

BOUSSOLE Monthly Cruise Report

Cruise 211

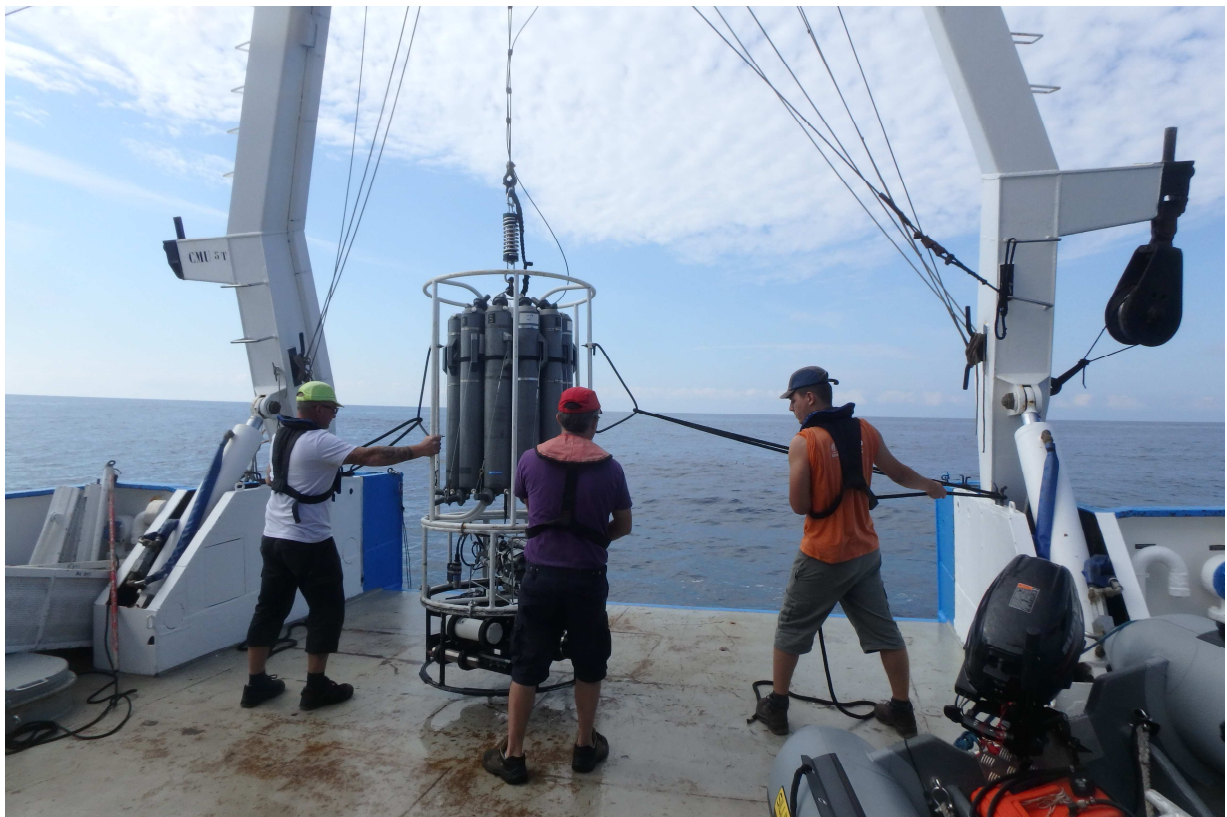
August 20-21, 2019

Duty Chief: Melek Golbol (golbol@obs-vlfr.fr)

Vessel: R/V *Téthys II*
(Captain: Joël Le Guennec)

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

Laboratoire d'Océanographie de Villefranche (LOV), 06230 Villefranche-sur-Mer, France



Deployment of the CTD and IOP package from the deck of the R/V *Téthys II* at the BOUSSOLE site.

BOUSSOLE project

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

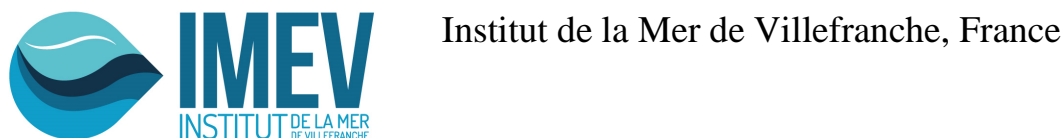
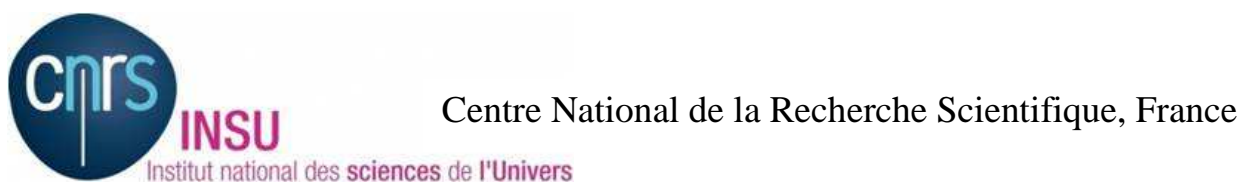
August 29, 2019



