

BOUSSOLE Monthly Cruise Report

Cruise 245

August 03-05, 2022

Duty Chief: Melek Golbol (melek.golbol@imev-mer.fr)

Vessel: R/V Europe
(Captain: Arnaud Béhoteguy)

Science Personnel: Ewen Ancel, Matthieu Bressac, Lucas Courchet, Cyril Debost, Emilie Diamond-Riquier, Céline Dimier, Melek Golbol, Louis Petiteau, Judicaël Rivier, Paco Stil and Vincenzo Vellucci

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

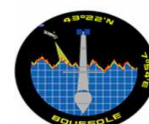


A view of the R/V Europe from the dinghy after maintenance operations on the BOUSSOLE buoy.

BOUSSOLE project

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

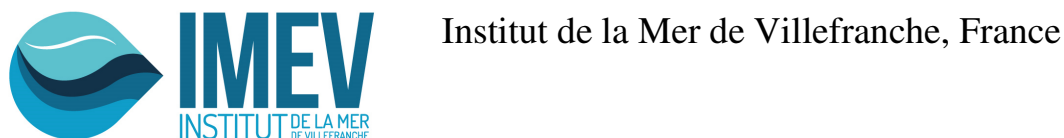
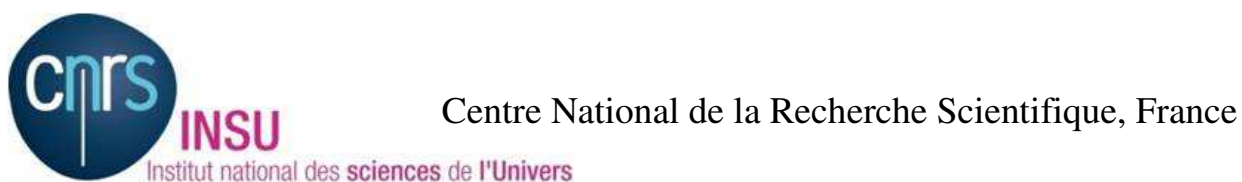
August 29, 2022



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



Contents

1. Cruise Objectives
2. Cruise Summary
3. Cruise Report
4. Problems identified during the cruise

Appendices

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 DO and 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 pCO₂ CARIOCA sensors, the optode 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

Data were downloaded from the SeapHOx sensor installed on the buoy at 3 m depth for the MOOSE program via the communication cable on the top of the buoy. It combines a pH sensor with a Sea-Bird SBE37 MicroCAT CTD+DO sensor.

Cruise Summary

The first day was used for maintenance on the top of the BOUSSOLE buoy, for CTD casts with water sampling, for C-OPS profiles and for a Secchi disk at the BOUSSOLE site. There were some problems with the CTD due to a faulty extension cable but the problem was solved. The second day was used for diving operations and maintenance on the buoy, for C-OPS profiles, for CTD casts with water sampling, for a Secchi disk at the BOUSSOLE site. The third day was planned for the MOOSE-DYFAMED program but a CTD cast with water sampling at 15 m depth was performed for BOUSSOLE program due to a problem of sampling the day before.

Wednesday 03 August 2022

The sea state was smooth with a gentle breeze. The sky was blue and the visibility was good. Firstly, the functioning of the buoy was checked on the top of the buoy, the surface sensor could be heard working. Solar panels and surface sensor were cleaned. Then, a CTD cast was performed at the BOUSSOLE site. The connection with the CTD was lost from 300 m depth during the descent. Nevertheless, the descent of the CTD Rosette was continued to 400 m depth for the IOP cast, it was not possible to sample water during the ascent. When the CTD was onboard, some tests were performed on the deck of the ship. It appeared that the problem was due to a faulty extension cable. The electrocarrier cable which was too short was extended and the faulty extension cable was removed. After that, 3 C-OPS profiles and a CTD cast were performed. The CTD worked correctly. Finally, a Secchi disk was performed at the BOUSSOLE site before returning to the Nice harbour.

Thursday 04 August 2022

The sea state was smooth with a light breeze. The sky was blue and the visibility was good. When arrived at the BOUSSOLE site, the buoy battery and Junction Box were switched off and the three DL3 (surface, 4 and 9 m) were recovered. A first connection via Wi-Fi was obtained for one of the DL3s on the dinghy, however, the download time was high and it was decided to perform the download on board the R/V *Téthys II*. However, the Wi-Fi was not stable enough to perform the download of a large file for the three instruments. Furthermore, SeapHOx data were downloaded.

Then 3 C-OPS profiles and a CTD cast with water sampling were performed at the BOUSSOLE site. Then, the divers returned at sea in order to re-install the DL3s at 4 and 9 m. The surface DL3 was reinstalled and the functioning of the buoy was checked: all instruments were working after the buoy restart, i.e. instruments from all depths were seen or heard working. Sensors were cleaned, pictures were taken and 3 consecutive dark measurements were performed by divers switching on and off the main battery.

Then, a CTD cast with water sampling was performed. A cap was put on the backscattering meter for dark measurements and a 0.2µm filter put on the a-Sphere absorption meter for the dissolved matter absorption measurements. This cast was stopped at 10 depths during the ascent of the CTD. Finally, a Secchi disk was performed at the BOUSSOLE site before returning to the Nice harbour.

Friday 05 August 2022

The sea state was smooth with a moderate breeze. The sky was blue. Firstly, the RESPIRE drifting mooring line was recovered then a Manta horizontal net was performed in the way to DYFAMED site. When arrived at the DYFAMED site, a CTD with water sampling was performed to sample at 5 m depth for HPLC, metagenomics, nutrients and cytometry for EFFICACY project because this depth was missed due to a problem of sampling the day before. Finally, a deep CTD cast with water sampling and two triple zooplankton vertical nets were performed for the MOOSE-DYFAMED program before returning to the Nice harbour.

Pictures taken during this cruise can be found at:

<https://photos.app.goo.gl/r2mzNrvJxcBu55B67>

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 03 August 2022 (UTC)

People on board: Ewen Ancel, Lucas Courchet (engineer), Céline Dimier, Melek Golbol and Paco Stil.

- 0600 Departure from the Nice harbour.
- 0940 Arrival at the BOUSSOLE site.
- 1000 Maintenance on the top of the buoy (checking, solar panels cleaning).
- 1050 CTD 01, 300 m with water sampling, IOP profile at 400 m).
- 1150 C-OPS 01, 02, 03.
- 1240 Maintenance on the electrocarrier cable.
- 1310 CTD 02, 400 m with water sampling at 400, 150, 80, 70, 60, 50, 40, 30, 20, 10 and 5 m for HPLC, a_p , TSM, TA/TC, DO and pH.
- 1340 Secchi 01, 24 m.
- 1345 Departure to the Nice harbour.
- 1710 Arrival to the Nice harbour.

Wednesday 04 August 2022 (UTC)

People on board: Lucas Courchet, Cyril Debost, Céline Dimier, Melek Golbol, Judicaël Rivier, Paco Stil and Vincenzo Vellucci.

- 0515 Departure from the Nice harbour.
- 0850 Arrival at the BOUSSOLE site.
- 0900 Diving operations: recovery of the DL3 (surface, 4 and 9 m).
SeapHOx data downloading.
- 1015 C-OPS 04, 05, 06.
- 1105 CTD 03, 400 m with water sampling at 400, 200, 150, 80, 70, 60, 50, 40, 30, 20, 10 and 5 m for HPLC, a_p and cytometry.
- 1145 Diving operations: re-installation of the DL3s, buoy functional checking, cleaning, dark measurements, pictures.
- 1240 CTD 04, 400 m with water sampling at 60, 50, 20 and 5 m for TSM, metagenomics, nutrients and cytometry (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 m) (with cap on the HS6).
- 1425 Secchi 02, 27 m.
- 1430 Departure to the Nice harbour.
- 1830 Arrival to the Nice harbour.

Friday 05 August 2022 (UTC)

People on board: Matthieu Bressac, Lucas Courchet, Emilie Diamond-Riquier, Louis Petiteau and Paco Stil.

- 0600 Departure from the Nice harbour.
- 0920 Arrival at the RESPIRE drifting mooring line site (43°19.670'N; 7°46.620'E)
- 0940 Recovery of the RESPIRE drifting mooring line.
- 1025 Departure to DYFAMED site.
- 1055 Manta horizontal net.
- 1140 Arrival to DYFAMED site.
- 1145 CTD 05, 15 m with water sampling for HPLC, a_p , metagenomics, nutrients and cytometry.
- 1210 CTD MOOSE 166, 1780 m with water sampling.
- 1350 Triple zooplankton vertical nets x 2 (100 and 200m).
- 1430 Departure to the Nice harbour.
- 1805 Arrival to the Nice harbour.

