

# BOUSSOLE Monthly Cruise Report

**Cruise 241**

**April 03-05, 2022**

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

Vessel: R/V Téthys II

(Captain: Dany Deneuve)

**Science Personnel:** Ewen Ancel, Cyril Debost, Céline Dimier, Elsa Dor, Melek Golbol, Pablo Liger and Paco Stil.

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



The newly calibrated pCO<sub>2</sub> CARIOCA sensor installed on the BOUSSOLE buoy at 3 m depth by the divers.

**BOUSSOLE project**

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

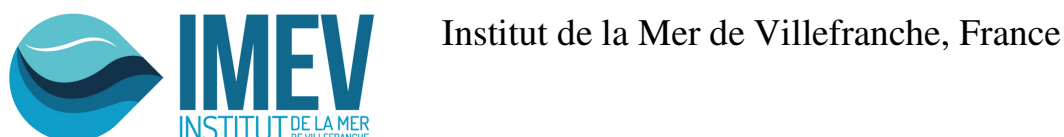
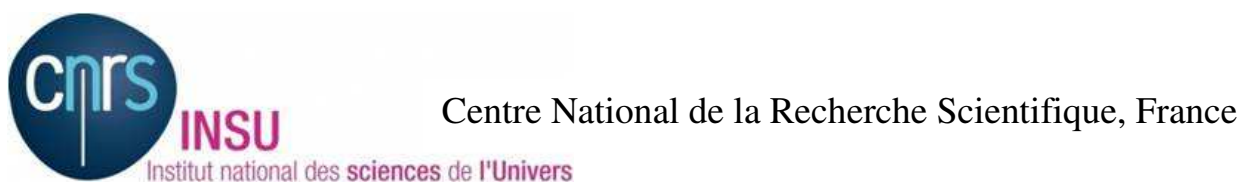
*April 25, 2022*



## 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



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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  $\mu\text{m}$  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 pCO<sub>2</sub> 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](http://www.obs-vlfr.fr/Boussole/html/publications/pubs/BOUSSOLE_TM_214147.pdf))

### Additional operations

A SBE37 CTD connected to a DL3 (data logger) was affixed on the Rosette for testing. It will be installed on the BOUSSOLE buoy before its deployment. Data acquired will be compared to the main CTD.

The second day, an additional CTD cast down to 35 m depth was performed in order to sample water for an intercomparison study of HPLC analyses.

The last day, divers replaced the PCO<sub>2</sub> CARIOCA sensor at 3 m depth with a newly calibrated one.



The SeapHOx installed on the buoy at 3 m depth for the MOOSE program which was recovered during the previous cruise was reinstalled on the buoy. It combines a pH sensor with a Sea-Bird SBE37 MicroCAT CTD+DO sensor. A cable connected to this sensor was brought to the surface and installed on the top of the buoy. It will be used to download data during next cruises.

A hydrophone which was installed on the lower buoy superstructure in the frame of a collaboration with the Geoazur Lab was recovered.

## **Cruise Summary**

The first day was used entirely for MOOSE/DYFAMED operations, which could not happen the day before because of bad weather. The second day was used for CTD casts with water sampling, for CIMEL measurements, for C-OPS profiles and for a Secchi disk at the BOUSSOLE site.

The third day was used for diving operations, for C-OPS profiles, for CTD casts with water sampling, for a Secchi disk at the BOUSSOLE site and for a Manta net at the DYFAMED site for MOOSE program.

### **Sunday 03 April 2022**

This day was given to the MOOSE DYFAMED program.

### **Monday 04 April 2022**

The sea state was slight to smooth with a moderate breeze in the morning and a light breeze in the afternoon. 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. This cast was stopped at 10 depths during the ascent of the CTD. Then a CIMEL measurement was performed. Unfortunately, it was not possible to perform other CIMEL measurements because of a technical problem with the instrument.

Then 3 C-OPS profiles, a CTD cast with water sampling and a Secchi disk were performed at the BOUSSOLE site. Finally, a CTD cast with water sampling was performed down to 35 m depth in order to sample water for HPLC analyses intercomparison study before returning to the Nice harbour.

### **Tuesday 05 April 2022**

The sea state was smooth with a gentle breeze. The sky was blue and the visibility was excellent. Firstly, divers went at sea to recover the hydrophone and to replace the pCO<sub>2</sub> carioca sensor with the newly calibrated one. They reinstalled the SeapHOx sensor on the buoy and they also take pictures. The communication cable for this sensor was brought to the surface and installed on the top of the buoy for downloading data during next cruises. The other diving operations were not performed during this cruise because the buoy is currently not working.

Then 3 C-OPS profiles, a Secchi disk, 2 CTD casts with water sampling were performed at the BOUSSOLE site. For the last CTD cast (CTD 05), a cap was put on the backscattering meter for dark measurements.

Finally, a Manta net was performed at the DYFAMED site for the MOOSE program before returning to the Nice harbour.

Pictures taken during this cruise can be found at:

<https://photos.app.goo.gl/dbmkUHws5UgCeK6x6>

Data from the BOUSSOLE cruises and buoy are available at:

[http://www.obs-vlfr.fr/Boussole/html/boussole\\_data/login\\_form.php](http://www.obs-vlfr.fr/Boussole/html/boussole_data/login_form.php)

## **Cruise Report**

### **Sunday 03 April 2022**

MOOSE operations.

## Monday 04 April 2022 (UTC)

People on board: Ewen Ancel, Céline Dimier, Elsa Dor (student), Melek Golbol and Paco Stil.

0610 Departure to the BOUSSOLE site.  
0940 Arrival at the BOUSSOLE site.  
0945 CTD 01, 400 m with water sampling at 60, 35, 20 and 5 m for TSM, metagenomic, nutrients and cytometry.  
1045 CIMEL 01.  
1215 C-OPS 01, 02, 03.  
1320 CTD 02, 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.  
1415 Secchi 01, 16 m.  
1430 CTD 03, 35 m with water sampling at 35 m for HPLC intercomparison study.  
1435 Departure to the Nice harbour.  
1800 Arrival to the Nice harbour.

## Tuesday 05 April 2022 (UTC)

People on board: Cyril Debost, Céline Dimier, Elsa Dor, Melek Golbol, Pablo Liger, and Paco Stil.

0530 Departure to the BOUSSOLE site.  
0850 Arrival at the BOUSSOLE site.  
0900 Diving operations: SeapHOx sensor + cable installation, replacement of  $pCO_2$  CARIOCA sensor, recovery of hydrophone.  
1030 End of diving operation.  
1040 C-OPS 04, 05, 06.  
1140 CTD 04, 400 m with water sampling at 400, 200, 150, 80, 70, 60, 50, 40, 30, 20, 10 and 5 m for HPLC,  $a_p$ .  
1155 Secchi 02, 19 m.  
1255 CTD 05, 50 m with water sampling at 5 m for TSM,  $O_2$ , TA/TC, and pH.  
1315 Manta net (MOOSE program).  
1350 Departure to the Nice harbour.  
1700 Arrival to the Nice harbour.

