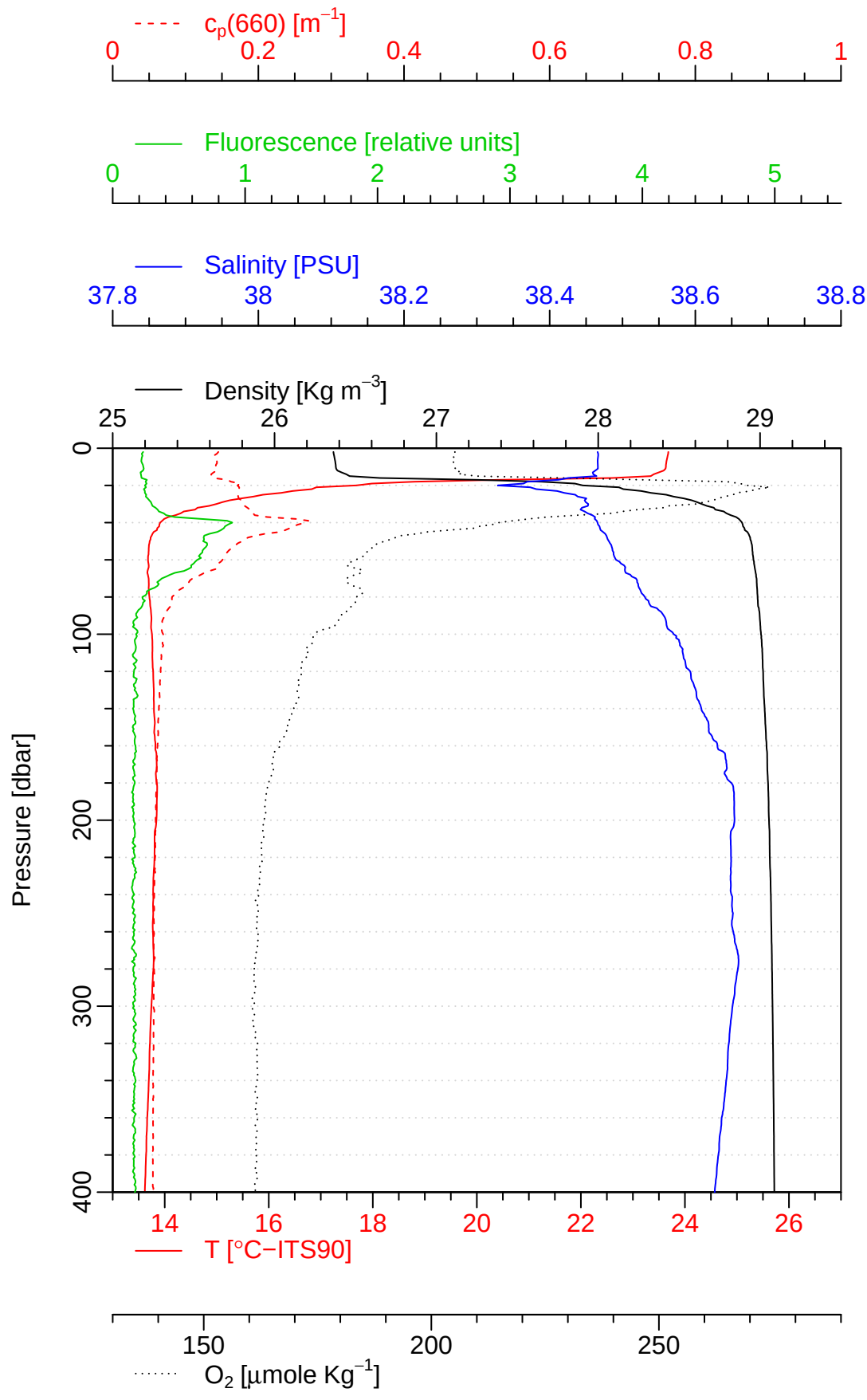

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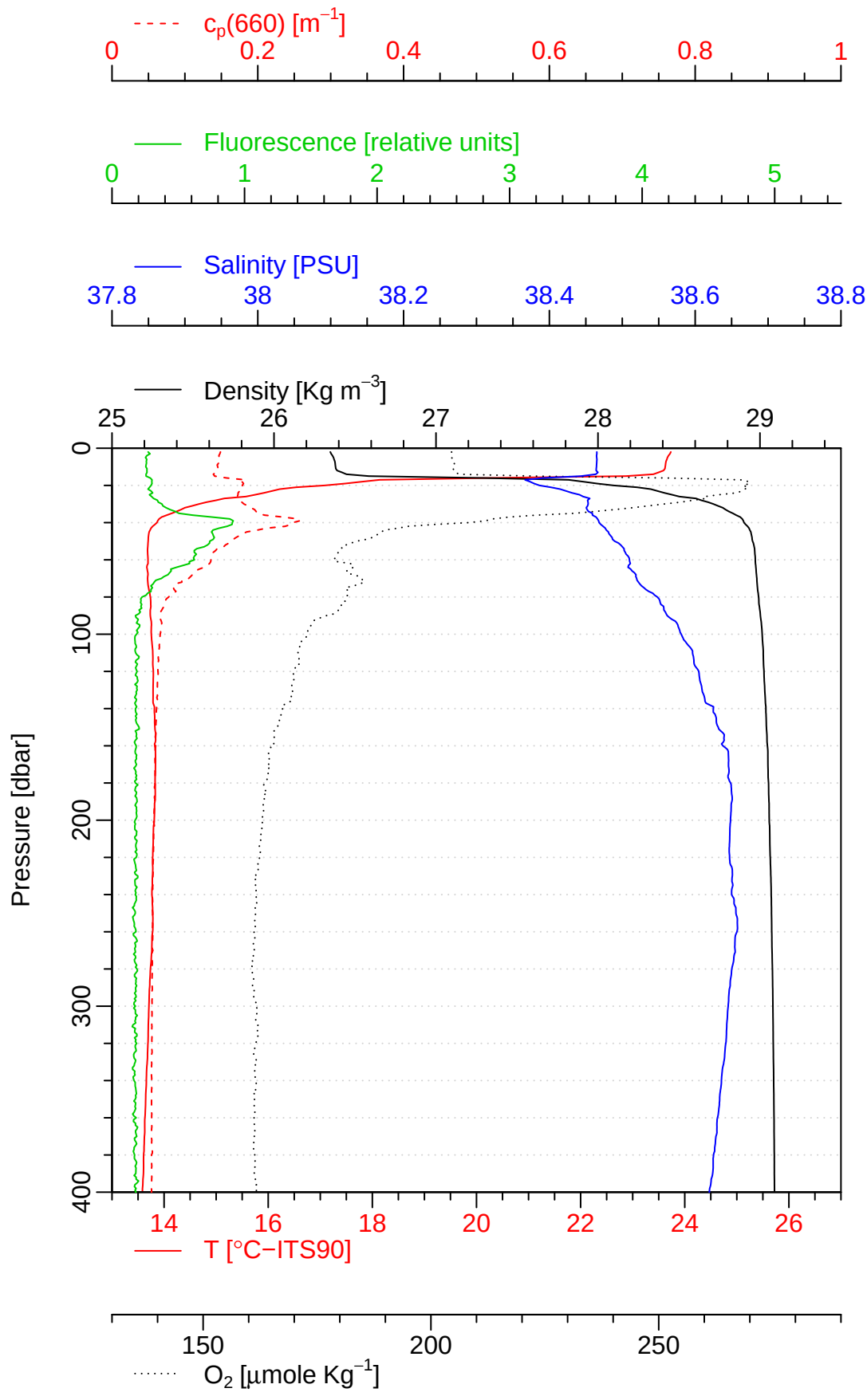
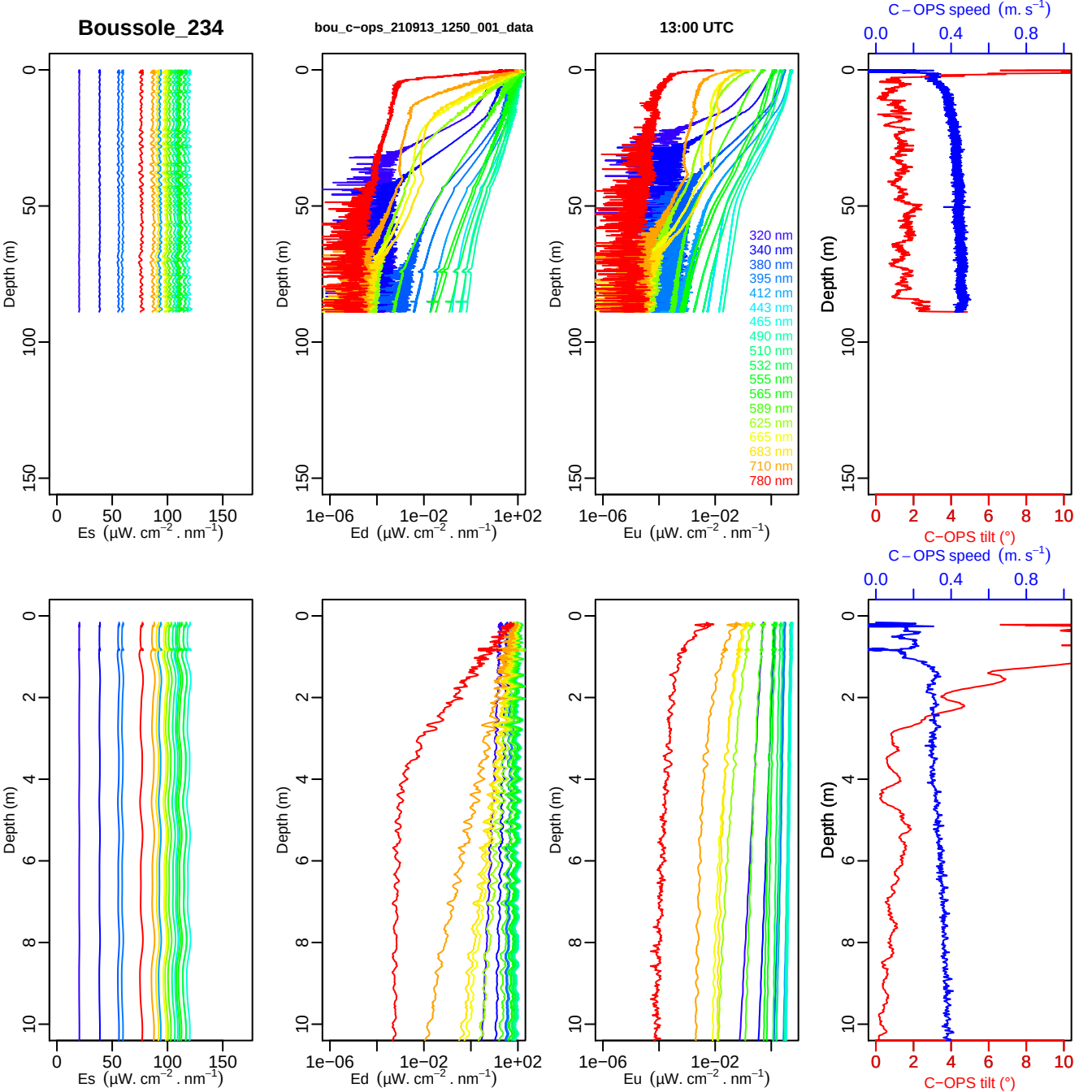
Latitude = 43 21.975 N