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), hand held CIMEL sun photometer measurements are to be performed consecutively where possible with C-OPS profiles. If sea conditions are poor but sky is good, hand held CIMEL sun photometer measurements can be made at intervals throughout the day to measure atmospheric optical thickness. CTD deployments are required at the start and the end of the C-OPS profiling day and around noon in the longer summer days or when there is a high possibility of a satellite matchup. The CTD package also includes a Chl fluorometer. Additional instrumentation for measurement of inherent optical properties has been added from December 2011. The package includes a hyperspectral absorption meter (Hobilabs a-Sphere), a multispectral backscattering meter (Hobilabs Hydroscat-6) and a multispectral beam transmissometer (Hobilabs Gamma-4). A CTD cast including a 0.2 μm filter installed on the inlet tube of the a-Sphere is to be performed once per cruise at the BOUSSOLE site for the dissolved matter absorption measurements. This cast will be stopped at ten depths during 2 or 7 min depending on the depths in order to ensure that the integrating cavity of the a-Sphere be completely filled at each of these depths during the ascent of the CTD.

Seawater samples are to be collected, filtered and stored into liquid nitrogen for subsequent HPLC pigment and particle absorption spectrophotometric filter analysis in the lab. Three replicates samples are to be collected at surface for total suspended matter weighting in the lab.

Divers check the underwater state of the buoy structure and instrumentation, take pictures for archiving, clean the sensor optical surfaces, and then take again some pictures after cleaning. Divers also put a neoprene cap on the backscattering meter and on the transmissometers for acquiring dark measurements (started in April 2009).

In addition, water samples are to be collected at two depths (5 m and 10 m) for dissolved oxygen (DO), total alkalinity (TA) and total inorganic carbon (TC) analysis (from March 2014). This operation is part of the BIO CAREX ANR project, in collaboration with the LOCEAN in Paris (J. Boutin and collaborators). The TA/TC samples will be processed by the National service for such analyses (SNAPOCO – LOCEAN in Paris). The results will allow checking the data collected by the two pCO_2 CARIOCA sensors and the two optodes installed on the buoy at 3 m and 10 m.

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 first day, a square grid survey was performed with the *R/V Téthys II* in order to characterize the spatial variability of the surface chlorophyll concentration in the vicinity of the BOUSSOLE buoy. Data were acquired by the underway fluorimeter installed on the ship. This operation will be performed once per cruise until the end of 2019 in the frame of the ROSACE project (Radiometry for Ocean Colour Satellites Calibration & Community Engagement). This project aims to propose a preliminary design of the new European infrastructure dedicated to System Vicarious Calibration (SVC) for the European Copernicus Ocean Colour missions.

The MOOSE DYFAMED cruise of 22nd August was cancelled because of bad weather, so their operations were performed during the last day of the BOUSSOLE cruise (21st August).

Cruise Summary

The first day of the cruise was used for CTD casts with water sampling, for surface chlorophyll measurement transect and for a Secchi disk at the BOUSSOLE site. The last day of the cruise was used for CTD casts with water sampling, for optical profiles, and for a Secchi disk at the BOUSSOLE site. This day was used for the deep CTD cast and zooplankton nets at the DYFAMED site in the frame of the MOOSE program. The diving operations were not performed during these cruise. There were completed the week before the beginning of this cruise, on August 12th, using the Papetee II ship, because of the unavailability of the divers during the BOUSSOLE cruise days.

Tuesday 20 August 2019

The sea state was calm with a light breeze. The sky was cloudy and the visibility was good. Firstly, a CTD cast was performed at the BOUSSOLE site. Similarly to what happened during the previous cruise, there was a failure on the conductivity sensor and pump between 300 m (downcast) and 200 m (upcast). The electrocarrier cable was checked and the continuity and isolation were tested by the ship chief engineer. The values were normal. During the lunchtime, the sea surface chlorophyll measurements grid was performed, centered on the BOUSSOLE site. Then, C-OPS profiles were attempted but failed because of the bad sky conditions during the acquisition (overcast sky, yet unstable irradiance). Then a second CTD cast with water sampling was performed at the BOUSSOLE site. We suspected the power I/O cable elongation between the CTD and the electrocarrier cable, it was removed and the second CTD was connected directly to the electrocarrier cable. A failure on the conductivity sensor and pump was detected only at 400 m depth at the end of the downcast and before the upcast. Finally the Secchi disk was performed before returning to the Nice harbour.