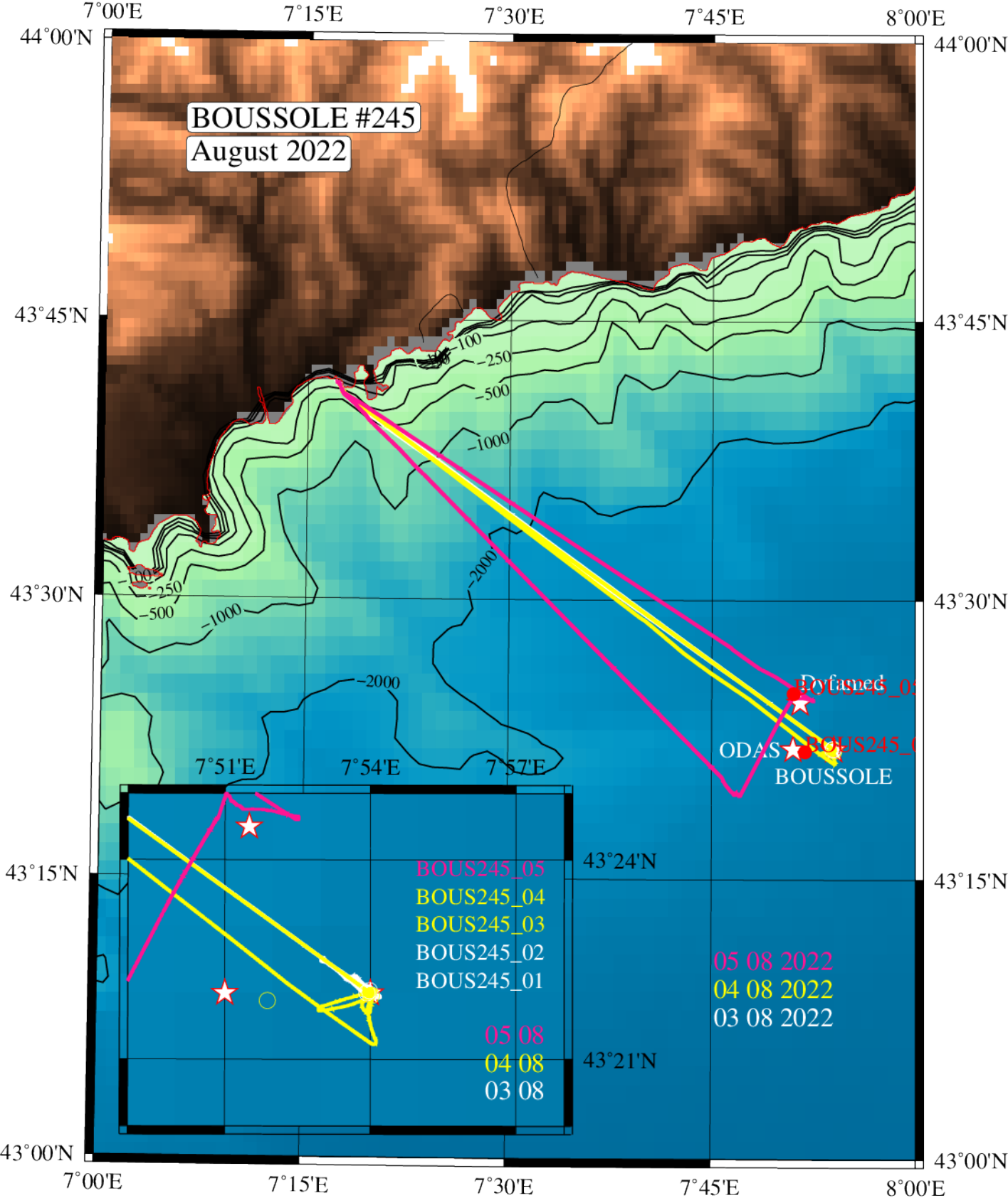
Problems identified during the cruise

- Buoy data could not be downloaded: the download time was high. The Wi-Fi was not stable enough to perform the download of a large file for the DL3s, maybe because of the cable.
By looking at the file present on the internal memory and their size, it appeared that the 9 m DL3 had worked correctly after the battery discharge, and the surface DL3 had continued working since the previous check, whereas the 4 m DL3 did not restart after the battery recovery. Nonetheless it appeared to be in working condition as a new file was created after switching it on with an external battery. All instruments were working after the buoy restart, i.e. instruments from all depths were seen or heard working.
- The BOUSSOLE C-OPS EdZ radiometer (S/N #152) was sent to the manufacturer for repair. The EdZ radiometer was replaced with the one shared among the marine optics and remote sensing group at LOV (S/N #182). So, the configuration of the C-OPS is different: there were some differences between EdZ and EuZ wavelengths.
- The CIMEL photometer did not work. Unfortunately, it is not possible to send it to the manufacturer for maintenance because of its obsolescence.
- The ship fluorometer is now out of service. It is not repairable because of its obsolescence. It will be replaced during the works planned on the R/V *Téthys* in 2023.
- Problems appeared during the installation of the CTD Rosette and the first cast (CTD 01): firstly, when the deck unit was connected to the sea cable and switched on, the fuse was blown. Then the fuse was replaced and the connection was successful, so the CTD was deployed but the communication was lost at 300 m depth. The CTD was brought onboard and several tests were performed: fuses were blown at several times. Tests were performed on the deck of the ship with the cable test: the cable test and the extension cable (connected between the CTD and the cable test) were damaged. The extension cable was suspected to be faulty. So, the electrocarrier cable was extended by the crew to avoid the use of the extension cable. Finally, the electrocarrier cable was connected directly to the CTD and it functioned correctly.
- CTD 04: there was a problem during the metagenomics filtration for the sample at 5 m depth. The filtration was performed without the filter of 3 μm diameter by mistake. So, the third day, an additional CTD (CTD 05) was performed with water sampling at 5 m in order to sample correctly this depth.
- The last day, it was noticed that the nitrogen in the nitrogen container was totally evaporated. The HPLC, cytometry and metagenomics samples were put in the freezer of the ship at -20°C , then at -40°C . When arrived at the lab, the samples of the last day were put in the nitrogen before stocking them in the freezer at -80°C . However, the samples stayed always cold.

Appendices

Cruise Summary Table for Boussole 245

Date	Black names (file ext: ".raw")	Profile names (file extension: ".raw")	CTD notées	Other sensors	Start Time	Duration	Depth max	Latitude (N)			longitude			Weather											
					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	Sea Swell H (m)	Swell dir.	Whitecaps
03/08/22			BOUS245 01		10:48	0:10:00	300	43	22.035	7	53.980	blue		0	7	103	1015	77.7		28.2	29.00	smooth			
		bou_c-ops_220803_1129_002_data.csv			11:51	0:04:06	101	43	22.093	7	53.722	blue	none	0	7.8	110	1016	72.5	good	29.5		smooth	0.3		no
		bou_c-ops_220803_1129_004_data.csv			12:05	0:04:06	101	43	22.218	7	53.491	blue	none	0	7.8	110	1016	72.5	good	29.5		smooth	0.3		no
		bou_c-ops_220803_1129_005_data.csv			12:16	0:04:02	101	43	22.411	7	53.174	blue	none	0	7.8	110	1016	72.5	good	29.5		smooth	0.3		no
			BOUS245 02	HPLC, ap, TSM, O ₂ , TA/TC & pH Secchi 01	13:08	0:29:00	400	43	22	7	53.992	blue		0	8	100	1014	72.7		28.4	29.15	smooth			
					13:40	0:04:00	24	43	22	7	54	blue		0					good			smooth			
04/08/22																									
		bou_c-ops_220804_0958_001_data.csv			10:14	0:04:00	98	43	21.09	7	53.047	blue	none	0	4.7	260	1016	75	good	28		smooth	0.2		no
		bou_c-ops_220804_0958_002_data.csv			10:23	0:04:03	100	43	21.086	7	53.028	blue	none	0	4.7	260	1016	75	good	28		smooth	0.2		no
		bou_c-ops_220804_0958_003_data.csv			10:32	0:03:18	81	43	21.081	7	53.008	blue	none	0	4.7	260	1016	75	good	28		smooth	0.2		no
			BOUS245 03	HPLC, ap & cyto	11:06	0:33:00	400	43	21.96	7	54.023	blue		1	3.6	148	1015	67.9		29.7	29.10	smooth			
			BOUS245 04	TSM, metagenomics, cyto & nutrients Secchi 02	13:01	1:22:00	400	43	21.882	7	51.881	blue		1	4.4	239	1015	60		28.4	29.10	smooth			
				14:25	0:04:00	27	43	22	7	54	blue		1					good			smooth				
05/08/22			BOUS245 05	HPLC, ap, metagenomics, cyto & nutrients	11:52	0:03:00	16	43	25.007	7	51.032	blue		1	6.8	226	1013	76.8		28.5	28.00	smooth			