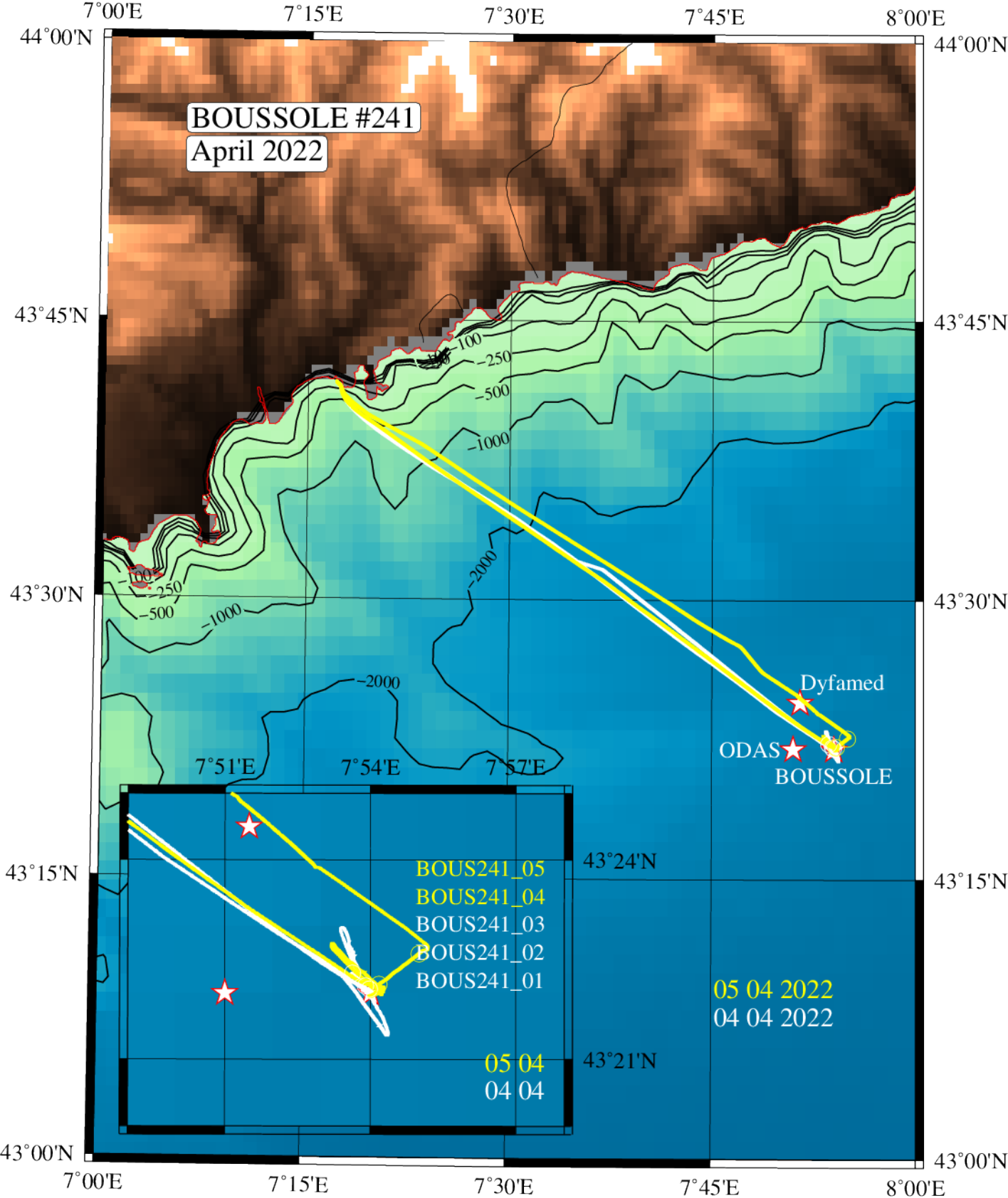
## Problems identified during the cruise

- Only one CIMEL measurement was performed during this cruise. The photometer stopped working after the first measurement for some unknown reason.
- There were some spikes in the temperature, salinity and oxygen data acquired by the CTD during the upcasts.
- At the end of the second day, we noticed that there was a leak in the inlet tube of the temperature sensor of the main CTD. So, the head of the temperature sensor was replaced.

# **Appendices**

Cruise Summary Table for Boussole 241

| Date     | Black names        | Profile names                      | CTD notes                           | Other sensors                   | Start Time | Duration | Depth max | Latitude (N)     |                |         | Longitude |          |          | Sky  | Clouds | Quantity (#/8) | Weather | Wind sp. (kn) | Wind dir. | Atm. Pressure (hPa) | Humidity (%) | Visibility | T air | T water | Sea | Sea Swell H (m) | Swell dir. | Whitecaps |
|----------|--------------------|------------------------------------|-------------------------------------|---------------------------------|------------|----------|-----------|------------------|----------------|---------|-----------|----------|----------|------|--------|----------------|---------|---------------|-----------|---------------------|--------------|------------|-------|---------|-----|-----------------|------------|-----------|
|          | (file ext: ".raw") | (file extension: ".raw")           |                                     |                                 |            |          |           | (GMT (hour.min)) | (hour.min.sec) | (meter) | (Degree)  | (Minute) | (Degree) |      |        |                |         |               |           |                     |              |            |       |         |     |                 |            |           |
| 03/04/22 | DYFAMED operations |                                    |                                     |                                 |            |          |           |                  |                |         |           |          |          |      |        |                |         |               |           |                     |              |            |       |         |     |                 |            |           |
| 04/04/22 |                    | BOUS241_01                         | TSM, metagenomics, cyto & nutrients | 9:46                            | 1:40:00    | 400      | 43        | 22.057           | 7              | 53.981  | blue      |          | 1        | 11.8 | 112    | 1018           | 59.9    |               | 11.5      | 13.64               | slight       |            |       |         |     |                 |            |           |
|          |                    |                                    | CIMEL 01                            | 10:50                           | 0:10:00    |          | 43        | 22.191           | 7              | 53.604  | blue      |          | 1        |      |        | 1018           |         |               |           |                     |              |            |       |         |     |                 |            |           |
|          |                    | bou c-ops 220404_1208_001_data.csv |                                     | 12:16                           | 0:05:42    | 148      | 43        | 22.203           | 7              | 53.773  | blue      |          | 0        | 4.8  | 118    | 1018           | 56.1    | good          | 11.9      |                     |              | slight     | 0.7   |         |     |                 |            | no        |
|          |                    | bou c-ops 220404_1208_002_data.csv |                                     | 12:32                           | 0:05:20    | 141      | 43        | 22.459           | 7              | 53.676  | blue      |          | 0        | 4.8  | 118    | 1018           | 56.1    | good          | 11.9      |                     |              | slight     | 0.7   |         |     |                 |            | no        |
|          |                    | bou c-ops 220404_1208_003_data.csv |                                     | 12:47                           | 0:05:02    | 138      | 43        | 22.697           | 7              | 53.570  | blue      |          | 0        | 4.8  | 118    | 1018           | 56.1    | good          | 11.9      |                     |              | slight     | 0.7   |         |     |                 |            | no        |
|          |                    |                                    | BOUS241_02                          | HPLC, ap & cyto                 | 13:20      | 0:39:00  | 400       | 43               | 22.106         | 7       | 53.904    | blue     |          | 0    | 3.6    | 104            | 1017    | 53.8          |           | 11.7                | 13.68        | smooth     |       |         |     |                 |            |           |
|          |                    |                                    |                                     | Secchi 01                       | 14:15      | 0:04:00  | 16        | 43               | 22             | 7       | 54        | blue     |          | 0    |        |                |         |               |           |                     |              |            |       |         |     |                 |            |           |
|          |                    | BOUS241_03                         |                                     | 14:28                           | 0:05:00    | 35       | 43        | 22.294           | 7              | 53.635  | blue      |          | 0        | 1.1  | 83     | 1016           | 52.4    |               | 12.5      | 13.70               | smooth       |            |       |         |     |                 |            |           |
| 05/04/22 |                    | bou c-ops 220405_1012_001_data.csv |                                     | 10:41                           | 0:05:10    | 132      | 43        | 22.279           | 7              | 53.895  | blue      |          | 0        | 7.1  | 190    | 1014           | 66.3    | excellent     | 12.5      |                     |              | smooth     | 0.5   |         |     |                 | no         |           |
|          |                    | bou c-ops 220405_1012_002_data.csv |                                     | 10:58                           | 0:05:04    | 132      | 43        | 22.464           | 7              | 53.569  | blue      |          | 0        | 7.1  | 190    | 1014           | 66.3    | excellent     | 12.5      |                     |              | smooth     | 0.5   |         |     |                 | no         |           |
|          |                    | bou c-ops 220405_1012_003_data.csv |                                     | 11:10                           | 0:05:04    | 133      | 43        | 22.603           | 7              | 53.389  | blue      |          | 0        | 7.1  | 190    | 1014           | 66.3    | excellent     | 12.5      |                     |              | smooth     | 0.5   |         |     |                 | no         |           |
|          |                    |                                    | BOUS241_04                          | HPLC & ap                       | 11:40      | 0:33:00  | 400       | 43               | 22.129         | 7       | 54.181    | blue     |          | 0    | 10.7   | 107            | 1014    | 67            |           | 12.3                | 14.04        | smooth     |       |         |     |                 |            |           |
|          |                    |                                    |                                     | Secchi 02                       | 11:55      | 0:04:00  | 19        | 43               | 22             | 7       | 54.000    | blue     |          | 0    |        |                |         |               |           |                     |              |            |       |         |     |                 |            |           |
|          |                    |                                    | BOUS241_05                          | TSM, TA/TC, O <sub>2</sub> & pH | 12:54      | 0:06:00  | 50        | 43               | 22.592         | 7       | 55.004    | blue     |          | 0    | 10.8   | 196            | 1013    | 63.3          |           | 13.6                | 14.02        | smooth     |       |         |     |                 |            |           |



