BOUSSOLE Monthly Cruise Report

Cruise 237
December 07-09, 2021

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Vessel: R/V Téthys II
(Captain: Dany Deneuve)

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Deployment of the triple WP2 zooplankton net from the deck of the R/V *Téthys II* for the MOOSE DYFAMED program.

BOUSSOLE project

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

December 29, 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).

Projects-specific operations

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) and pH analysis (from October 2021). The TA/TC samples will be processed by the National service for such analyses (SNAPOCO – LOCEAN in Paris). The pH samples will be analysed in the *Institut de la Mer de Villefranche* by the MOOSE team. The results will allow checking the data collected by the two pCO_2 CARIOCA sensors, the two optodes and the pH sensor 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). Additional samples for cytometry analyses are to be collected at ten depths during the BOUSSOLE CTD sampling (from November 2021). These operations are 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

The "MOOSE DYFAMED" cruise scheduled for 5th December was cancelled because of bad weather forecasts, so their operations were performed during the BOUSSOLE cruise.

Cruise Summary

All of BOUSSOLE and MOOSE operations were performed the first day because of bad weather during the second and third days of the cruise. Nevertheless, the departure from the Nice harbour was delayed to the midday because of bad weather during the morning, so the working time at the BOUSSOLE site before the sunset was very short. This day was used for optical profiles, for CTD casts with water sampling at the BOUSSOLE site and for MOOSE DYFAMED operations (deep CTD cast and zooplankton nets).

Tuesday 07 December 2021

The sea state was slight with a light air. The sky was overcast yet the visibility was excellent. Firstly, four C-OPS profiles were performed at the BOUSSOLE site but only three of them were kept because the C-OPS was too much tilted during the descent for the second profile. Then, two CTD casts with water sampling were performed at the BOUSSOLE site. For the second cast (CTD #02), a cap was put on the backscattering meter for dark measurements. Finally, two triple WP2 zooplancton nets and a deep CTD cast were performed at the DYFAMED site for MOOSE program before returning to the Nice harbour.

Wednesday 08 December 2021

Bad weather prevented departure from the Nice harbour.

Thursday 09 December 2021

Bad weather prevented departure from the Nice harbour.

Pictures taken during this cruise can be found at:
https://photos.app.goo.gl/n9CwNHAZJuabKuuCA

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

Cruise Report

Tuesday 07 December 2021 (UTC)

People on bord: Ewen Ancel, Céline Dimier, Melek Golbol, Emilie Riquier Diamond and Paco Stil (engineer at IMEV)

1110 Departure to the BOUSSOLE site.
1420 Arrival at the BOUSSOLE site.
1430 C-OPS 01, 02, 03.
1530 CTD 01, 400 m with water sampling at 400, 200, 150, 80, 70, 60, 50, 40, 30, 20, 10 and 5 m for HPLC, a_p, TA/TC, O_2, pH and cytometry.
1640 CTD 02, 400 m with water sampling at 60, 40, 20 and 5 m for TSM, metagenomic, cytometry and nutrients (with cap on the HS6)
1700 Departure to the DYFAMED site.
1730 Arrival at the DYFAMED site.
1740 Zooplankton nets x2, 100 m and 200 m (MOOSE program).
1820 Deep CTD cast (MOOSE program)
2010 Departure to the Nice harbour.
2305 Arrival to the Nice harbour.

Wednesday 08 December 2021

Bad weather prevented departure from the Nice harbour.

Thursday 09 December 2021

Bad weather prevented departure from the Nice harbour.