Wednesday 21 August 2019

The sea state was slight with a light breeze in the morning and a gentle breeze in the afternoon. The sky was cloudy and the visibility was good. Firstly, a CTD cast with water sampling was performed at the BOUSSOLE site. We noticed again the same problem with the conductivity sensor and pump, which functioned incorrectly between 250 m (downcast) and 340 m (upcast). 3 C-OPS profiles were performed but the two first ones had to be stopped because of unstable irradiance (sky overcast). After that a second CTD cast was performed. A cap was put on the Hydroscat-6 for dark measurements and a 0.2 µm filter was put on the a-Sphere absorption meter for the dissolved matter absorption measurements. This CTD cast was stopped at 10 depths during the ascent of the CTD. There was again failure of the conductivity sensor and pump between 400 and 380 m depth (downcast and upcast). Finally, operations for MOOSE program (Zooplankton nets and deep CTD cast with water sampling) and a Secchi disk were completed at the DYFAMED station before returning to the Nice harbour.

Pictures taken during this cruise can be found at:
<https://photos.app.goo.gl/FBGCBwGry2MSnKvj6>

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 20 August 2019 (UTC)

People on board: Melek Golbol and Eduardo Soto Garcia.

0610	Departure from the Nice harbour.
0925	Arrival at the BOUSSOLE site.
0935	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 .
1015	Surface chlorophyll fluorescence grid.
1200	C-OPS attempted: failed (sky overcast and unstable irradiance)
1215	CTD 02, 400 m with water sampling at 400, 200, 150, 70, 60, 50, 40, 30, 20, 10 and 5 m for HPLC and a_p .
1250	Secchi disk 01, 21 m.

1300 Departure to the Nice harbour.
1600 Arrival to the Nice harbour.

Wednesday 21 August 2019 (UTC)

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

0500 Departure from the Nice harbour.
0815 Arrival at the BOUSSOLE site.
0825 CTD 03, 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 .
0935 C-OPS 01, 02, 03.
1010 CTD 04, 400 m with water sampling at 10 and 5 m for O₂, TA/TC and TSM (with 0.2 μ m filter on a-Sphere and 2 minutes stop at 400 and 150 m and 7 minutes stop at 80, 60, 50, 40, 30, 20, 10 and 5 m).
1135 Departure to the DYFAMED site.
1200 Arrival to DYFAMED site.
1205 Zooplankton nets x 2, 100 and 200 m.
1255 CTD MOOSE 132, 2350 m with water sampling.
1255 Secchi disk 02, 22 m.
1430 Departure to the Nice harbour.
1715 Arrival to the Nice harbour.