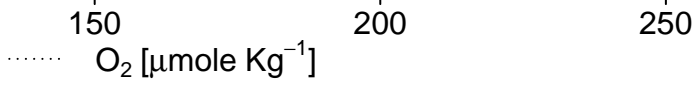
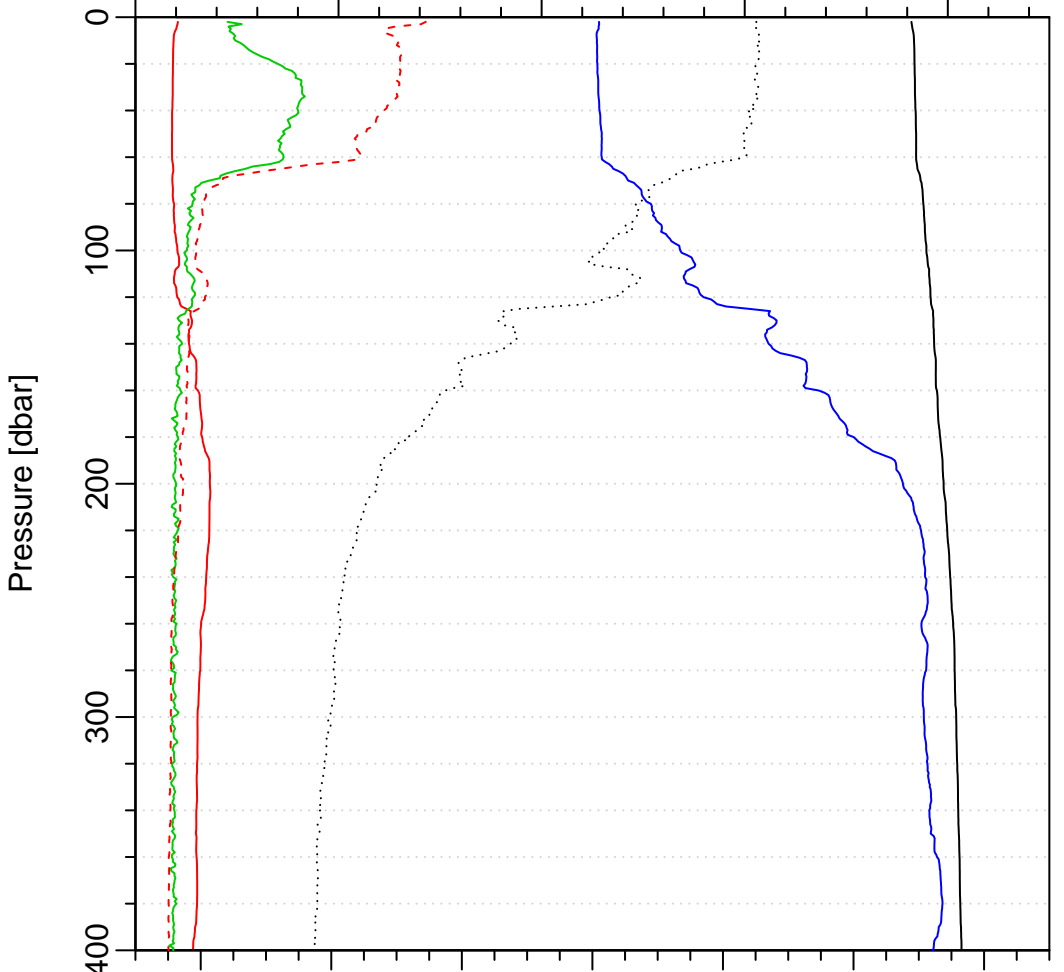
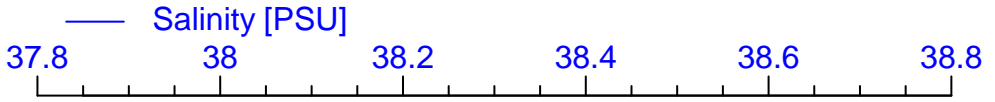
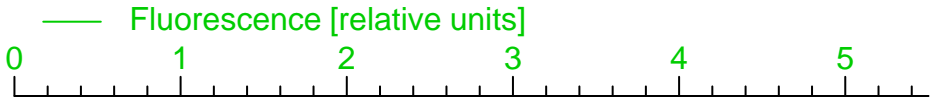
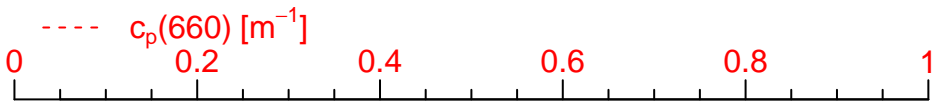
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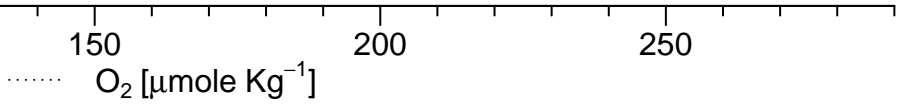
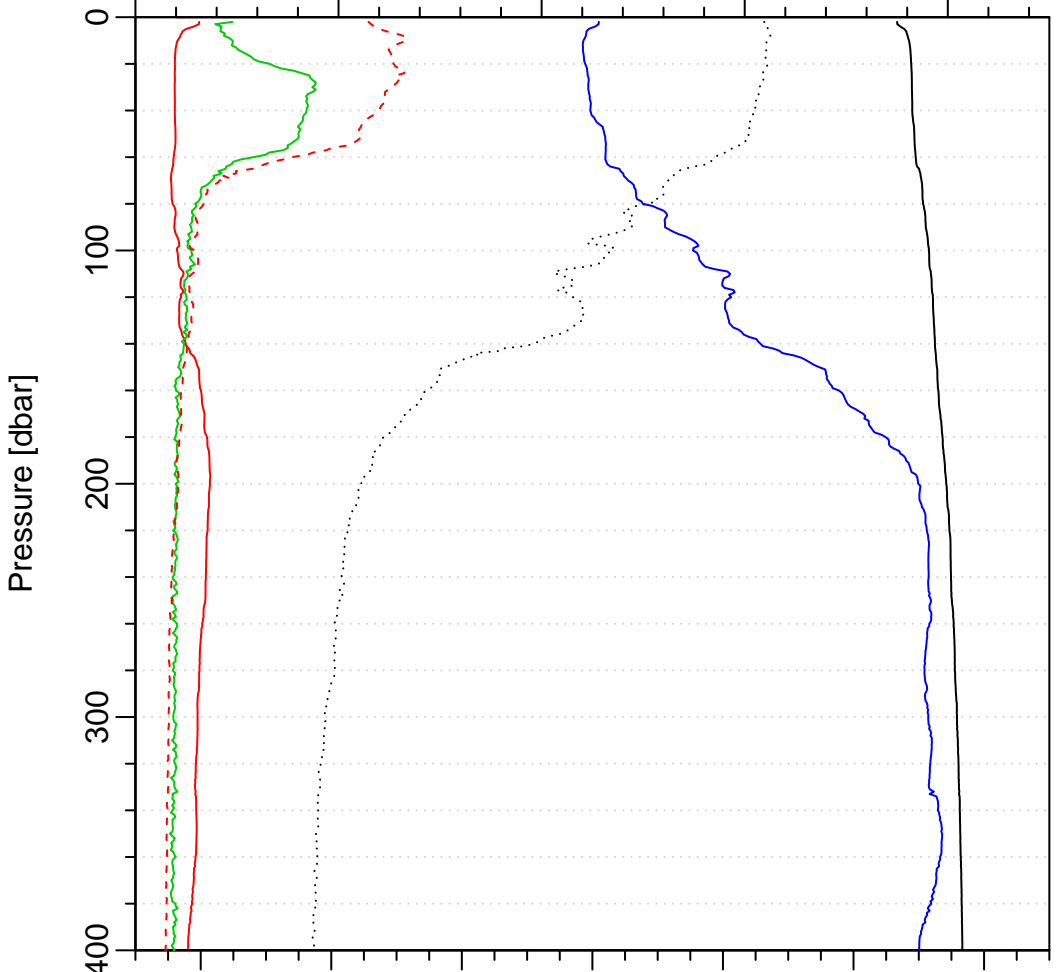
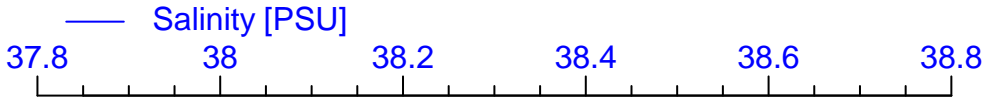
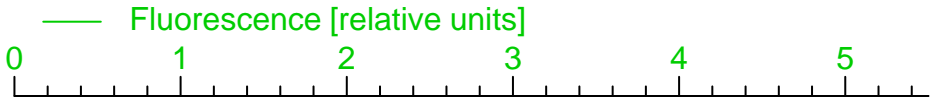
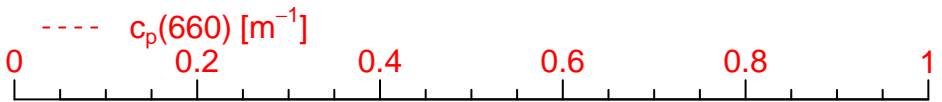
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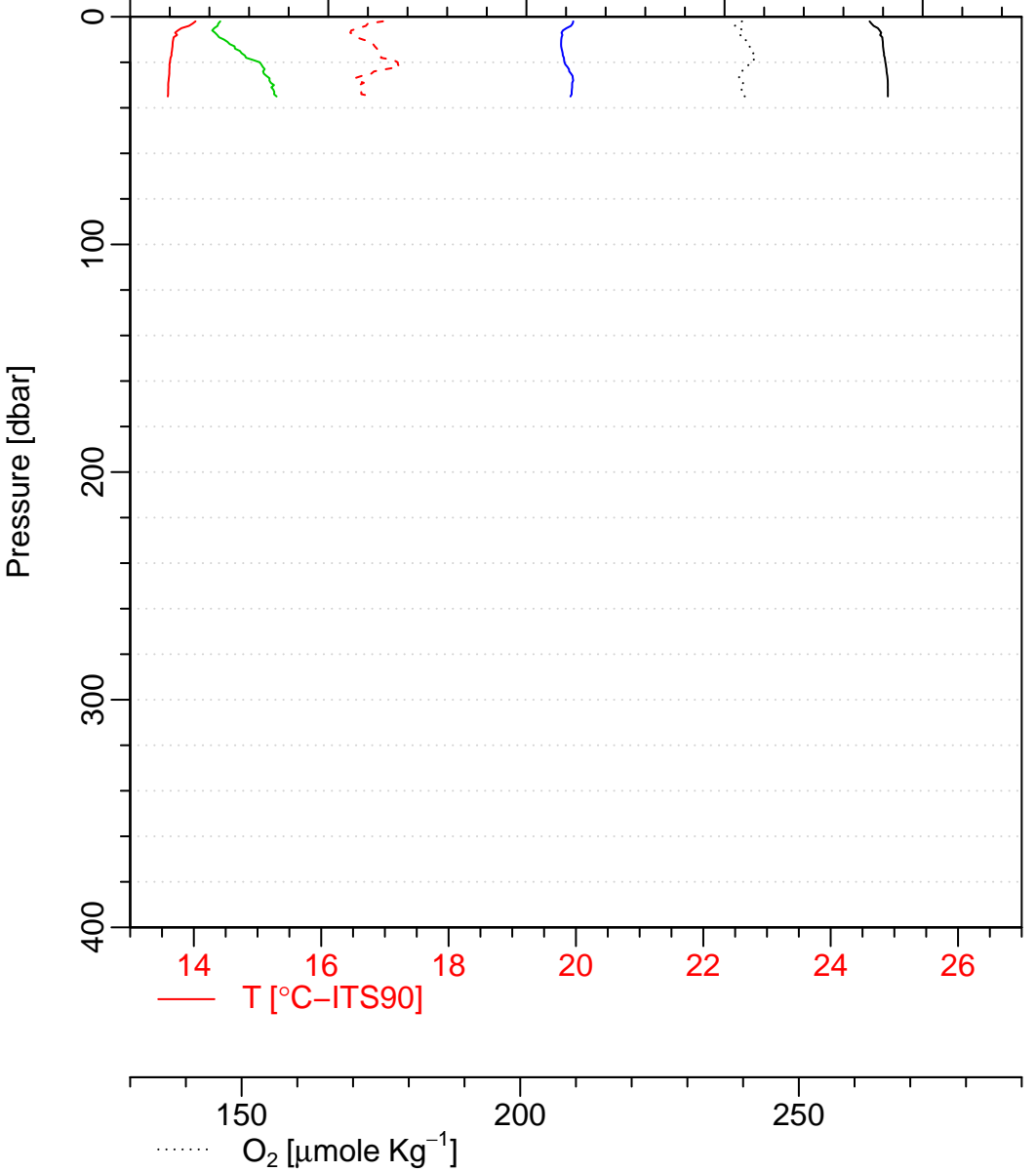