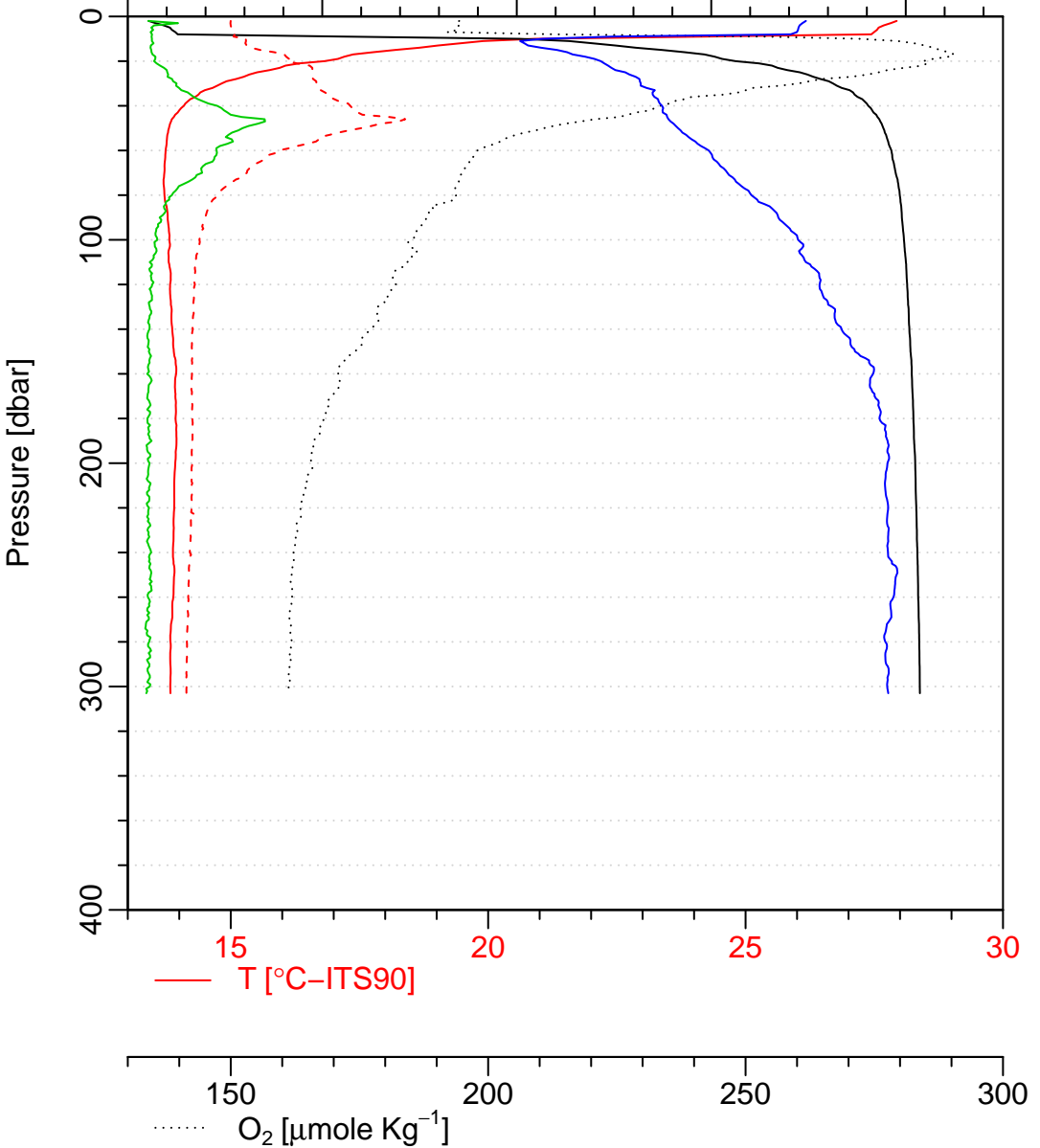
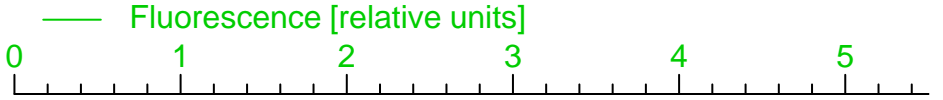
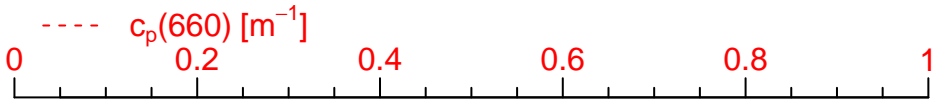
bous245_01

Date = 03/08/2022

Heure debut [TU] = 10:48

Longitude = 007 53.980 E

Latitude = 43 22.035 N



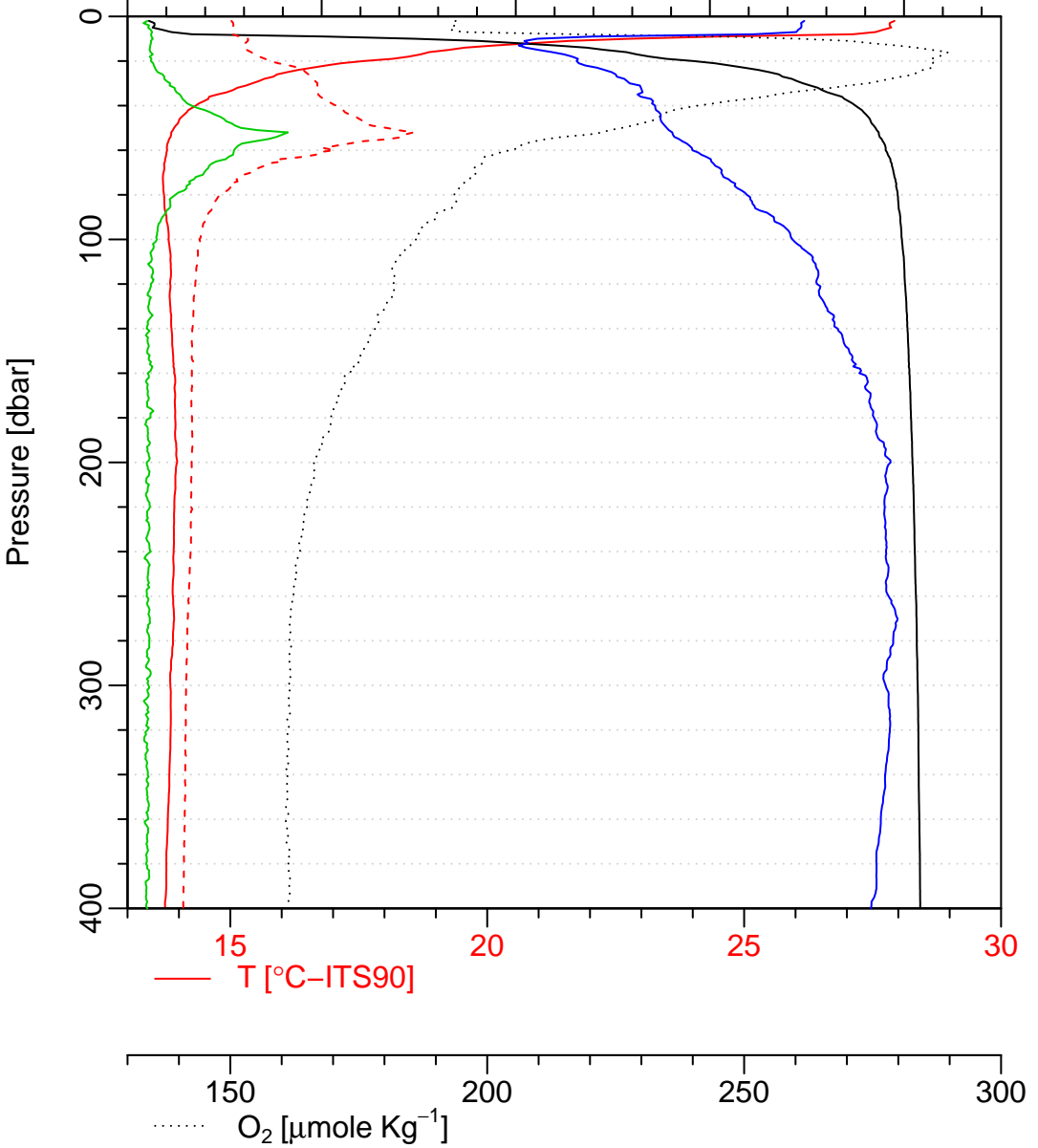
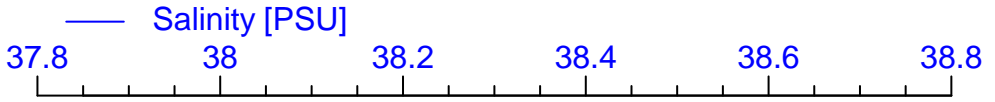
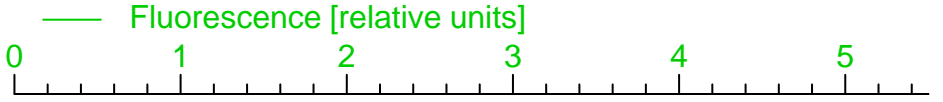
bous245_02