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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
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510 nm
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555 nm
565 nm
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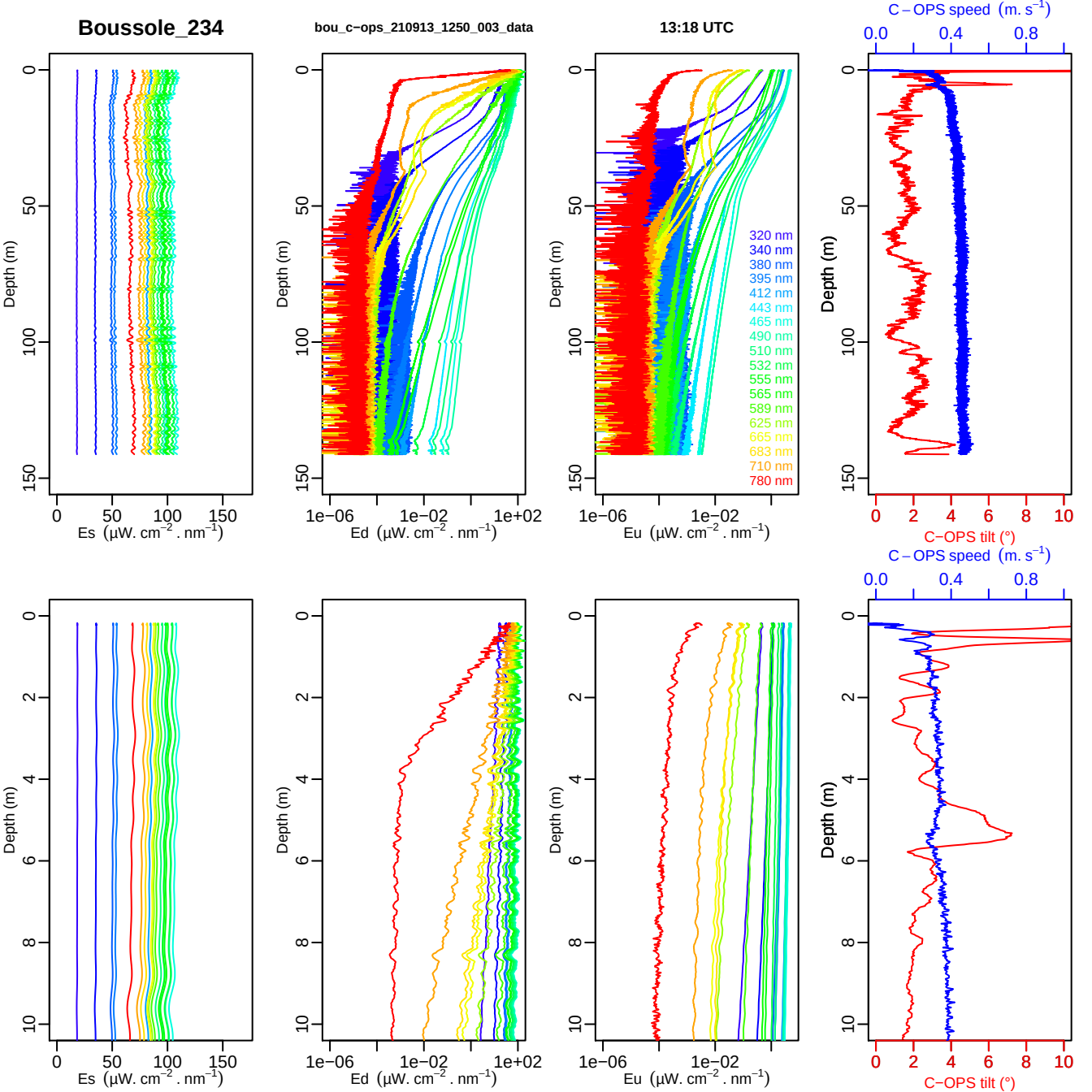
625 nm
665 nm
683 nm
710 nm
780 nm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C – OPS speed (m. s^{-1})
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0.4
0.8
Depth (m)
0
50
100
150
Es (µW. cm^{-2}. nm^{-1})
Ed (µW. cm^{-2}. nm^{-1})
Eu (µW. cm^{-2}. nm^{-1})
1e−06
1e−02
1e+02
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589 nm
625 nm
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683 nm
710 nm
780 nm
C−OPS tilt (°)
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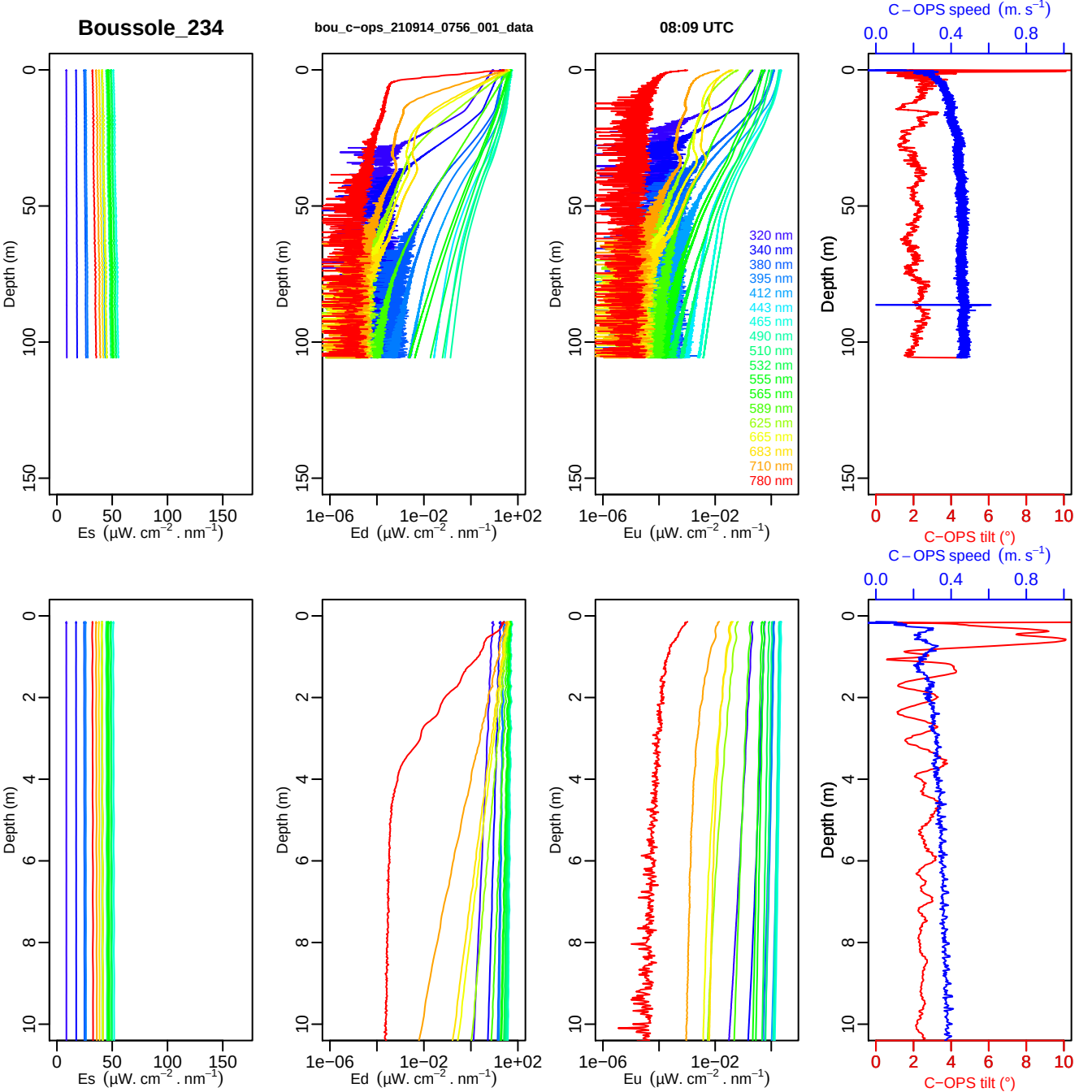
2
4
6
8
10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C – OPS speed (m. s^{-1})
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