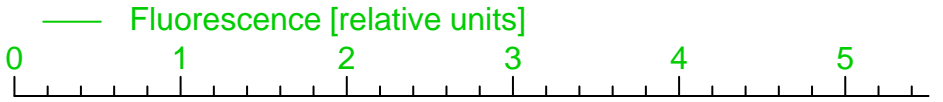
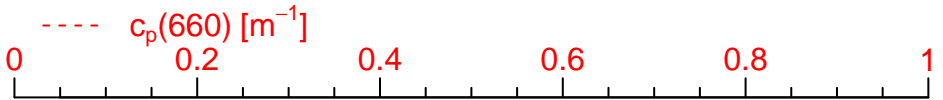
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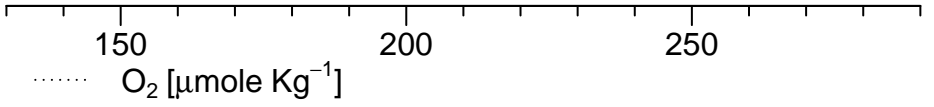
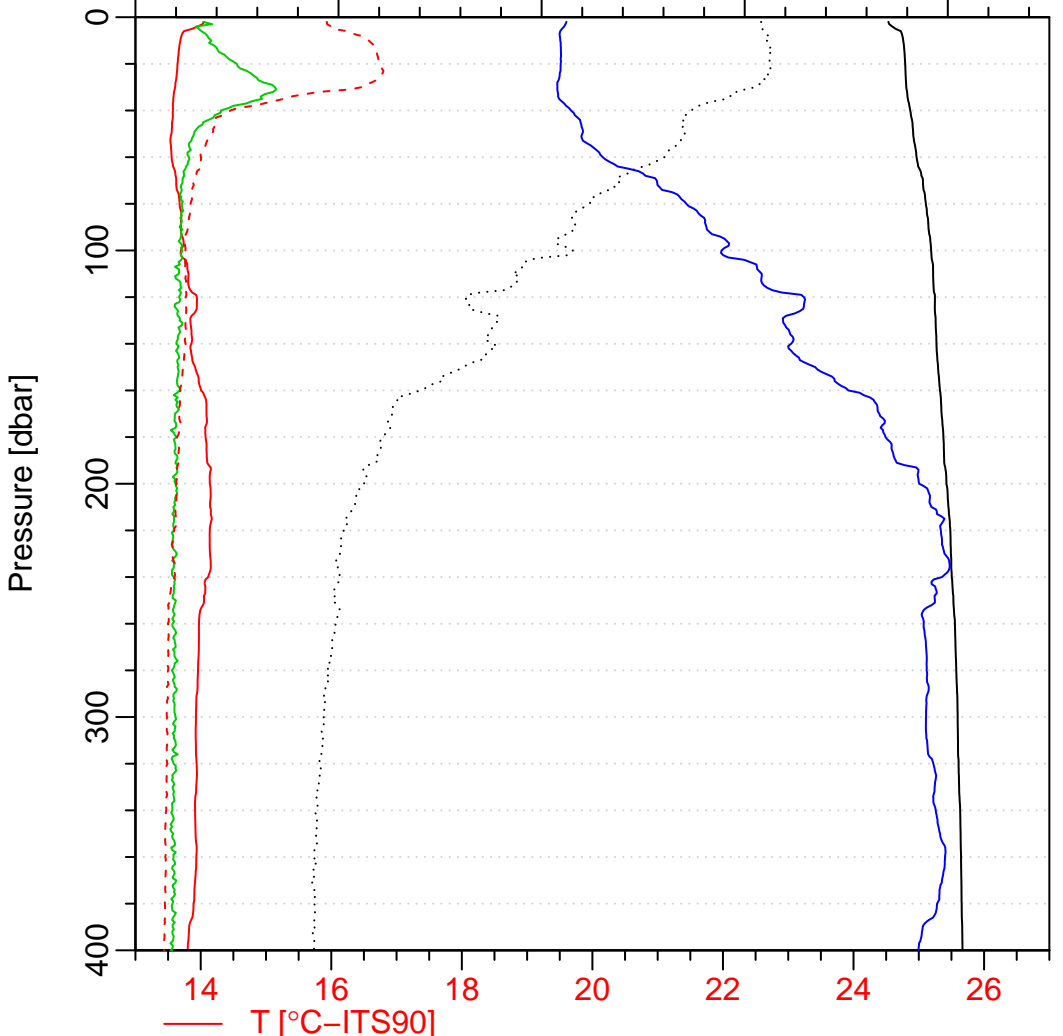
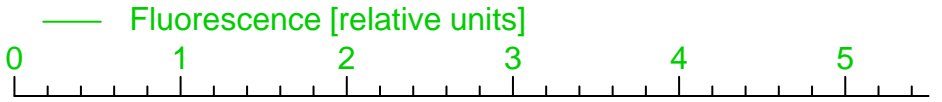
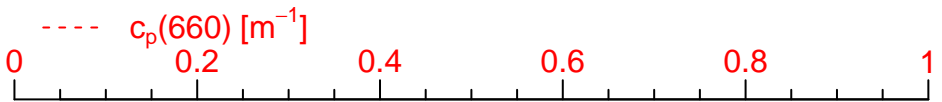
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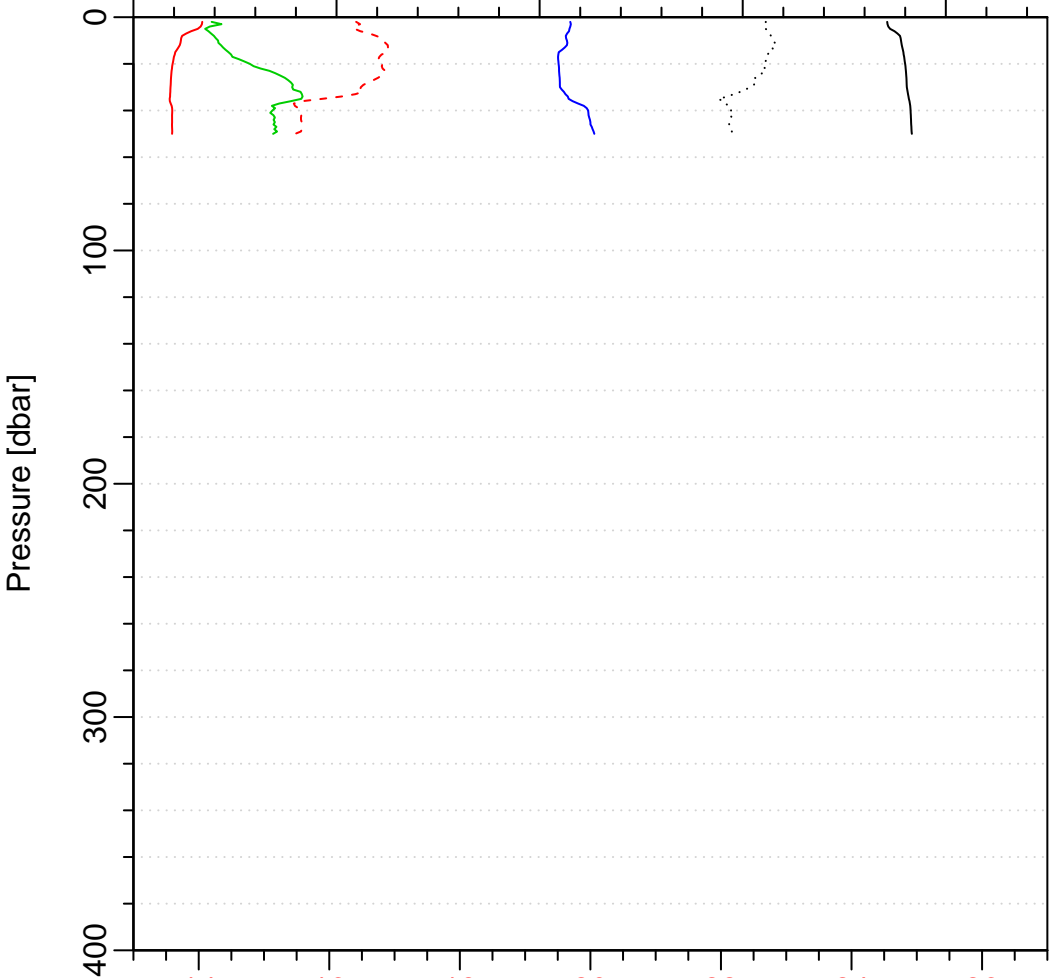
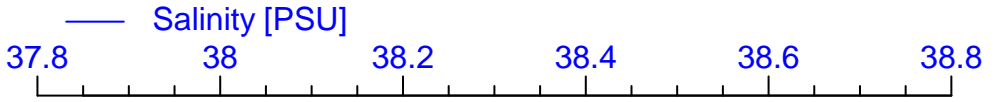
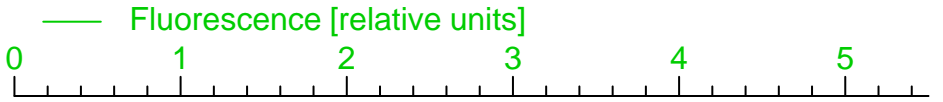
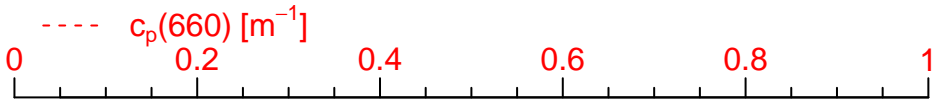