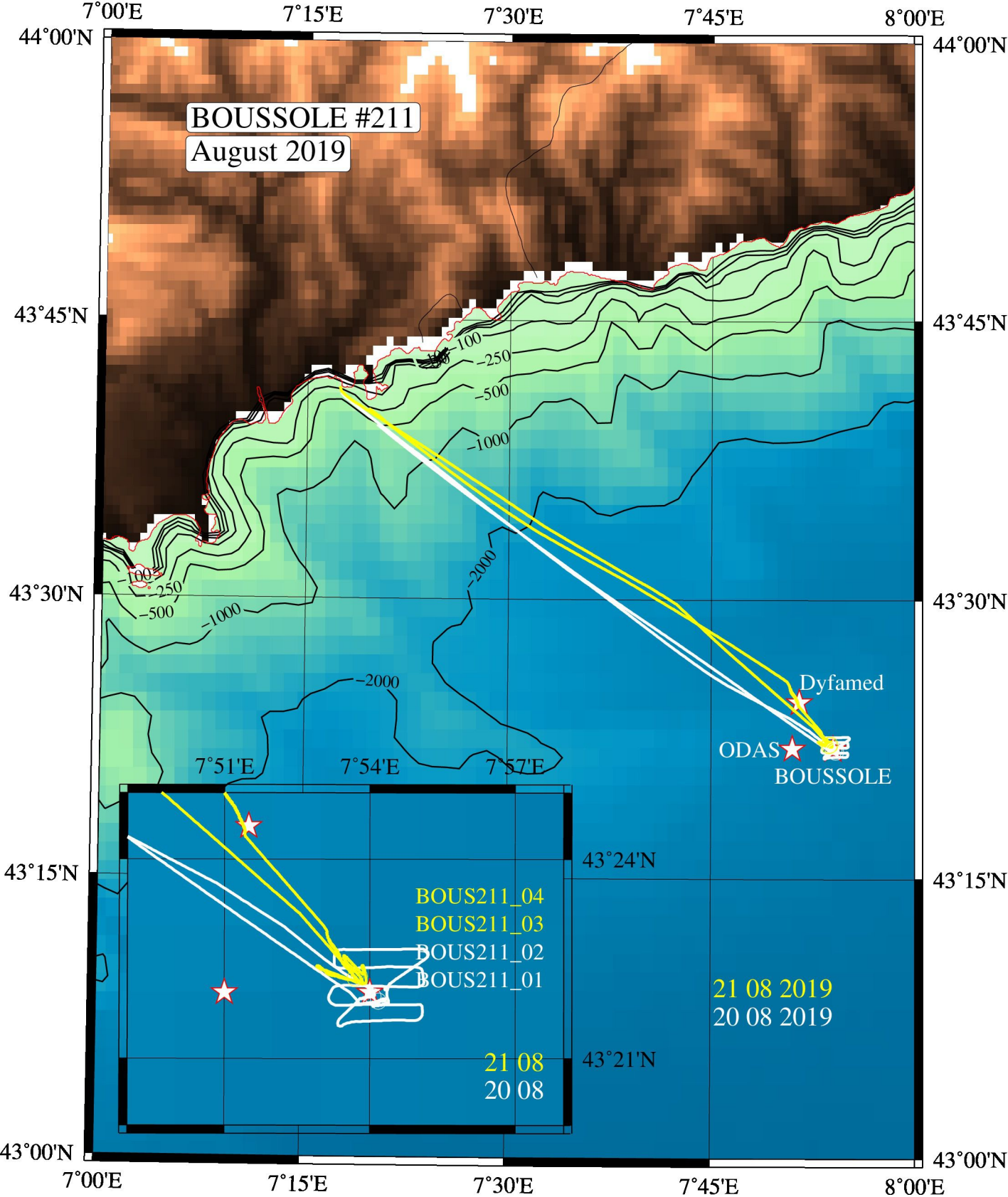
Problems identified during the cruise

- For all CTD casts, failure on the conductivity sensor and pump were detected between 200 and 400 m depth, as during the previous cruise. We did not solve this problem for the moment. It seems to be an obvious power issue, but we could not find its origin or how to address it. A technical report was written by Eduardo Soto, the engineer responsible for the CTDs of BOUSSOLE cruises, and was sent to Seabird for assistance. This document is attached to this cruise report.
- CTD 02: the Niskin bottle#4 was not closed, so there was no sample at 80 m depth.
- CTD 03: 2 superimposed filters were used inadvertently for the HPLC filtration of the 150 m sample. The two filters were kept for the lab analyses.
- The TSM sampling container was forgotten in the lab. So the triplicates were sampled directly in the 3 polycarbonate bottles after homogenization of the sample in the Niskin bottle.
- The weather conditions during this cruise were not optimal to perform C-OPS profiles (sky overcast with unstable irradiance). The first day, no profiles could be performed, the second day, two of the three profiles had to be stopped early during the descent because of the unstable irradiance.
- The C-Star transmissometer of the CTD package was not available because the instrument was sent to *Seabird – WET Labs* for calibration. The instrument was not returned in time for this cruise.