Date = 03/08/2022

Heure debut [TU] = 13:08

Longitude = 007 53.932 E

Latitude = 43 22.000 N



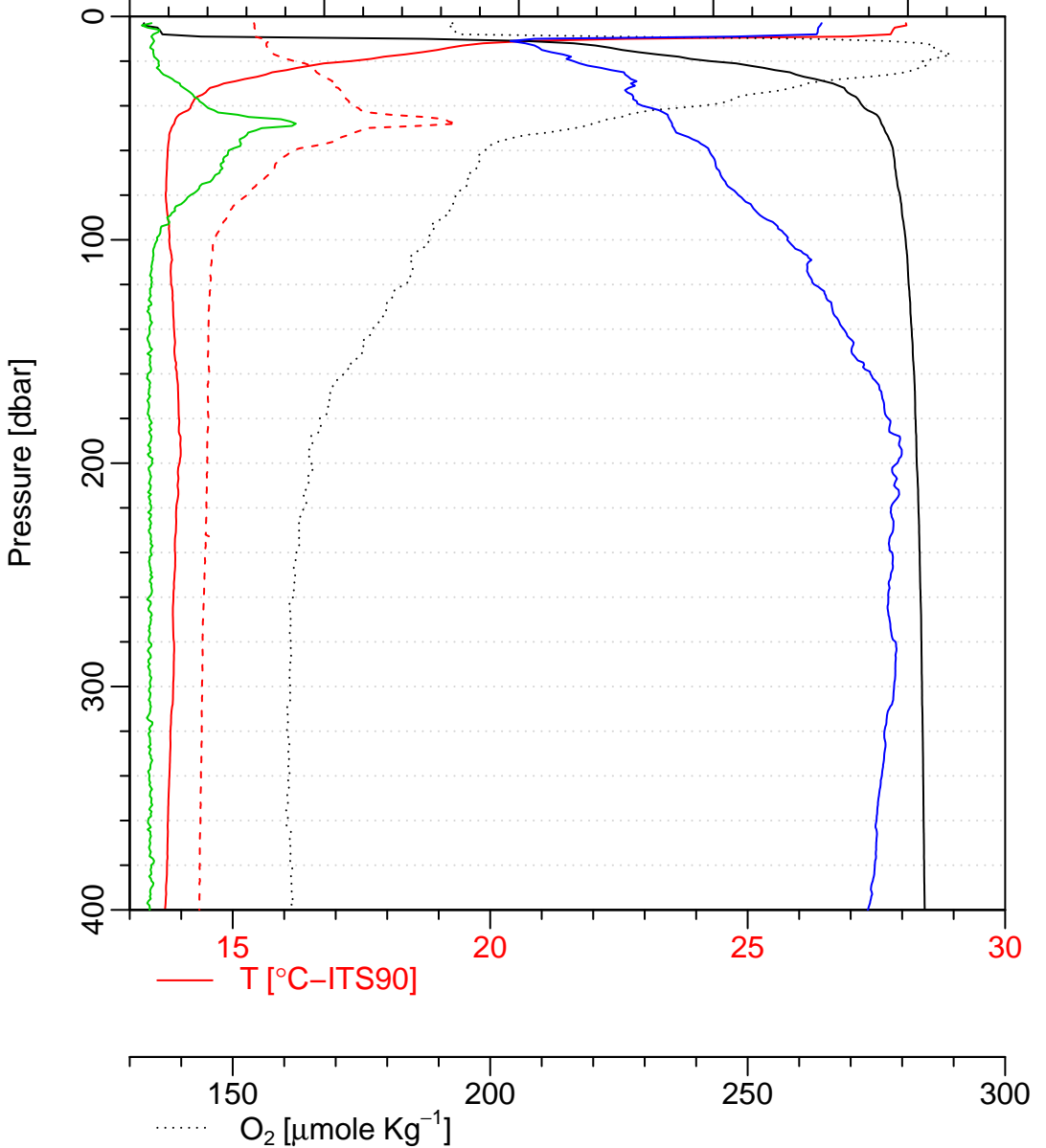
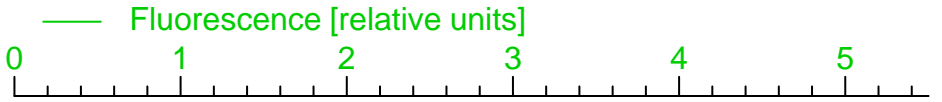
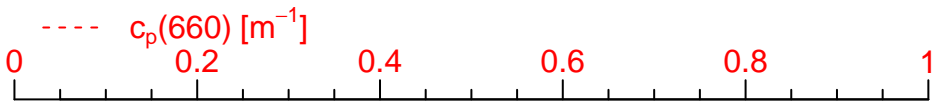
bous245_03

Date = 04/08/2022

Heure debut [TU] = 11:06

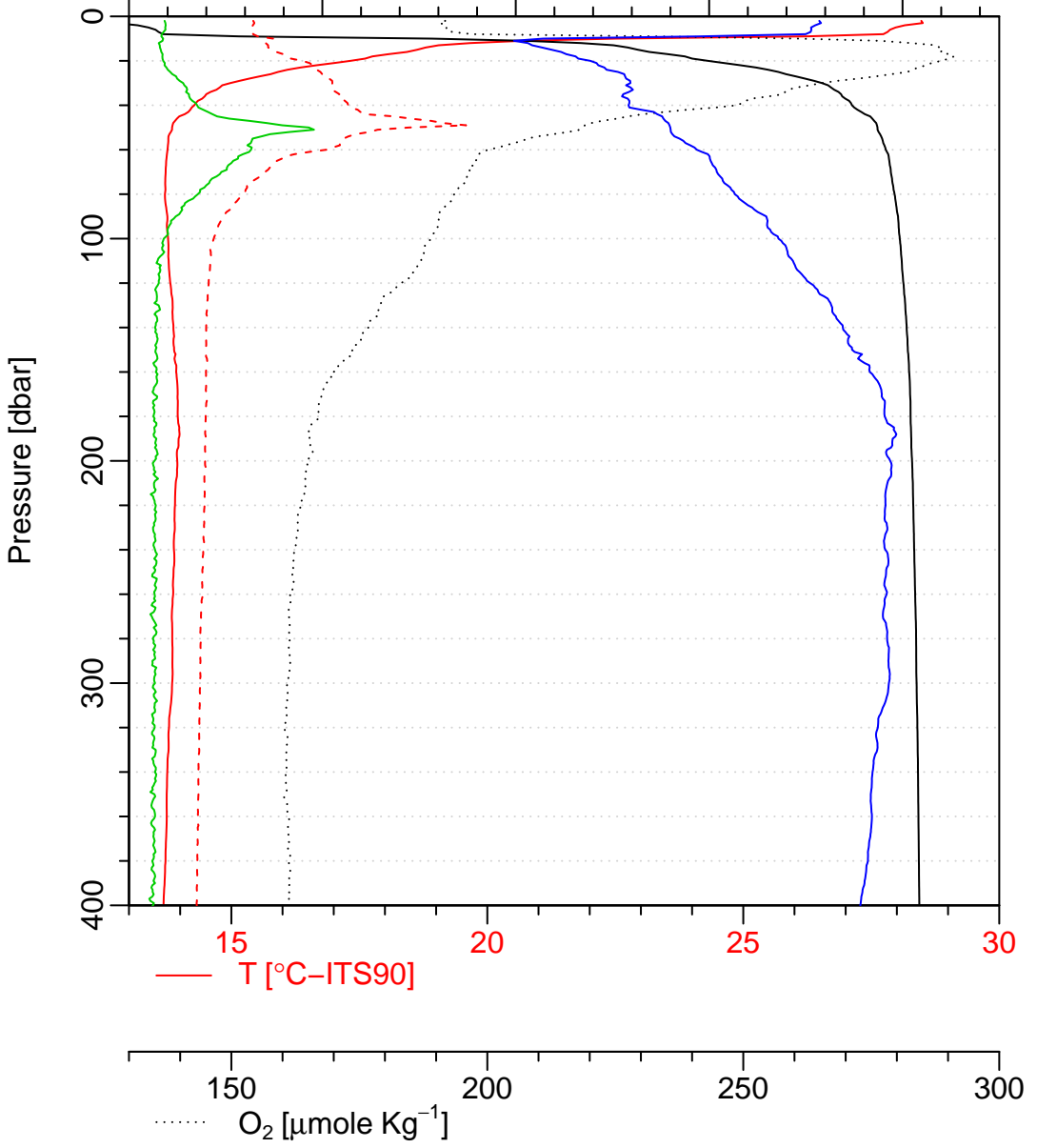
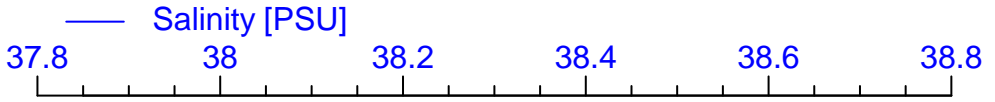
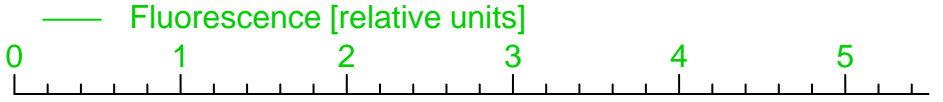
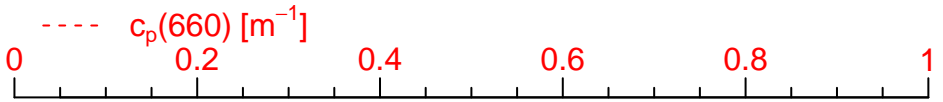
Longitude = 007 54.023 E

Latitude = 43 21.960 N



bous245_04

Date = 04/08/2022
Heure debut [TU] = 13:01
Longitude = 007 51.881 E
Latitude = 43 21.882 N