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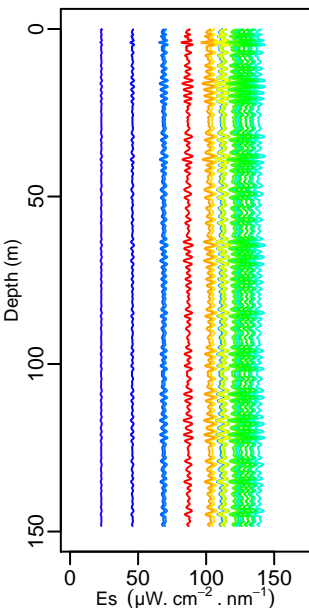
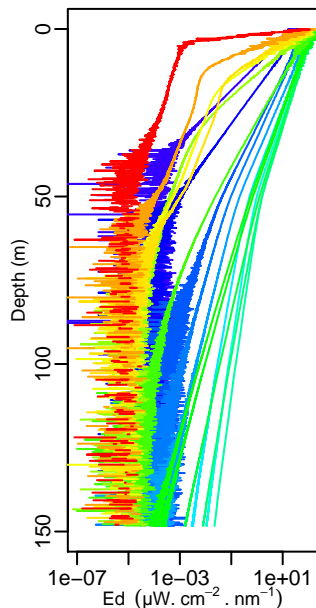
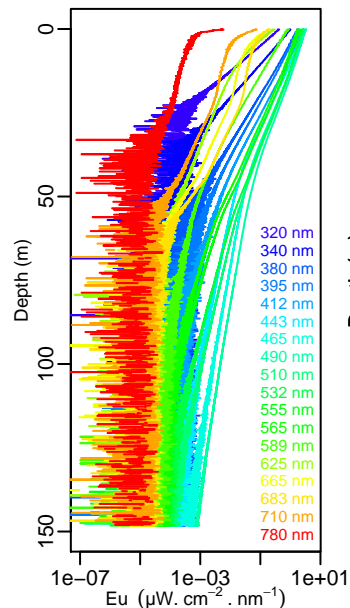
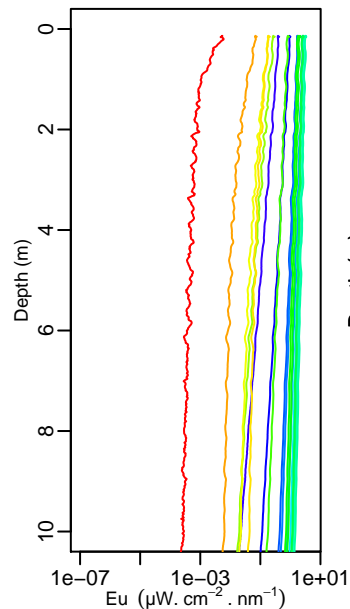
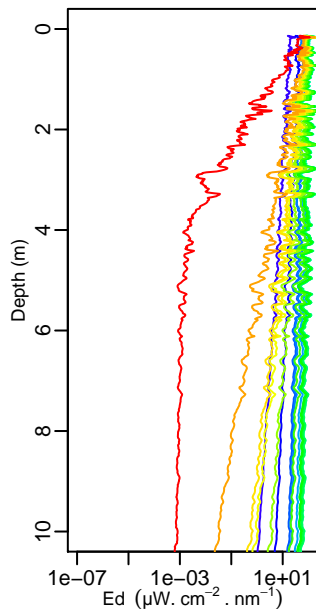
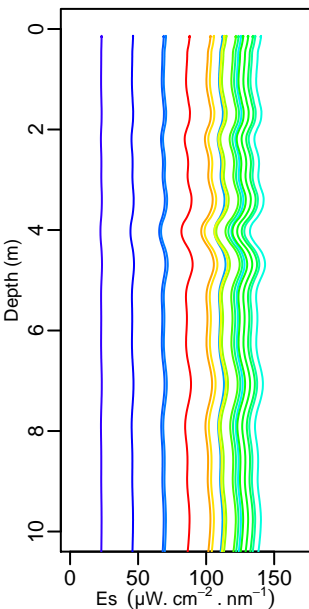
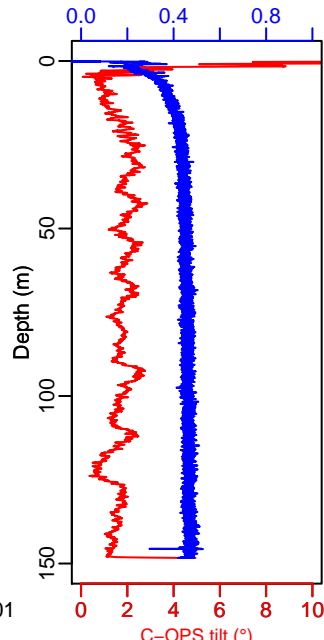
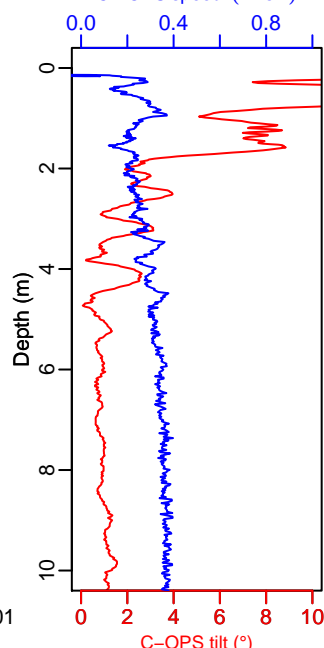
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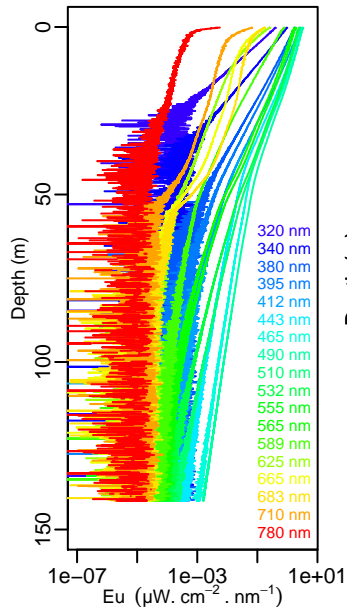
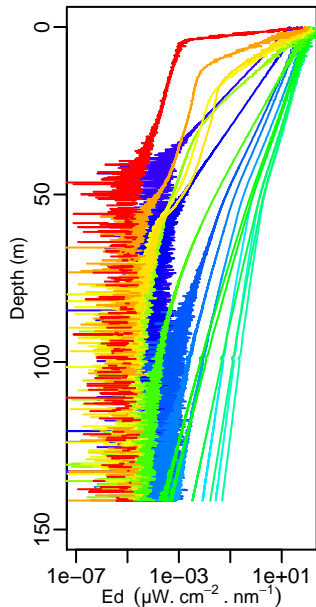
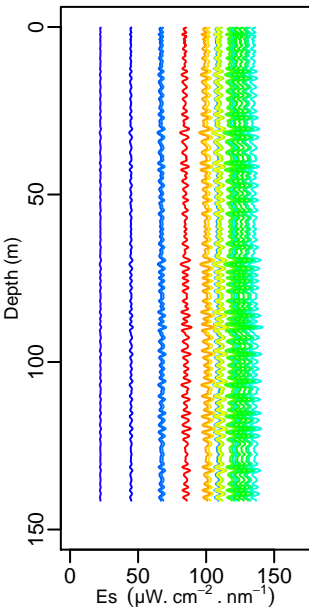