Appendices

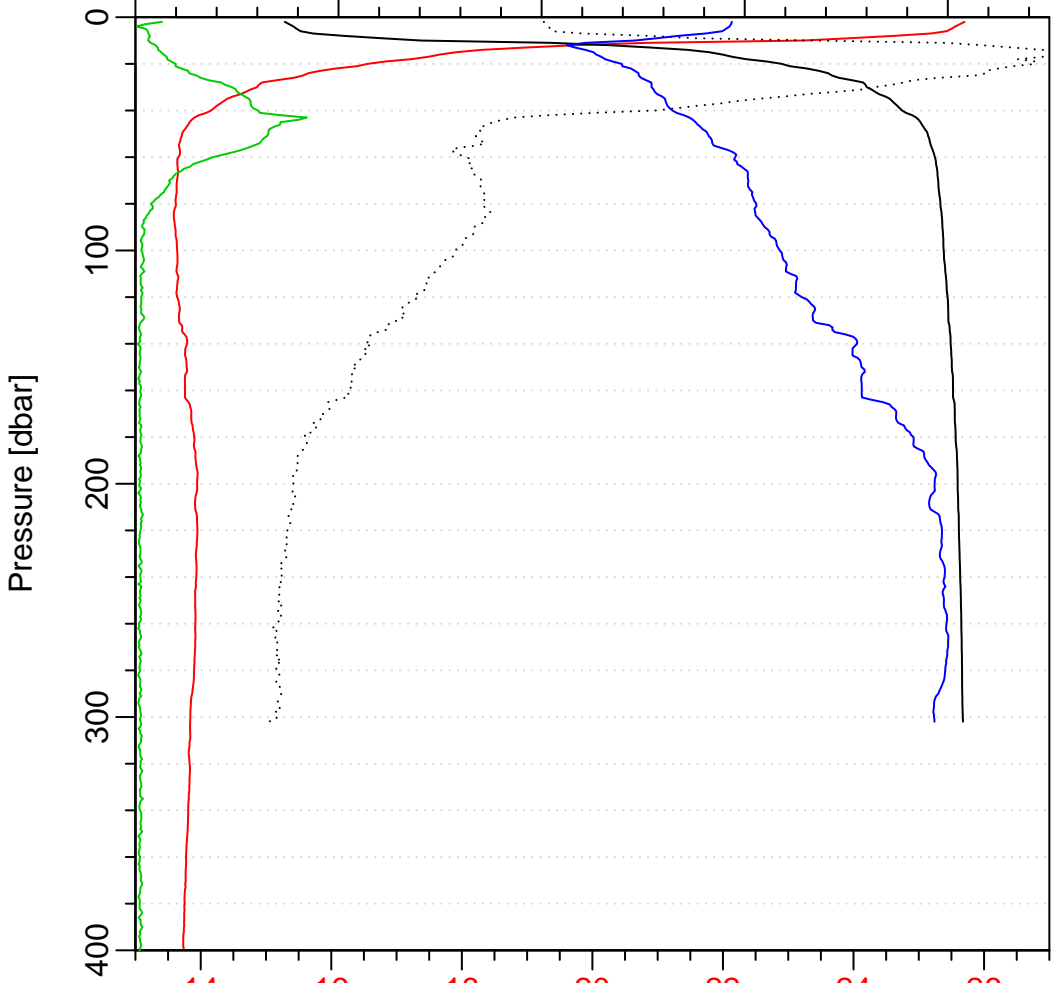
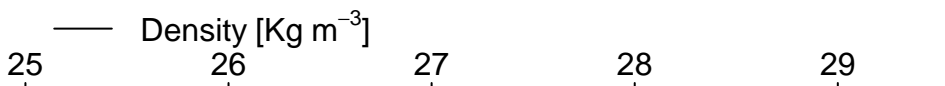
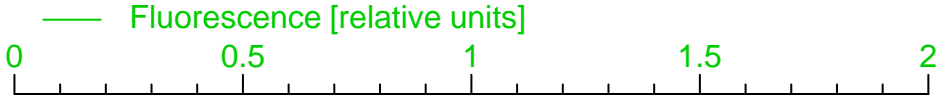
Cruise Summary Table for Boussole 211

Date	Black names (file ext: ".raw")	Profile names (file extension: ".raw")	CTD notées	Other sensors	Start Time		Depth max (meter)	Latitude (N)			Longitude			Weather		Atm. Pressure (hPa)	Humidity (%)	Visibility	T air	T water	Sea		Swell dir.	Whitecaps
					GMT (hour.min)	(min.sec)		(Degree)	(Minute)	(Degree)	(Minute)	Sky	Clouds	Quantity (#/8)	Wind sp. (kn)						Wind dir.	Sea Swell H (m)		
20/08/19			BOUS211_01	HPLC & Ap	09:34	36:00	400	43	21.934	7	54.038	cloudy		6	6	49	1017.8	78		25.7	25.70	calm		
			BOUS211_02	HPLC, Ap & TSM	12:14	29:00	400	43	21.865	7	54.176	cloudy		5	5	73	1017.3	83		25.8	25.93	calm		
				Secchi01		12:50	4:00	21	43	22	7	54	cloudy		5				good			calm		
21/08/19			BOUS211_03	HPLC & Ap	08:22	31:00	400	43	22.244	7	53.786	cloudy		4	6	102	1018.1	85		25.2	25.60	slight		
		bou_c-ops_190821_0911_001_data.csv			09:32	1:12	25	43	22.187	7	53.601	overcast	Sc, Ac	7	6	95	1018.3	84	good	25.3		slight	0.7	No
		bou_c-ops_190821_0911_002_data.csv			09:36	1:47	40	43	22.203	7	53.473	cloudy	Sc, Ac	5	6	95	1018.3	84	good	25.3		slight	0.7	No
		bou_c-ops_190821_0911_003_data.csv			09:45	4:35	114	43	22.254	7	53.200	cloudy	Sc, Ac	5	6	95	1018.3	84	good	25.3		slight	0.7	No
			BOUS211_04	O ₂ , TA/TC & TSM	10:09	1:22:00	400	43	22.214	7	53.701	cloudy		6	8	83	1018.2	81		25.5	26.08	slight		
				Secchi02		12:55	4:00	22	43	25	7	51	cloudy		4	9	124	1017.6	80	good	25.7	26.10	slight	



bous211_01

Date = 20/08/2019
Heure debut [TU] = 09:34
Longitude = 007 54.068 E
Latitude = 43 21.934 N