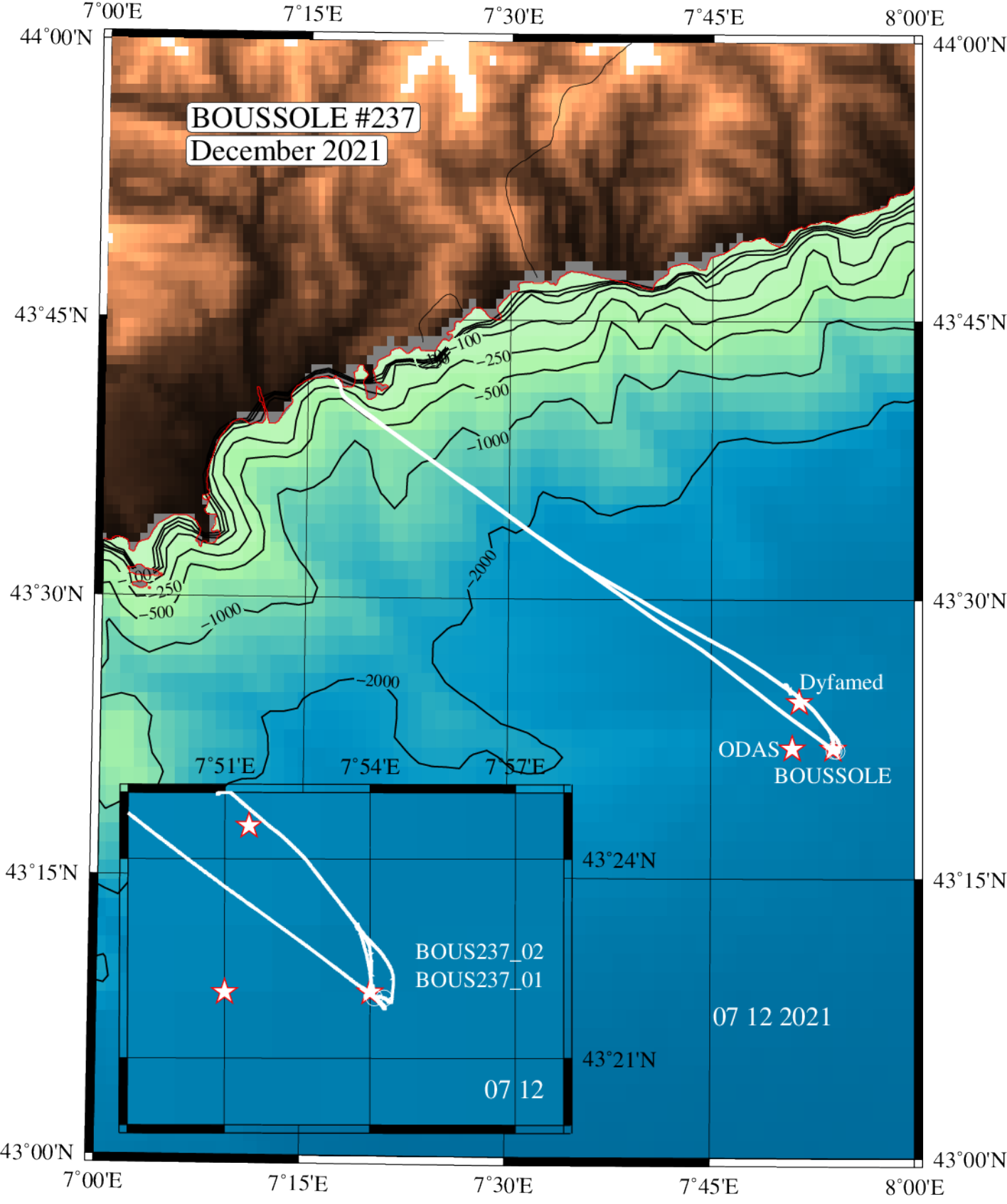
Problems identified during the cruise

- Four C-OPS profiles were performed at the BOUSSOLE site but only three of them were kept because the C-OPS was too much tilted during the descent for the second profile.
- The C-OPS profiles were performed belatedly in the day because we had to delay the departure from Nice harbour due to bad weather during the morning. During the last C-OPS profile, the sun elevation was low.
- The Secchi disk could not be performed because of the lack of time during the day. The BOUSSOLE operations were finished during the night with the last CTD deployment.
- Because of the lack of time, 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.