**Boussole\_241****bou\_c-ops\_220404\_1208\_001\_data****12:16 UTC****C-OPS speed ( $\text{m} \cdot \text{s}^{-1}$ )****C-OPS tilt ( $^\circ$ )**

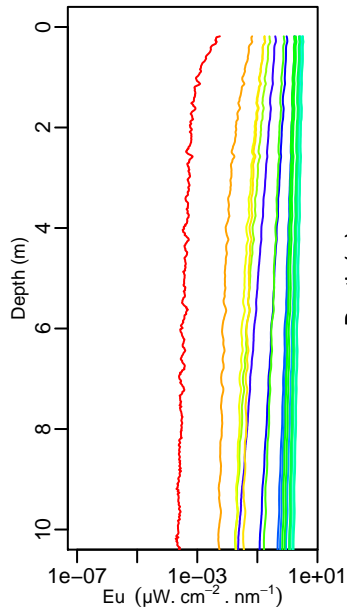
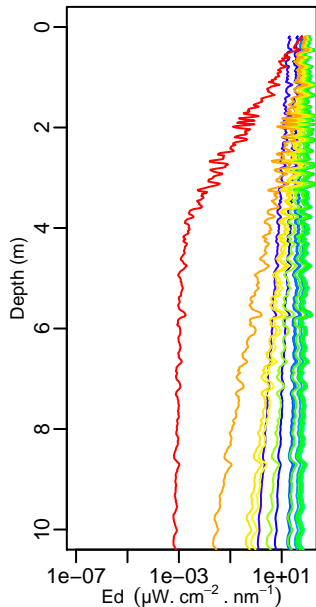
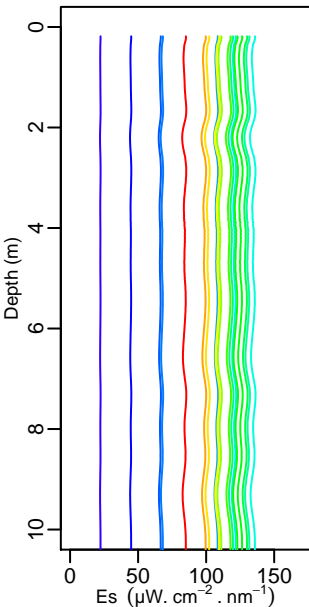
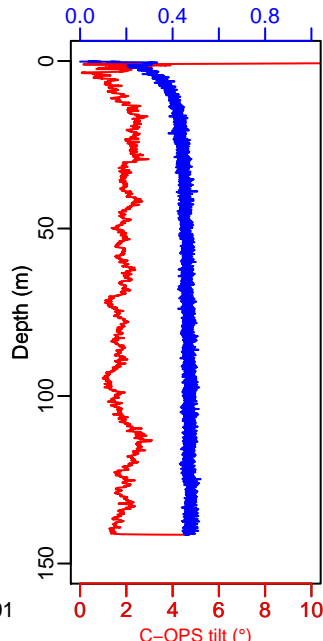
# Boussole\_241