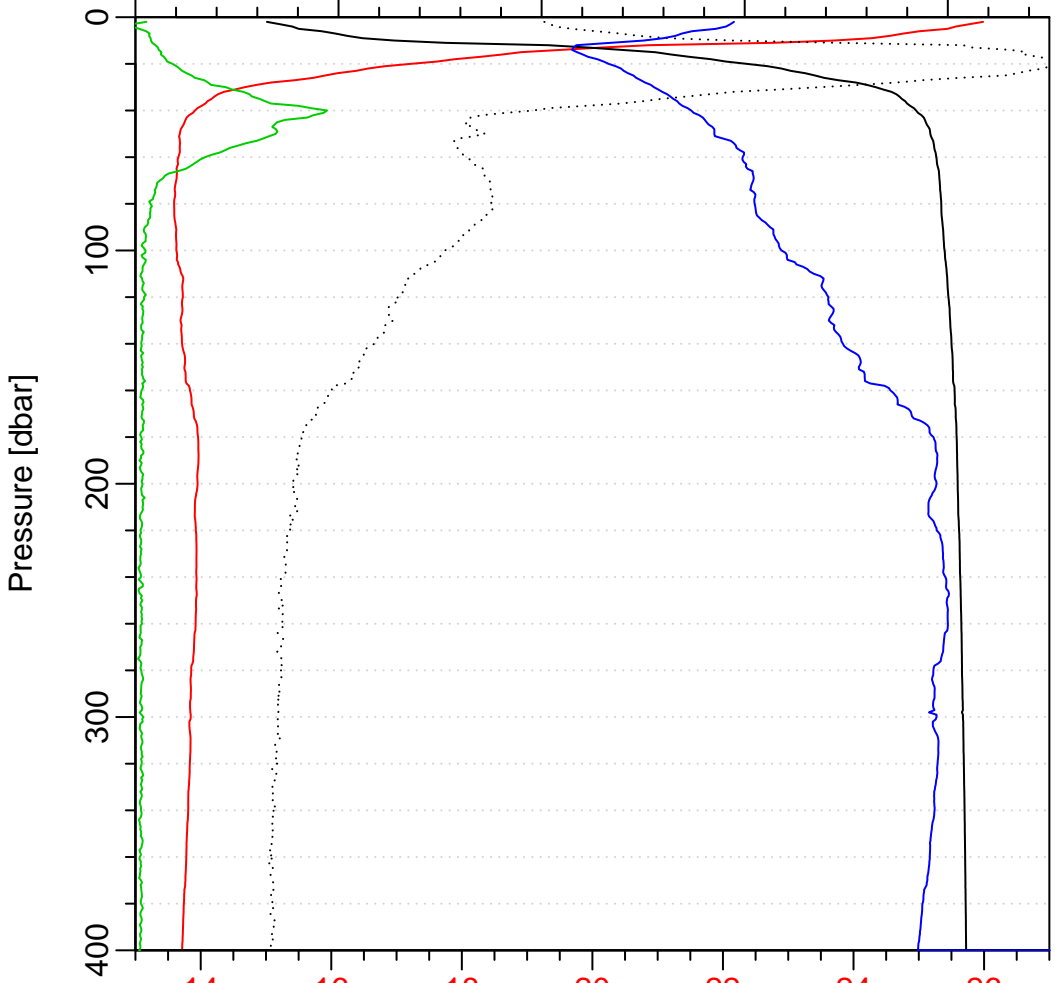
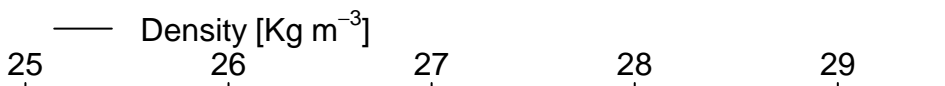
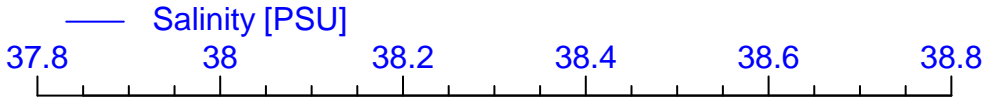
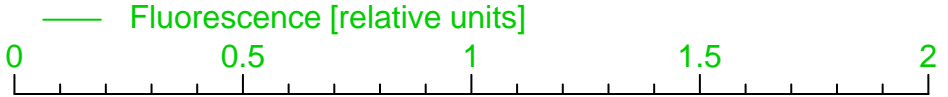


T [°C-ITS90]

O₂ [μmole Kg⁻¹]