Appendices

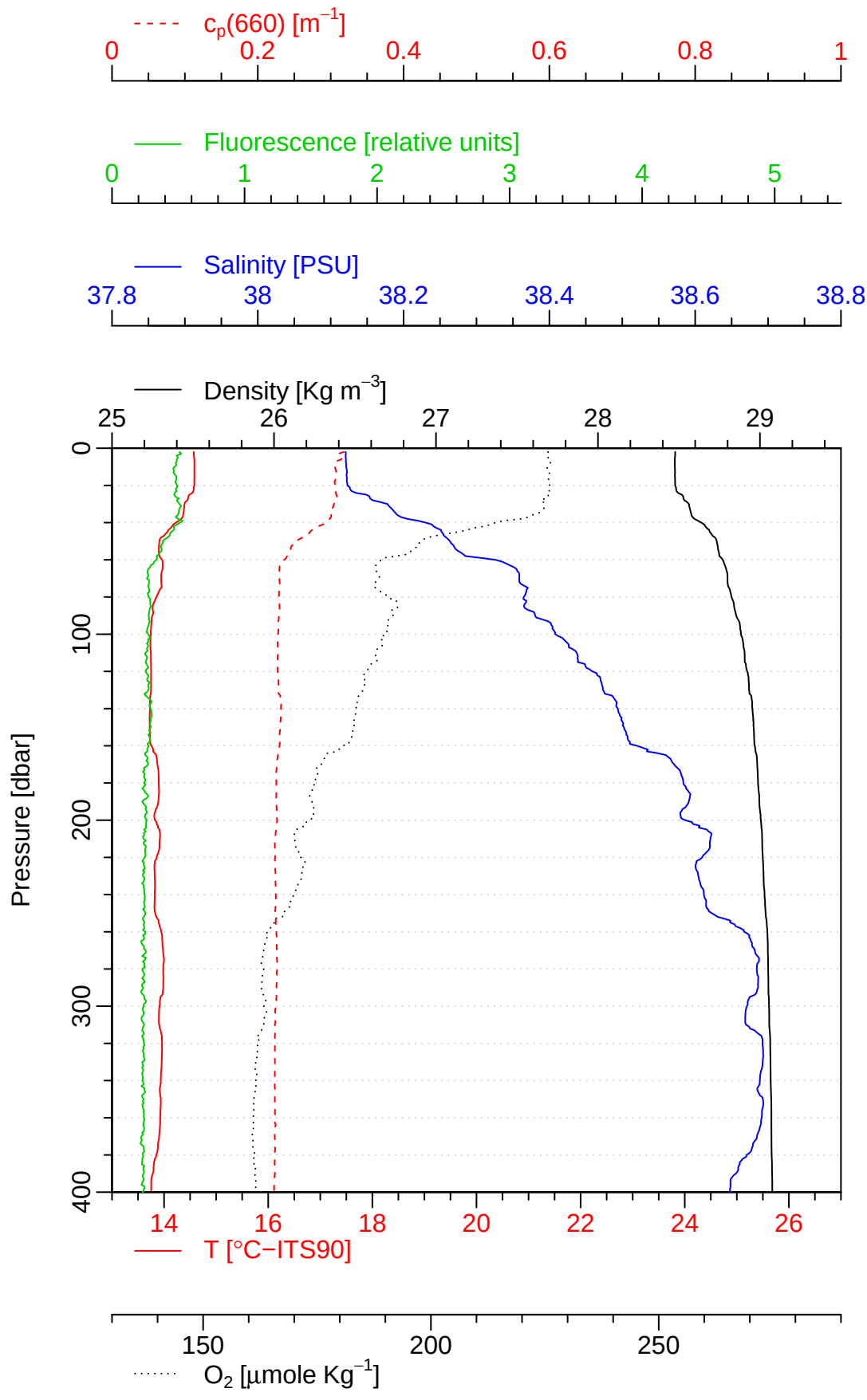
Cruise Summary Table for Boussole 237

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
07/12/21		bou_c-ops_211207_1418_001_data.csv			14:28	0:04:21	115	43	22.163	7	54.032	overcast	St	6	1	340	1012.3	58	excellent	12.4	14.80	slight	1		no
		bou_c-ops_211207_1418_003_data.csv			14:47	0:03:36	91	43	22.445	7	54.024	overcast	St	6	1	340	1012.3	58	excellent	12.4	14.80	slight	1		no
		bou_c-ops_211207_1418_004_data.csv			14:57	0:02:42	96	43	22.784	7	53.922	overcast	St	6	1	340	1012.3	58	excellent	12.4	14.80	slight	1		no
			BOUS237_01	HPLC, ap, Cyto, TA/TC, O_2 & pH	15:29	0:32:00	400	43	21.91	7	54.090	overcast		7	3	300	1012.3	60		12.4	14.57	slight			
			BOUS237_02	TSM, Metagenomics, Cyto & Nutrients	16:38	0:12:00	100	43	21.906	7	54.292	night		9	1	210	1011.8	58		12.4	14.59	slight			
08/12/21	Bad weather																								
09/12/21	Bad weather																								