bou\_c-ops\_220404\_1208\_002\_data

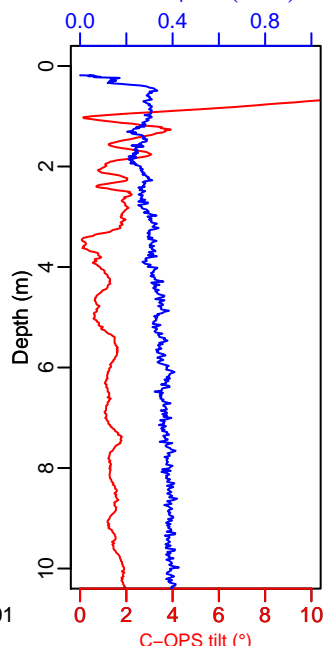
12:32 UTC



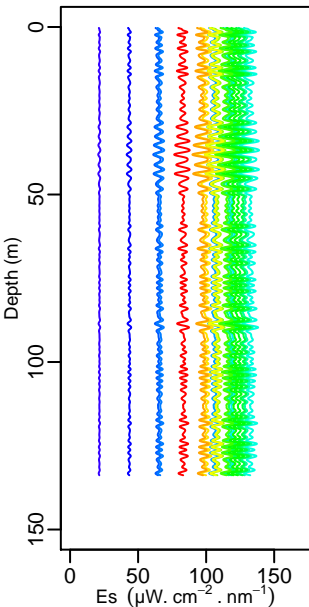
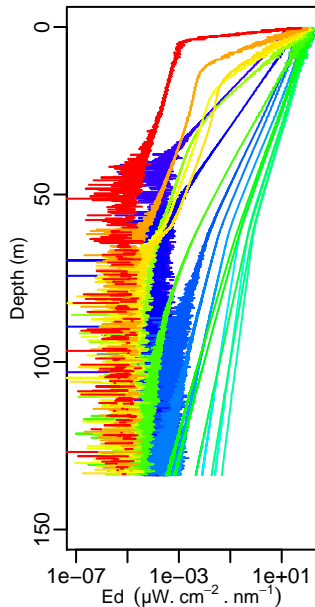
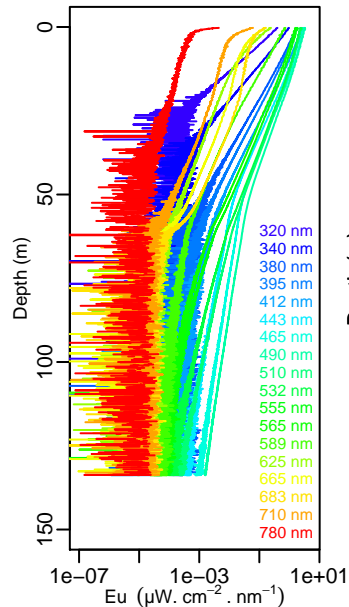
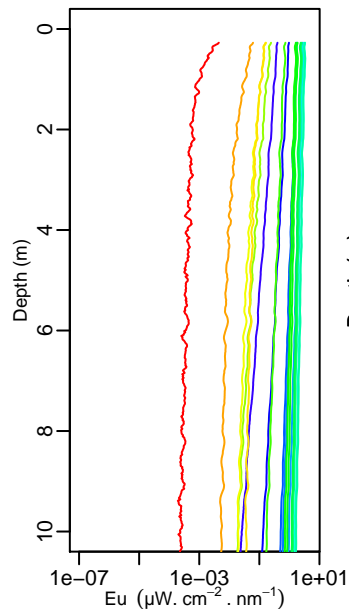
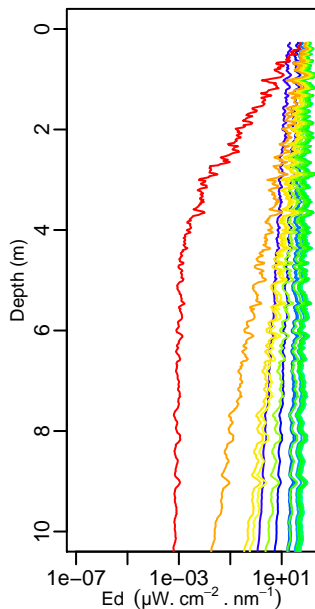
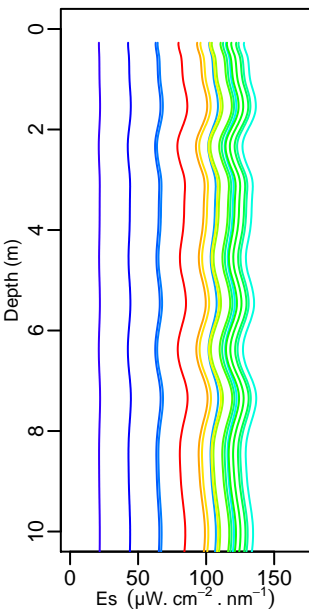
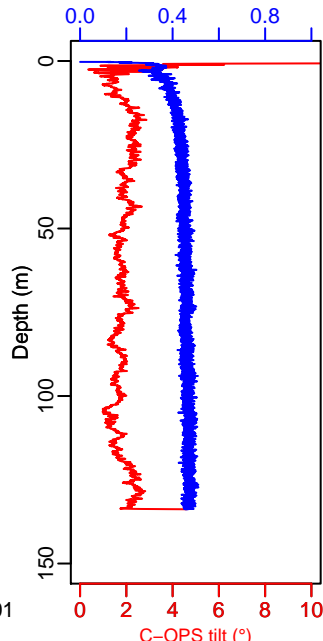
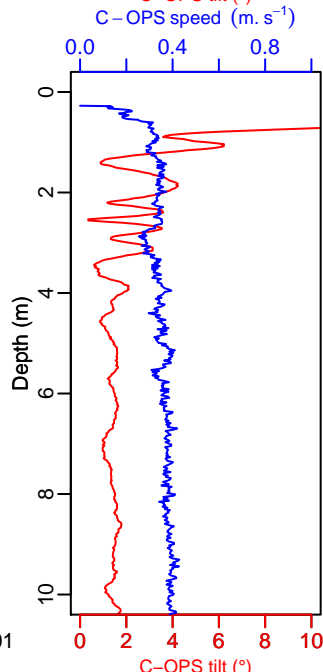
C-OPS speed (m.s<sup>-1</sup>)



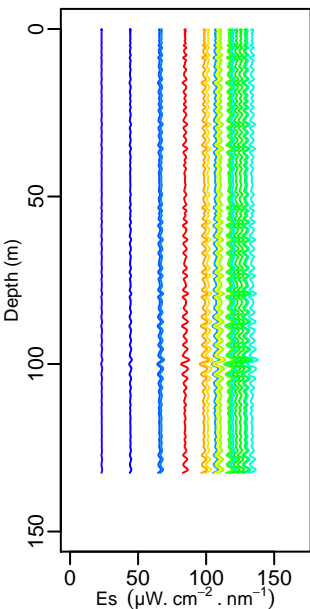
C-OPS tilt ( $^{\circ}$ )



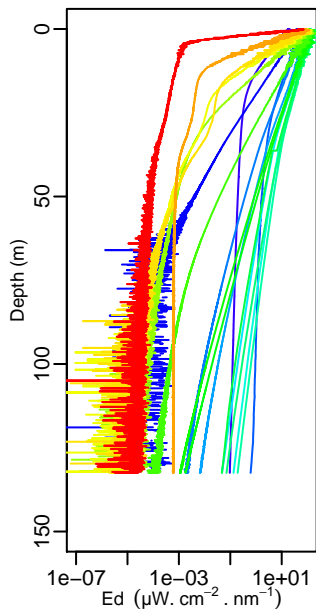


**Boussole\_241****bou\_c-ops\_220404\_1208\_003\_data****12:47 UTC****C-OPS speed (m. s<sup>-1</sup>)****C-OPS tilt (°)****C-OPS speed (m. s<sup>-1</sup>)**