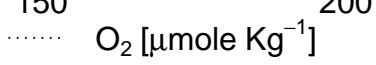
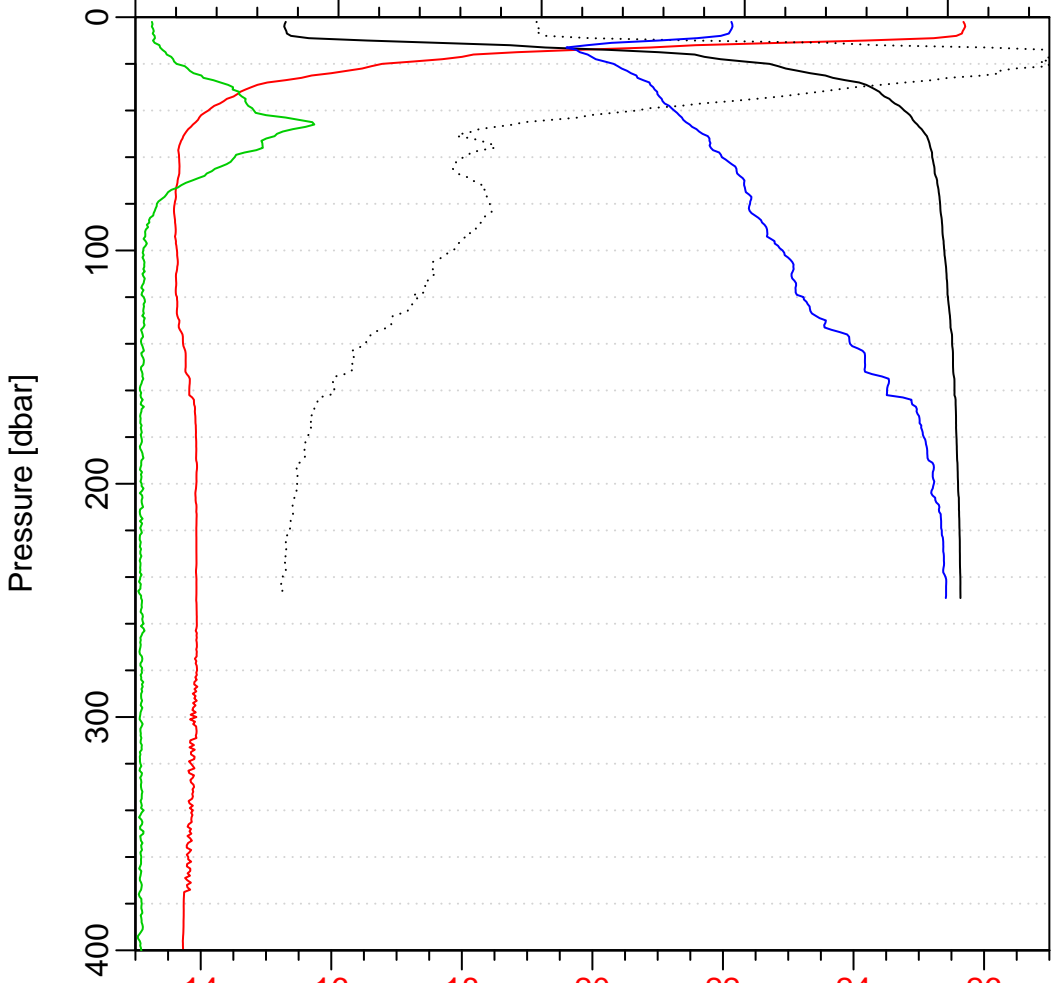
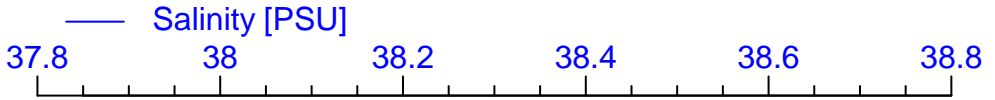
bous211_02

Date = 20/08/2019
Heure debut [TU] = 12:14
Longitude = 007 54.176 E
Latitude = 43 21.865 N