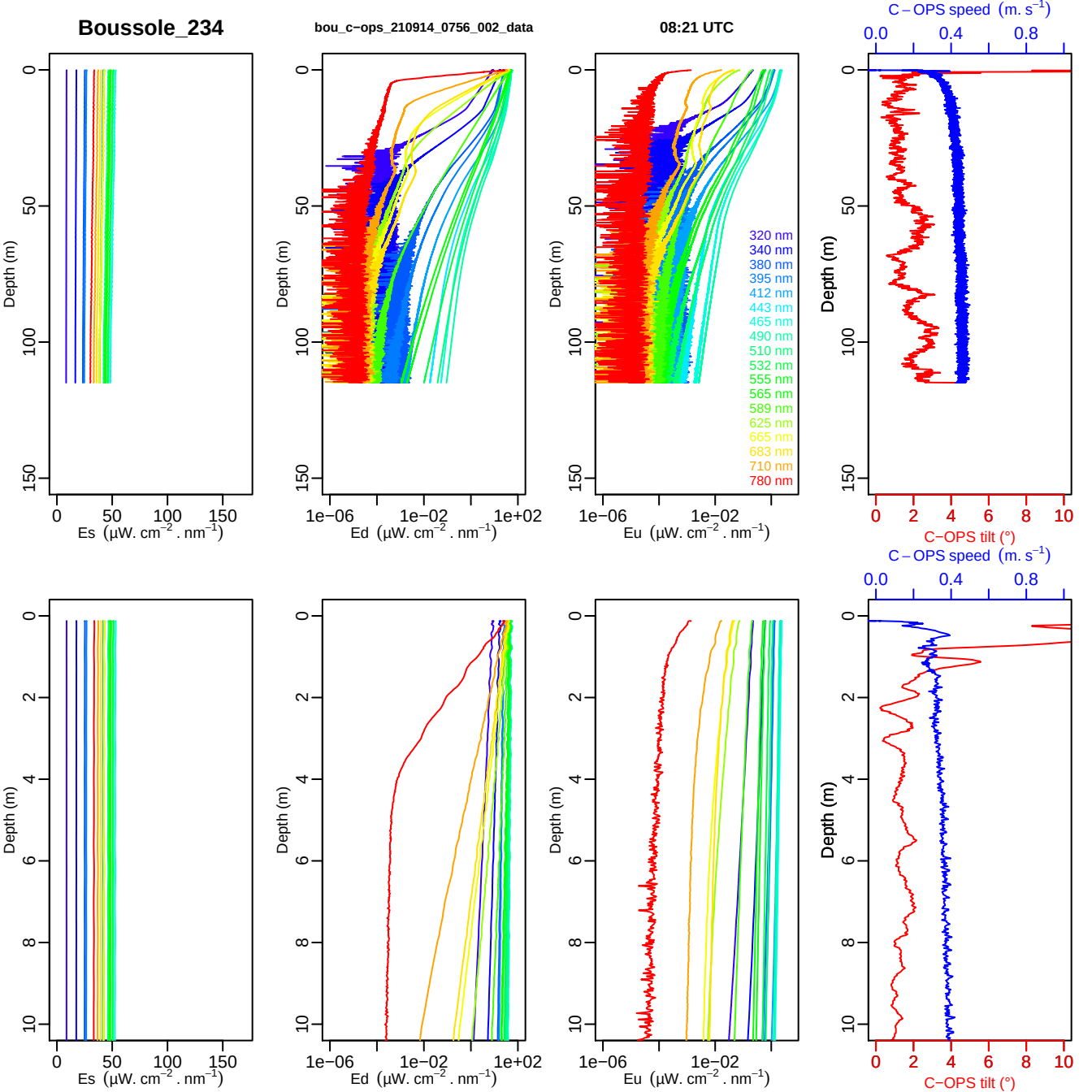
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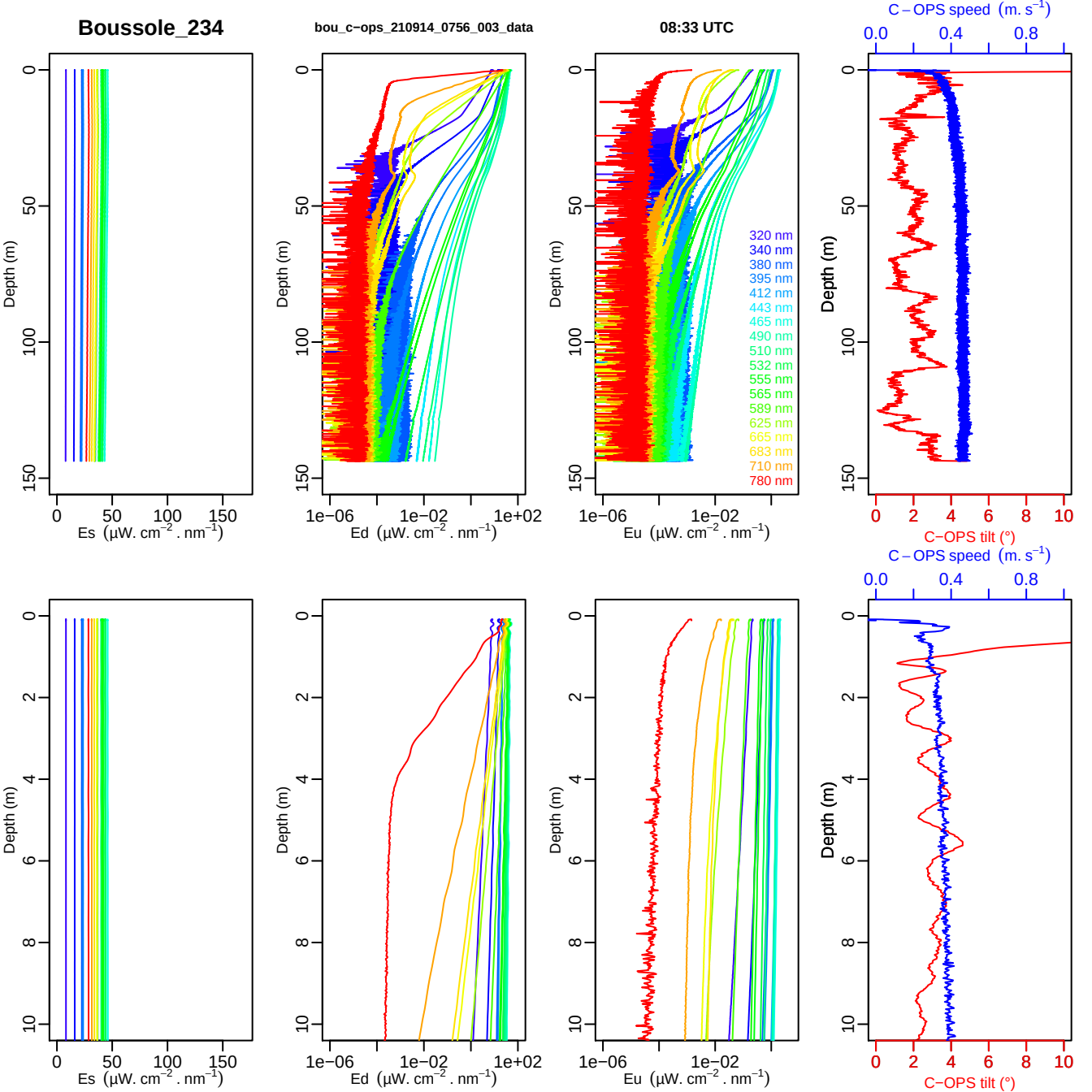
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