BOUSSOLE #237
December 2021
7°00'E
7°15'E
7°30'E
7°45'E
8°00'E
44°00'N
43°45'N
43°30'N
43°15'N
43°00'N
-100
-250
-500
-1000
-2000
Dyfamed
ODAS
BOUSSOLE
7°51'E
7°54'E
7°57'E
43°24'N
43°21'N
BOUS237_02
BOUS237_01
07 12
07 12 2021

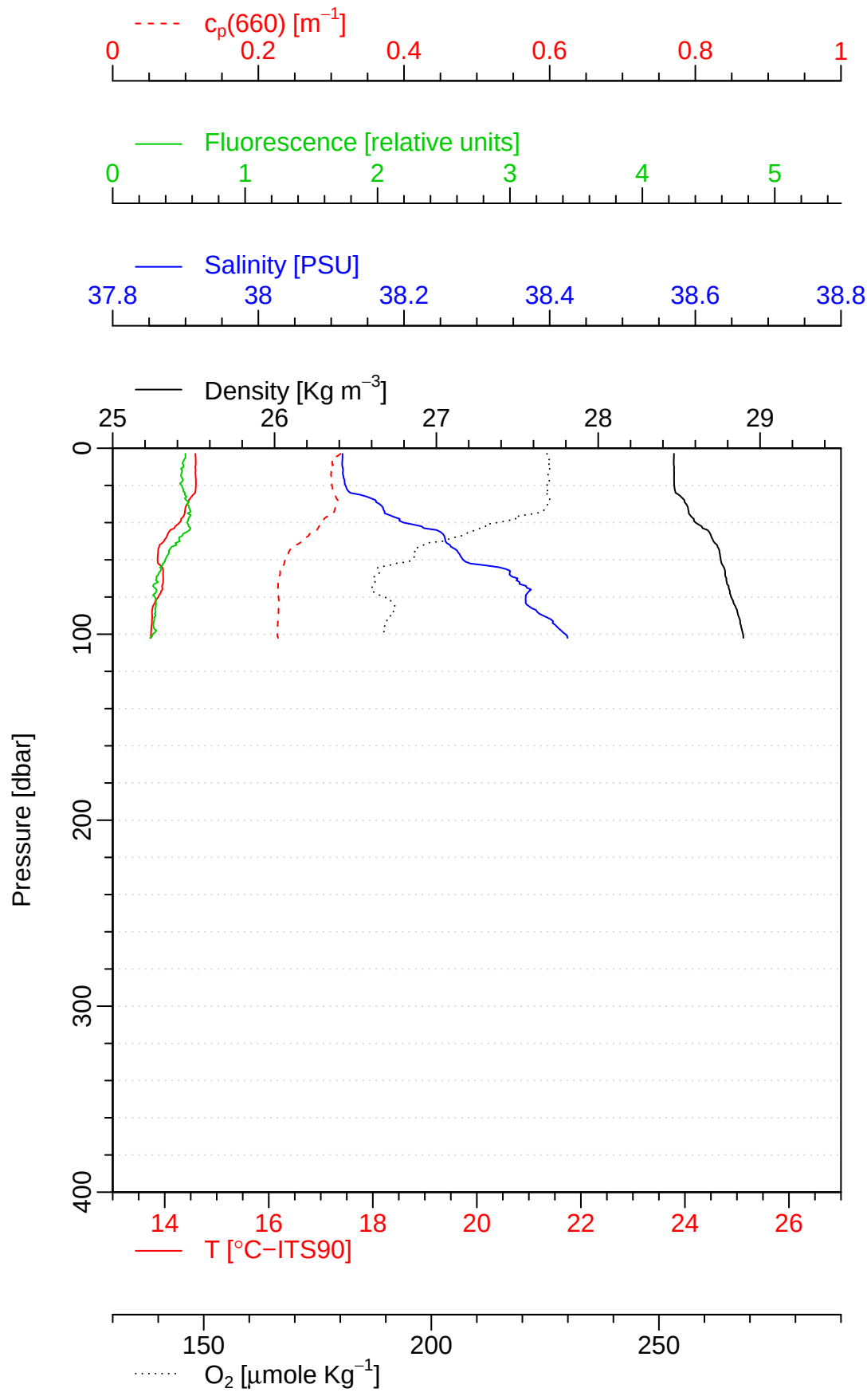
bous237_01

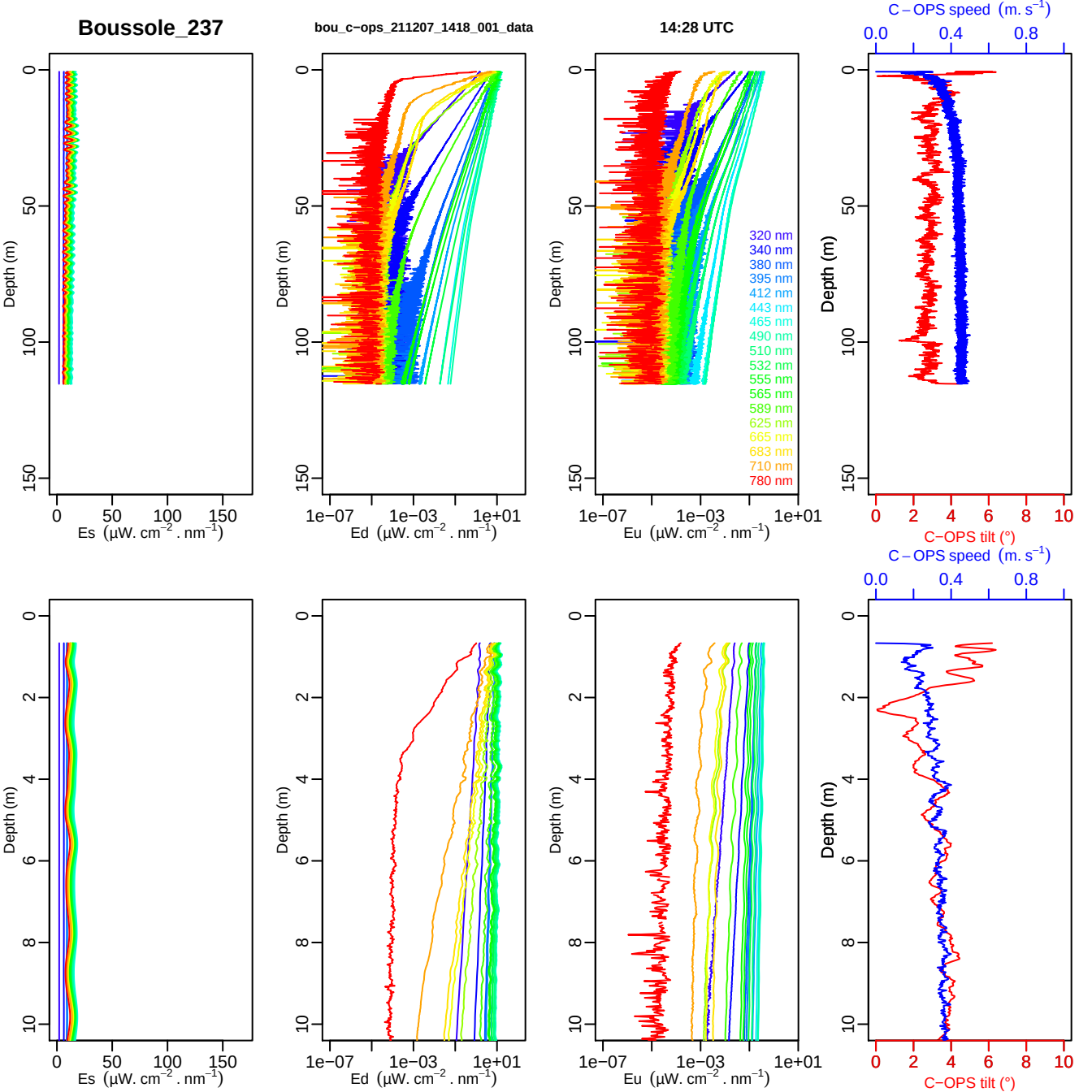
Date = 07/12/2021
Heure debut [TU] = 15:29
Longitude = 007 54.090 E
Latitude = 43 21.910 N