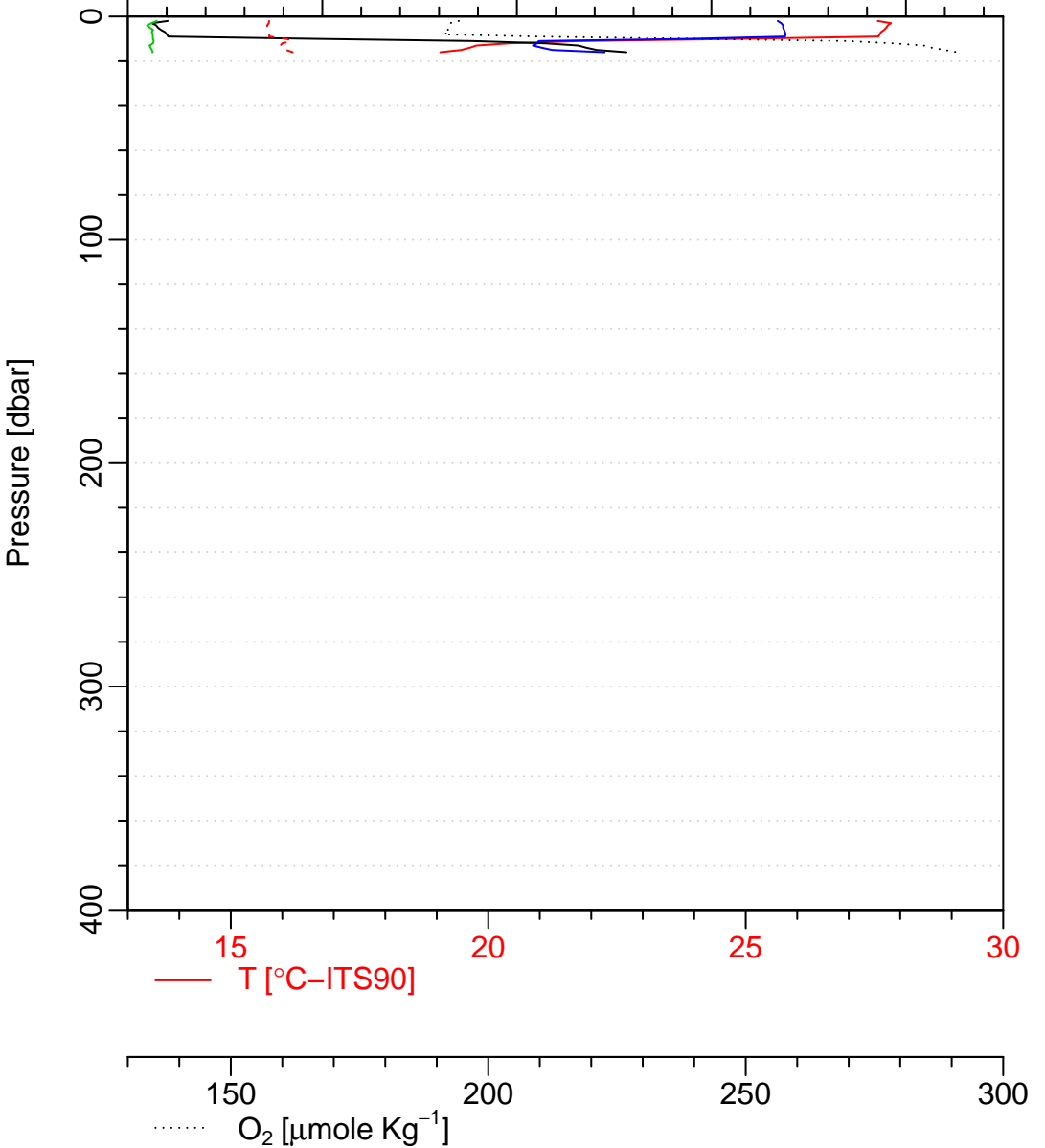
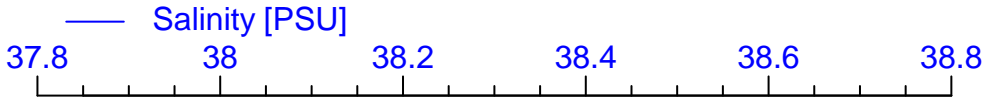
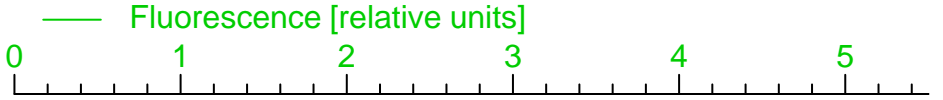
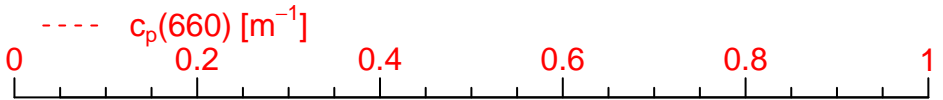
bous245_05

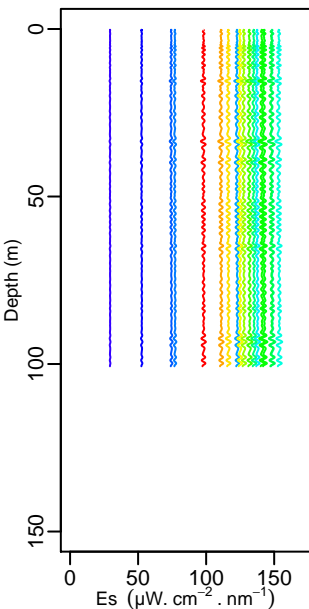
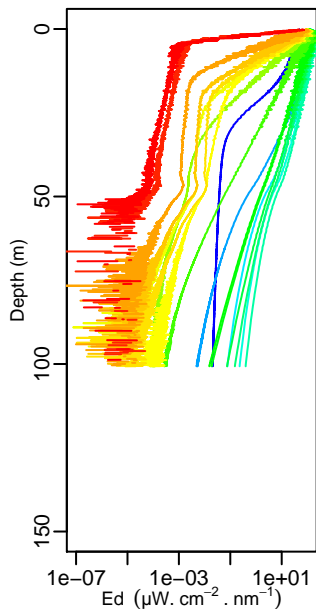
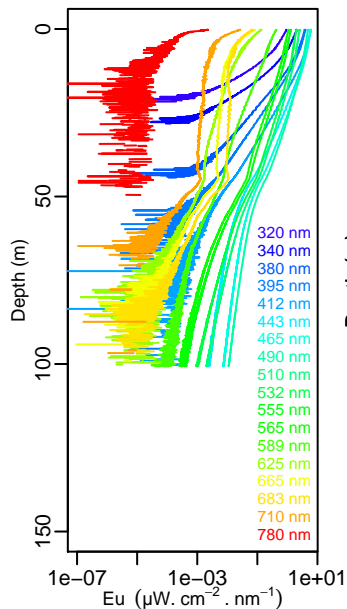
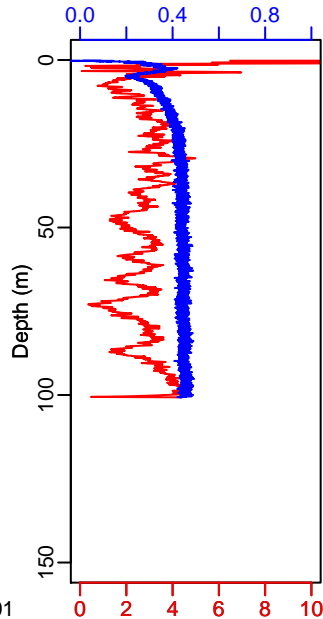
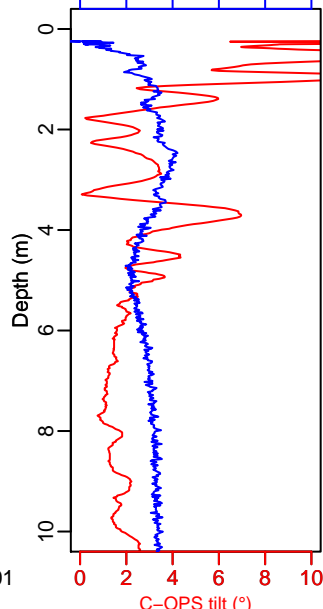
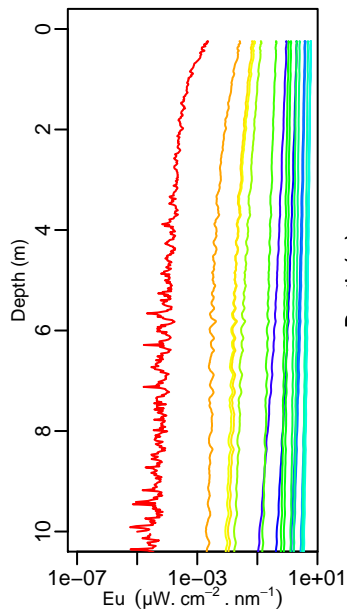
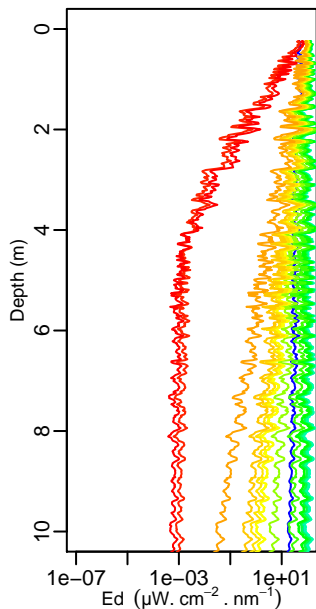
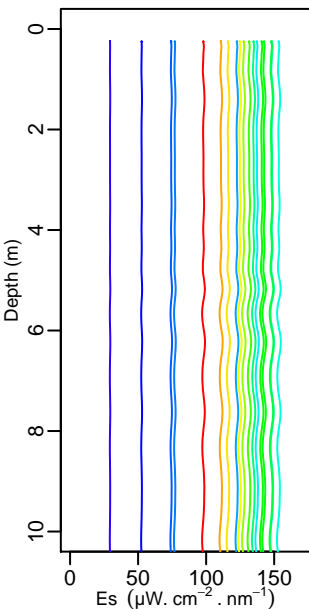
Date = 05/08/2022