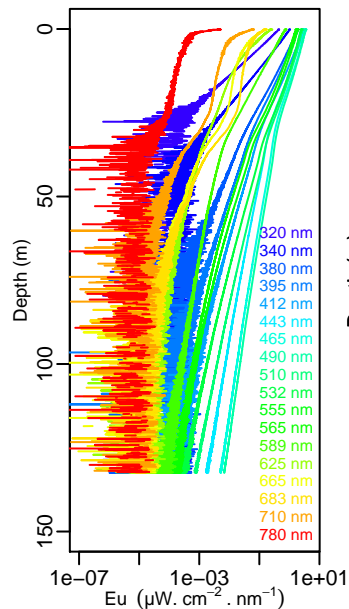
# Boussole\_241



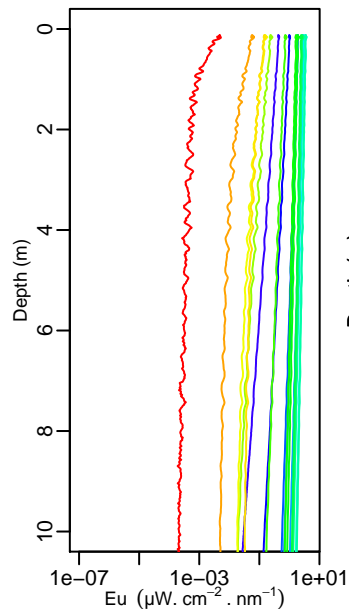
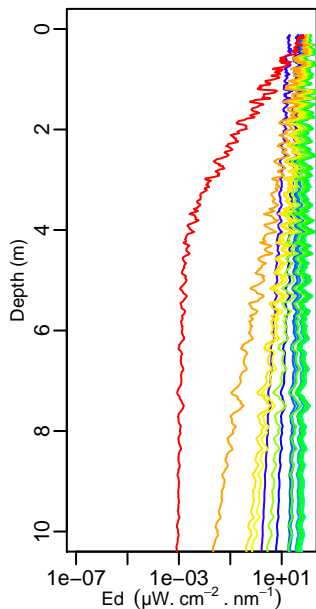
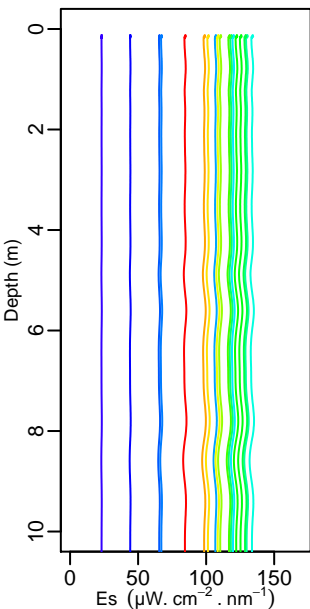
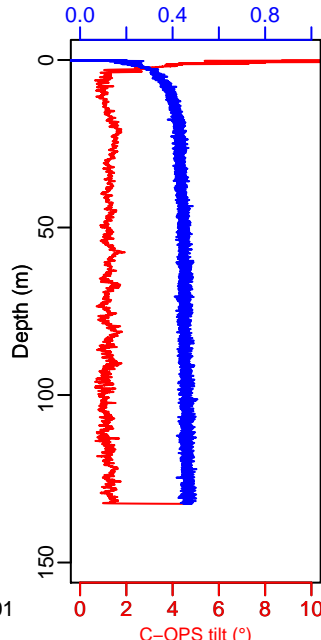
# bou\_c-ops\_220405\_1012\_001\_data



# 10:41 UTC

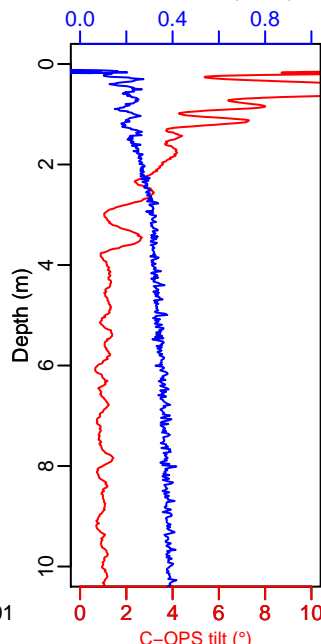


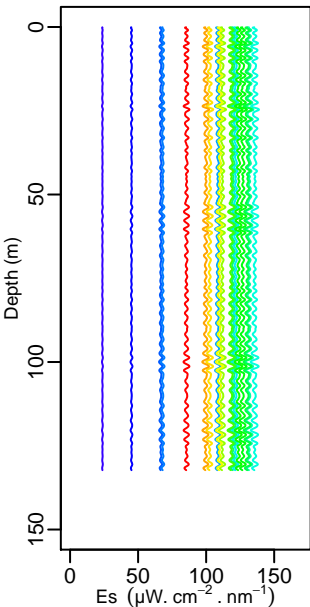
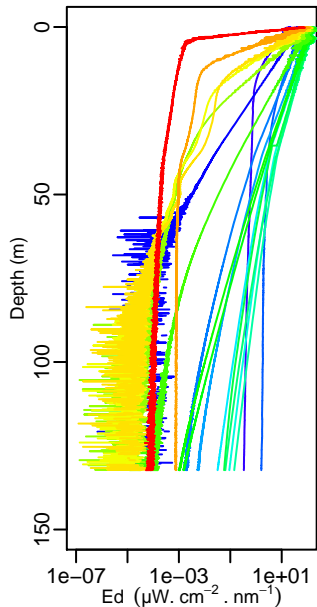
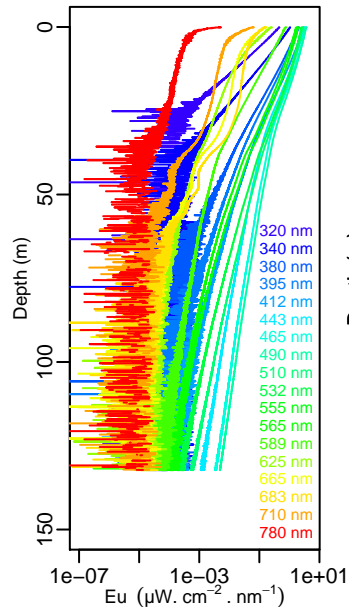
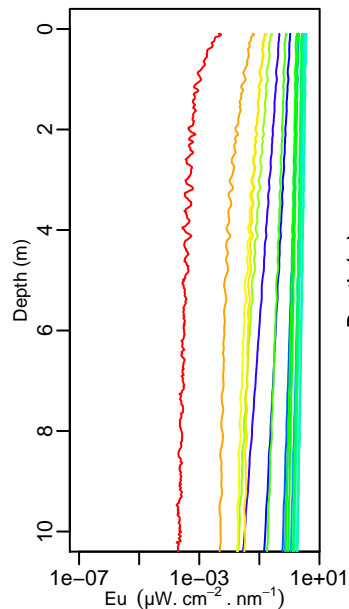
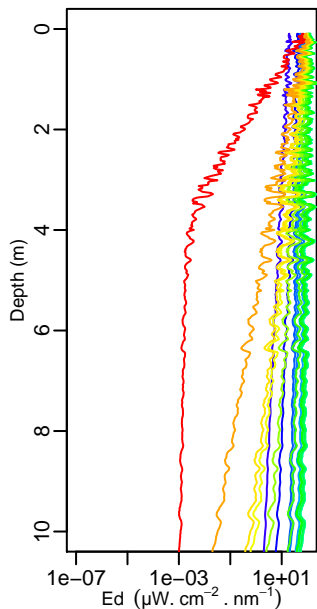
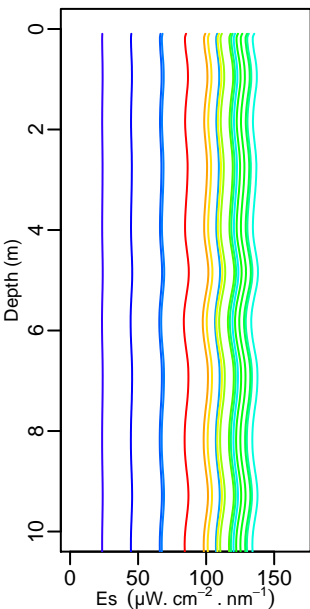
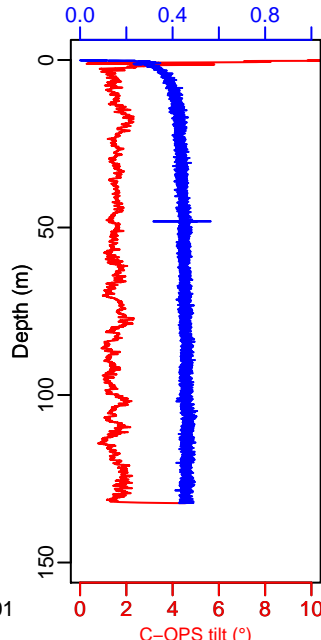
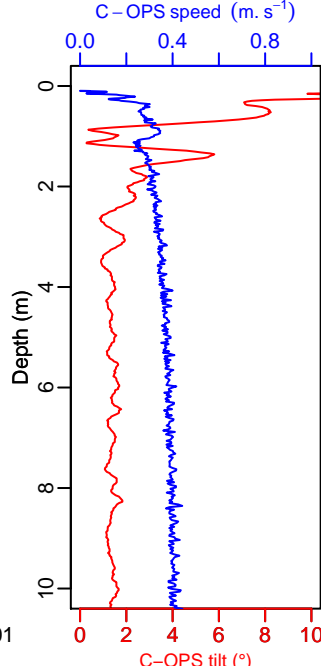
# C-OPS speed (m.s<sup>-1</sup>)



# C-OPS tilt (°)

# C-OPS speed (m.s<sup>-1</sup>)



**Boussole\_241****bou\_c-ops\_220405\_1012\_002\_data****10:58 UTC**C-OPS speed ( $\text{m} \cdot \text{s}^{-1}$ )C-OPS tilt ( $^\circ$ )C-OPS speed ( $\text{m} \cdot \text{s}^{-1}$ )

0.0 0.4 0.8

C-OPS tilt ( $^\circ$ )

# Boussole\_241

bou\_c-ops\_220405\_1012\_003\_data

11:10 UTC