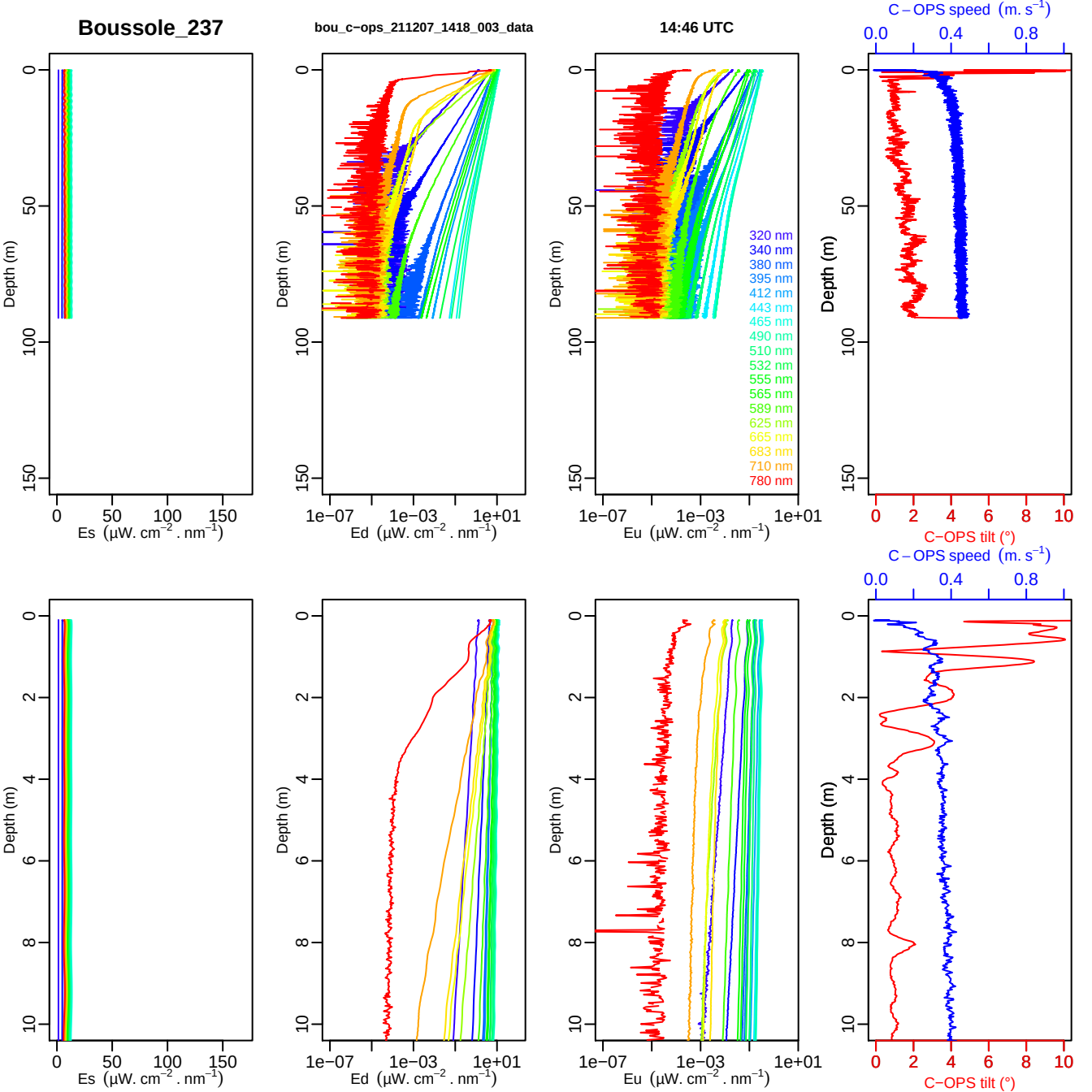


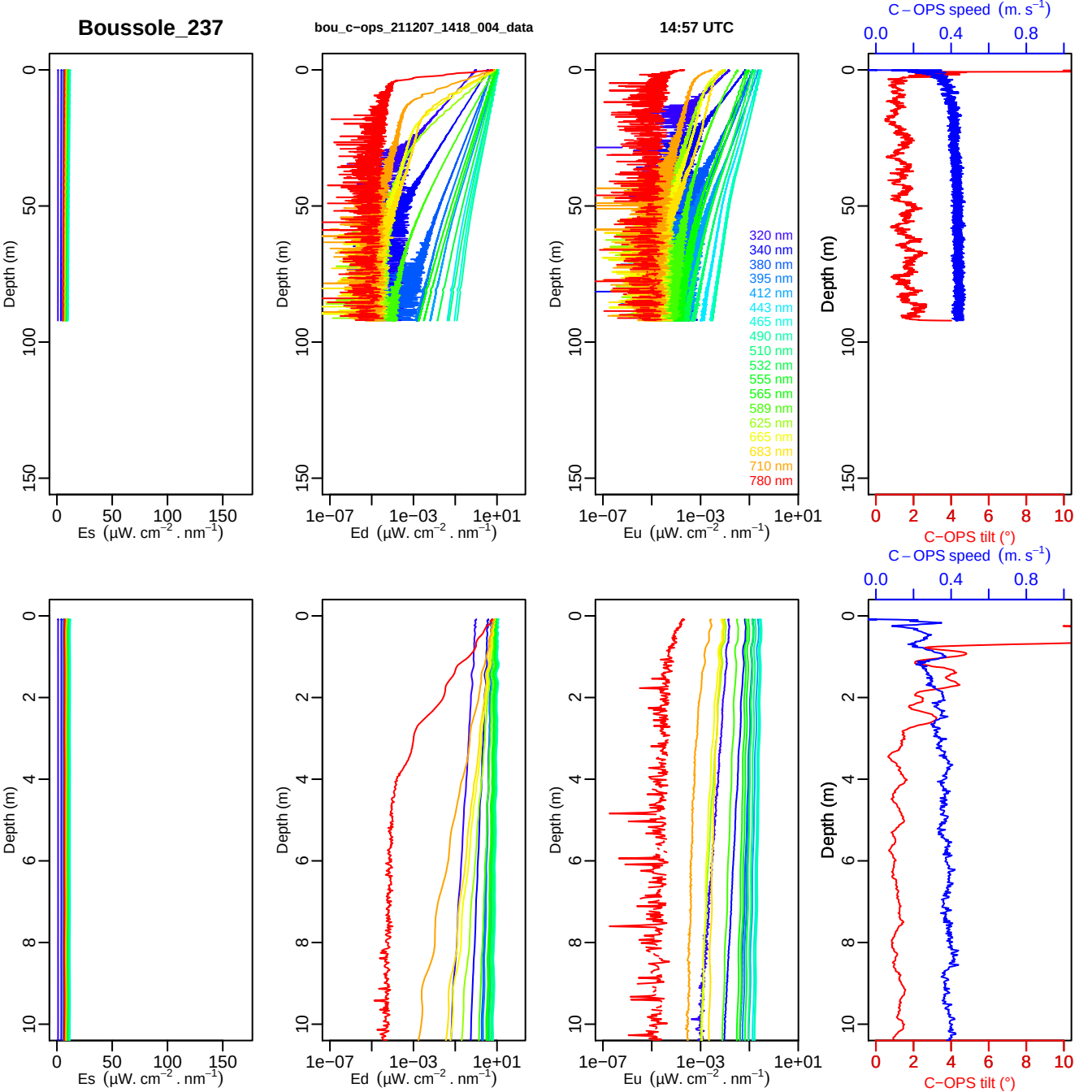
bous237_02

Date = 07/12/2021
Heure debut [TU] = 16:38
Longitude = 007 54.292 E
Latitude = 43 21.906 N




Boussole_237
bou_c-ops_211207_1418_001_data
14:28 UTC
Depth (m)
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


Boussole_237
bou_c-ops_211207_1418_003_data
14:46 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−07
1e−03
1e+01
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 (°)


Boussole_237
bou_c-ops_211207_1418_004_data
14:57 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−07
1e−03
1e+01
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 (°)