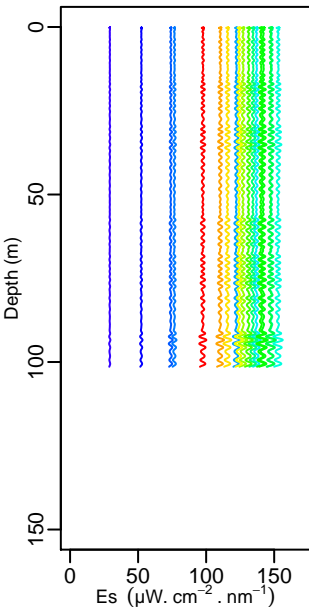
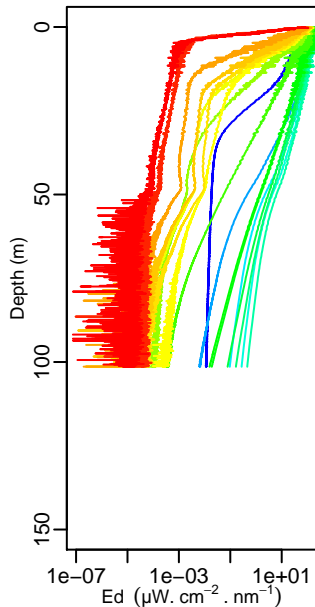
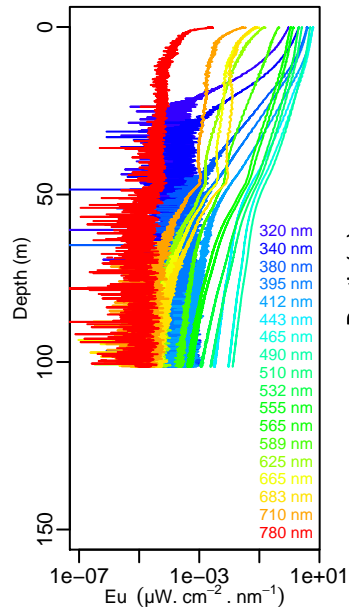
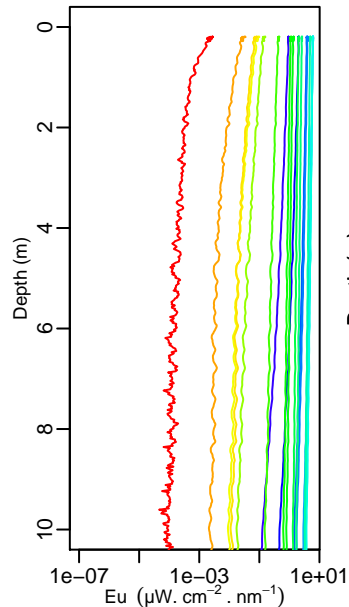
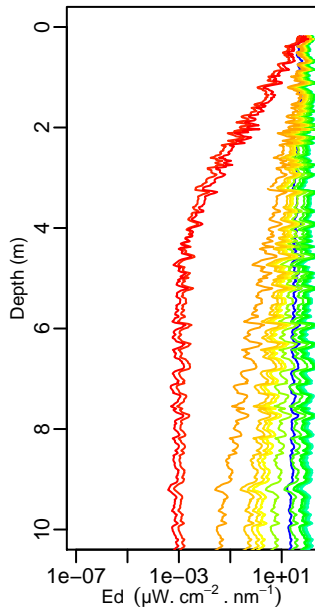
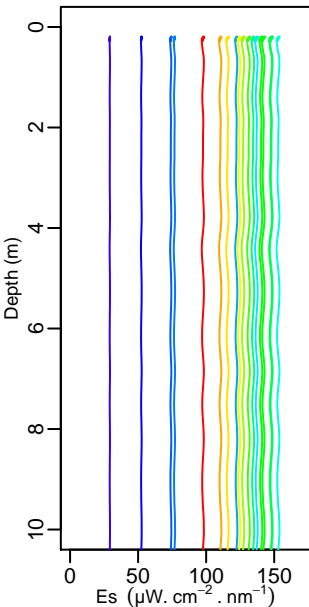
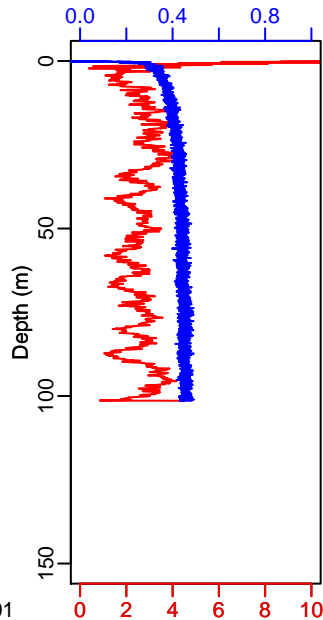
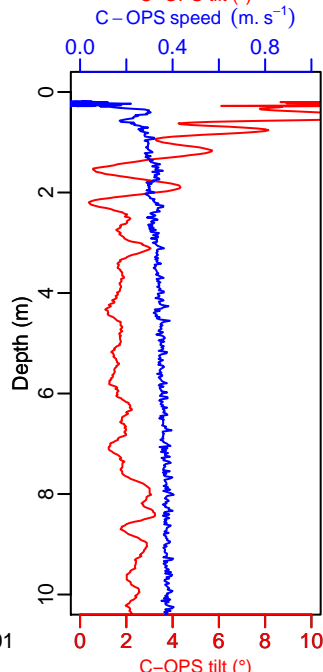
Heure debut [TU] = 11:49

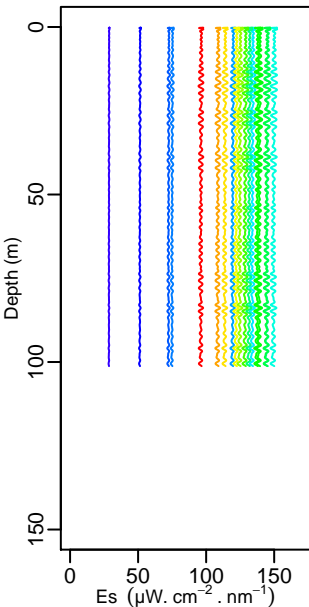
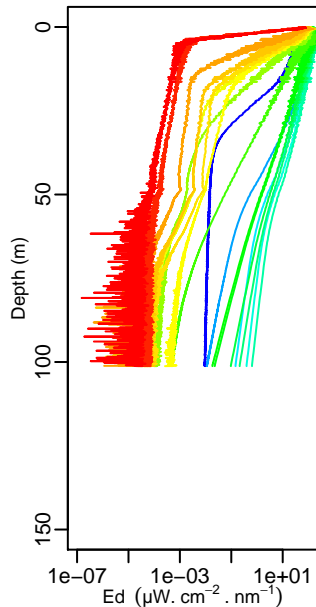
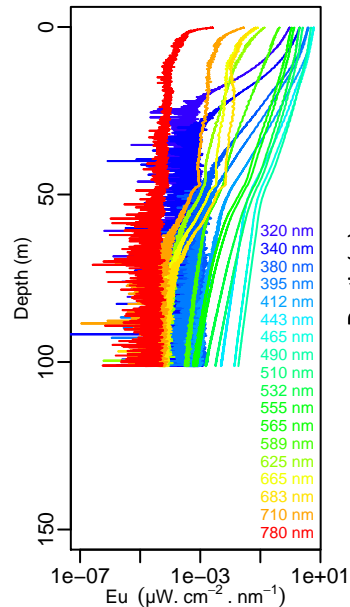
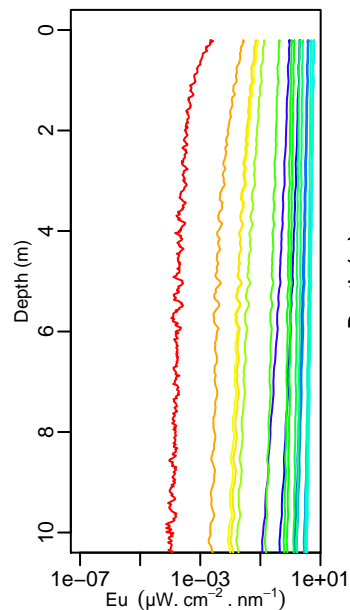
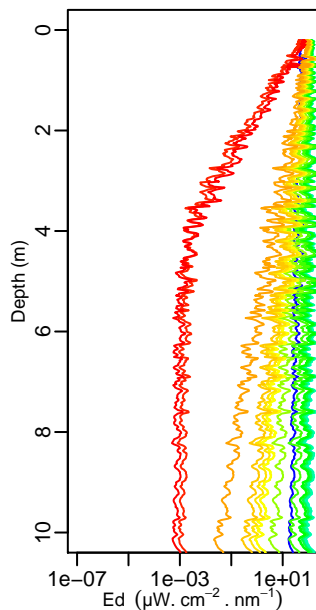
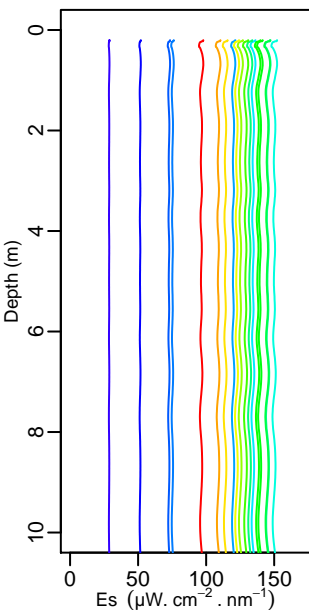
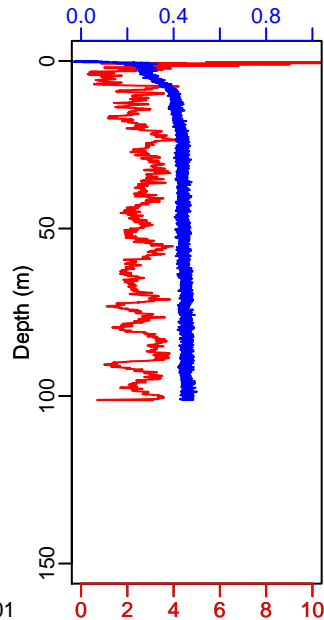
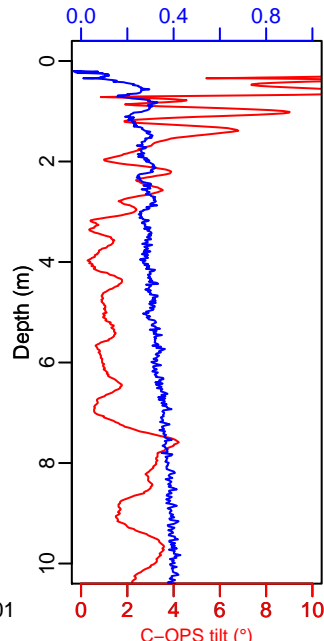
Longitude = 007 51.032 E

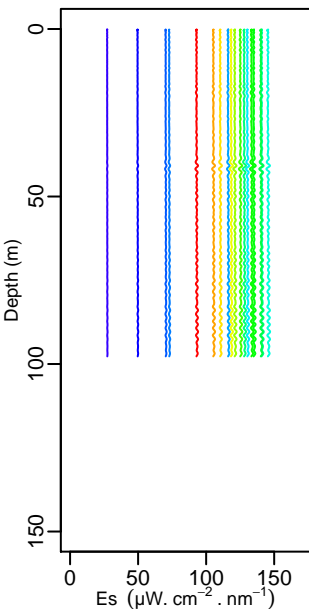
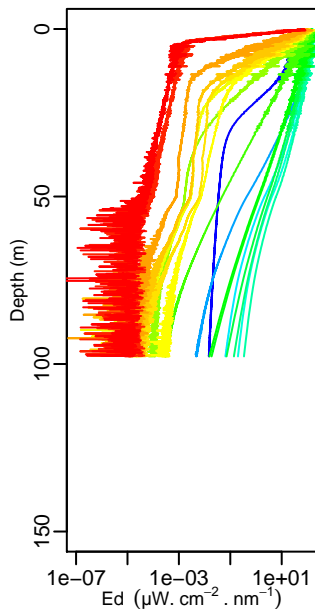
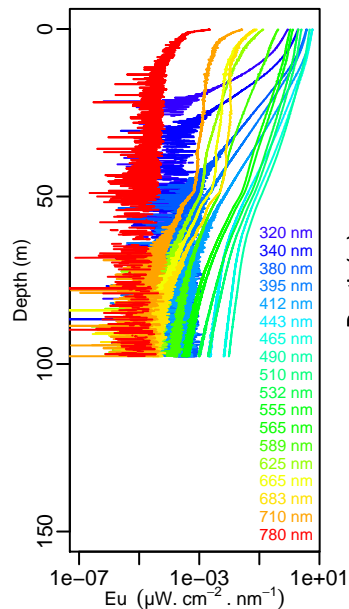
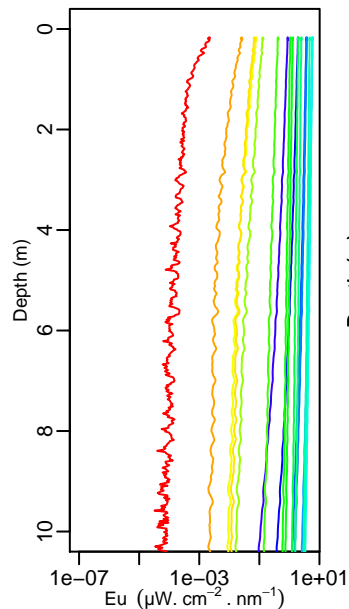
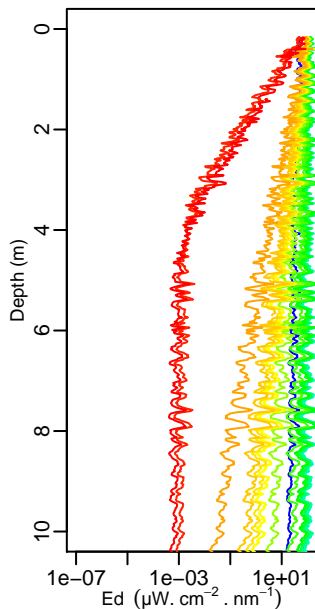
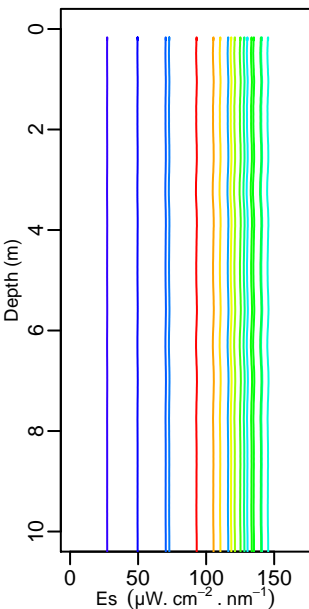
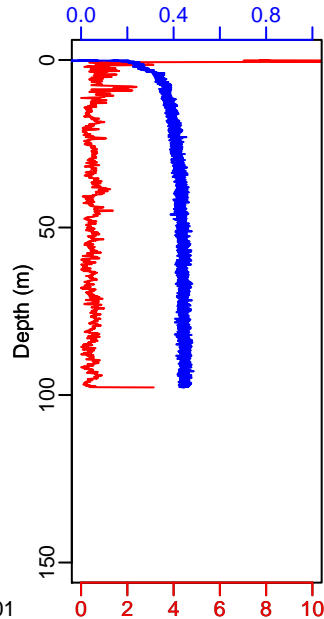
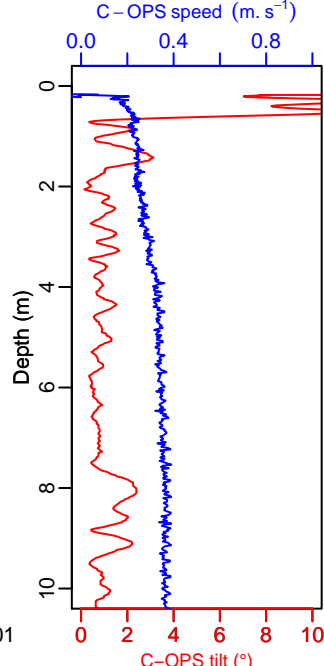
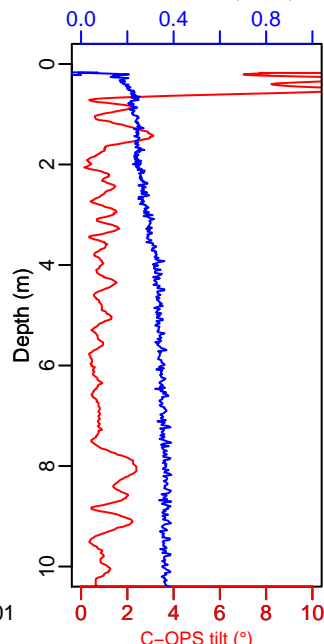
Latitude = 43 25.0007 N

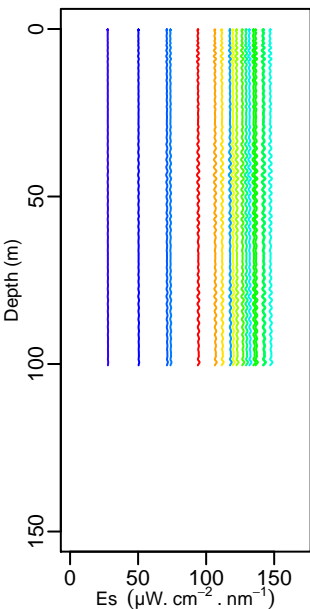
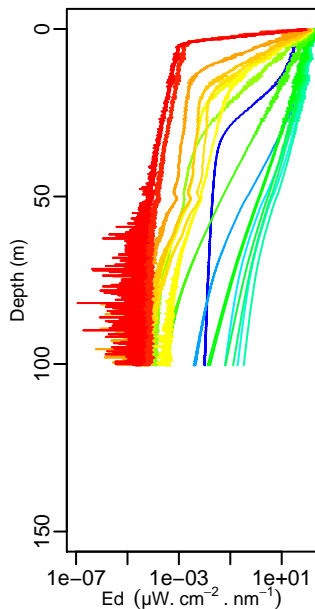
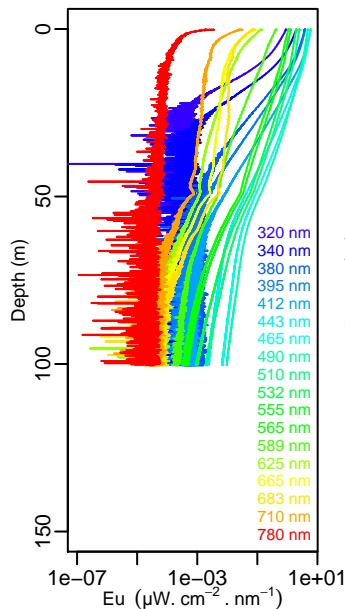
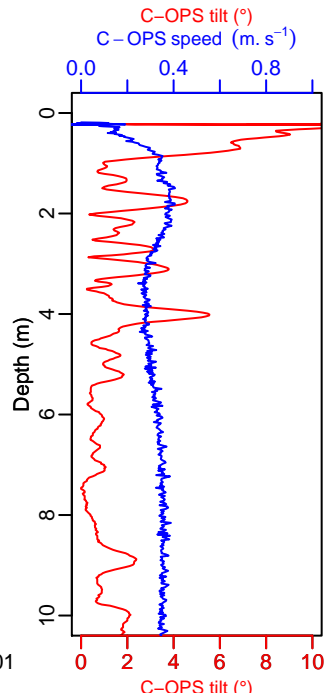
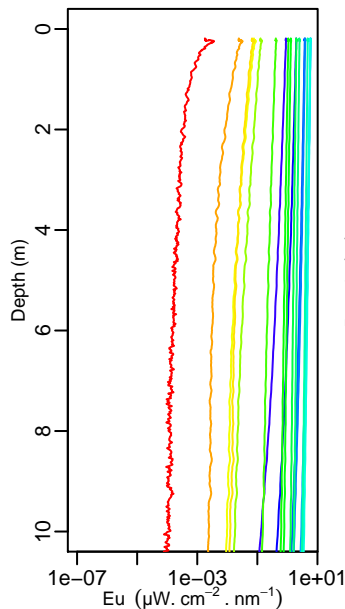
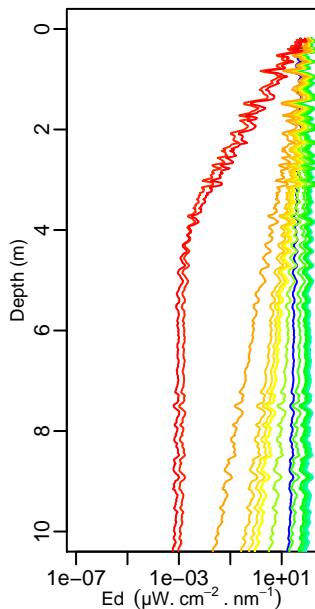
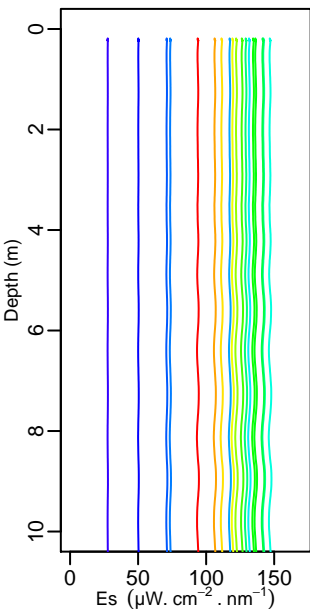
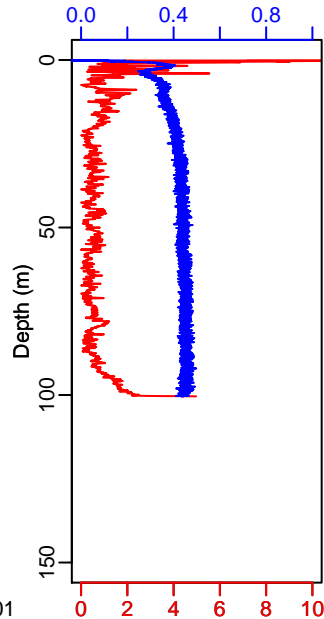


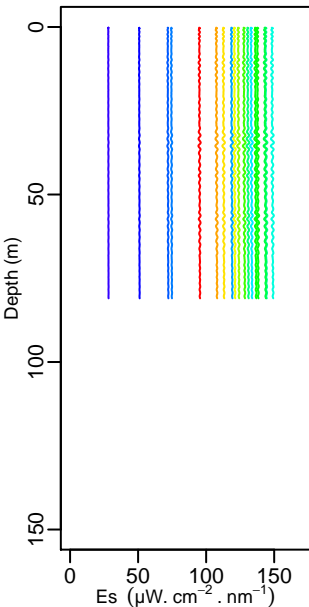
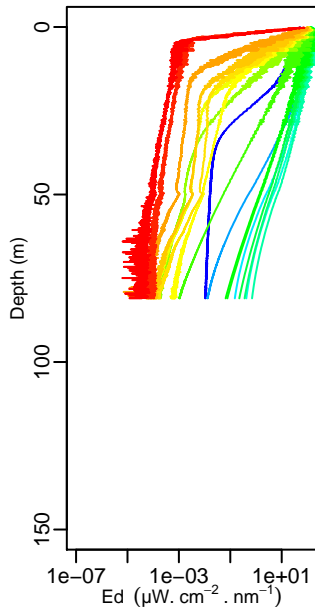
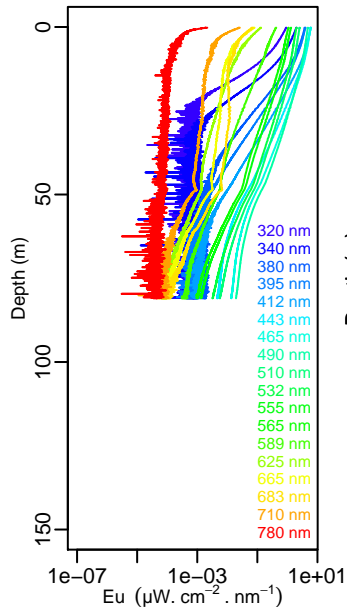
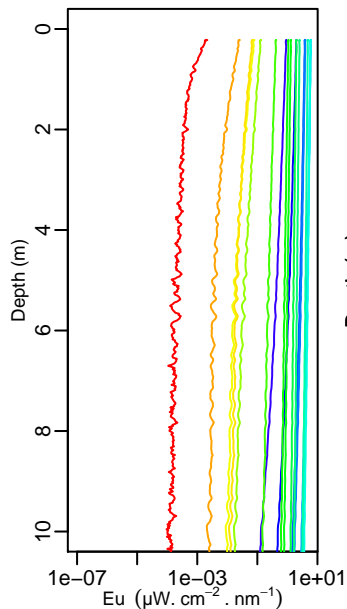
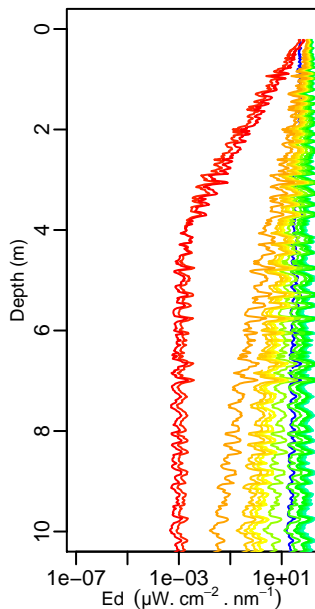
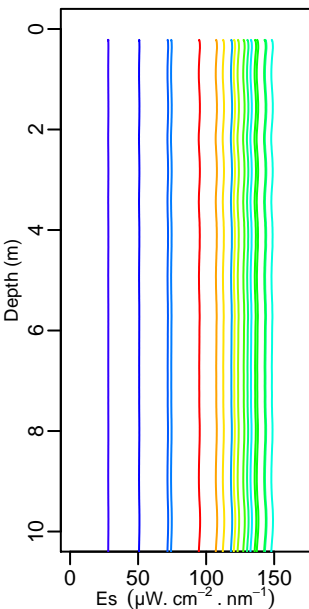
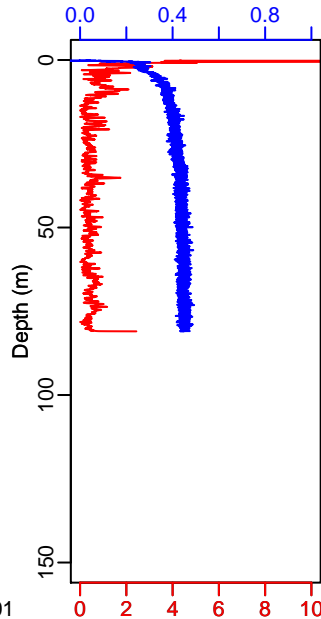
Boussole_245**bou_c-ops_220803_1129_002_data****11:51 UTC****C-OPS speed (m. s⁻¹)****C-OPS tilt (°)****C-OPS speed (m. s⁻¹)**

Boussole_245**bou_c-ops_220803_1129_004_data****12:05 UTC****C-OPS speed (m. s⁻¹)****C-OPS tilt (°)****C-OPS speed (m. s⁻¹)**

Boussole_245**bou_c-ops_220803_1129_005_data****12:16 UTC****C-OPS speed (m. s⁻¹)****C-OPS tilt (°)****C-OPS speed (m. s⁻¹)**

Boussole_245**bou_c-ops_220804_0958_001_data****10:14 UTC****C-OPS speed ($\text{m} \cdot \text{s}^{-1}$)****C-OPS tilt ($^\circ$)****C-OPS speed ($\text{m} \cdot \text{s}^{-1}$)****C-OPS tilt ($^\circ$)**

Boussole_245**bou_c-ops_220804_0958_002_data****10:23 UTC****C-OPS speed (m.s⁻¹)**

Boussole_245**bou_c-ops_220804_0958_003_data****10:32 UTC****C-OPS speed (m. s⁻¹)****C-OPS tilt (°)****C-OPS speed (m. s⁻¹)**