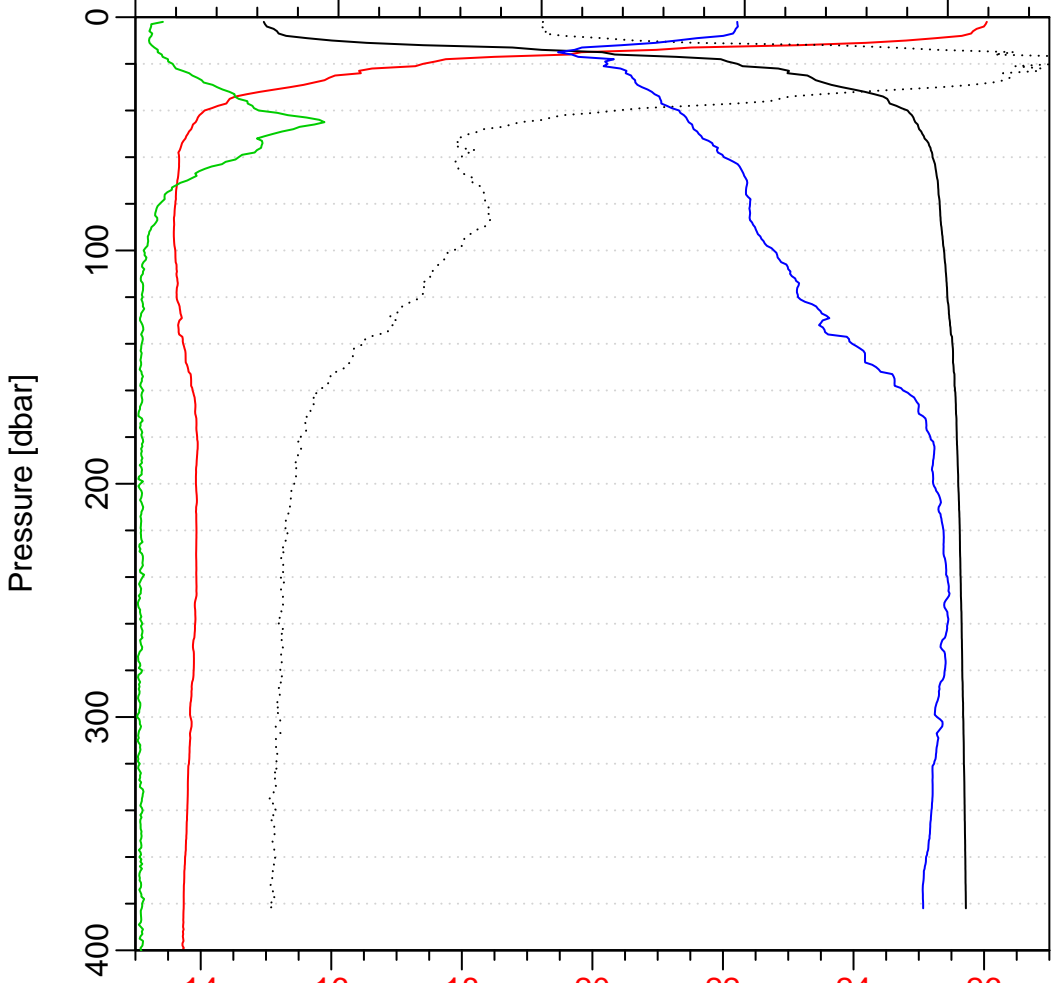
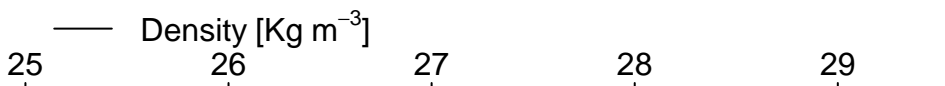
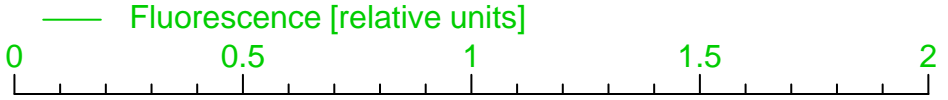
bous211_03

Date = 21/08/2019
Heure debut [TU] = 08:22
Longitude = 007 53.786 E
Latitude = 43 22.244 N



bous211_04

Date = 21/08/2019
Heure debut [TU] = 10:09
Longitude = 007 53.701 E
Latitude = 43 22.214 N



— T [°C-ITS90]

..... O₂ [μmole Kg⁻¹]

Technical report CTD 08/27/2019

During our monthly surveys, we have observed some issues since last July with our CTDs (two SBE 911+).

The profile begins as usual but at certain point (there's not a clear trend : it could happens in the downcast or the upcast, sooner or later and different depths), the conductivity sensor, sbe4, starts malfunctioning , the frequency of the sensor score 0,0, usually as a micro-short, and the pump stops immediately. Obviously, the values of both salinity and density are out of range, but the rest of sensors seem to work properly (Fluor Chelsea Aquatracka 3, sbe 43 (values affected by lack of flow through the pump system), Rinko DO and temp, the carousel of niskins and the altimetre.

Our first guess was the cable between the conductivity sensor and the fish so we checked and cleaned the connections and changed it, nothing changed.

So, we tried changing the sbe4, after that, the pump and its cable. Later, the power I/O cable elongation between the ctd and the ship cable.

Thinking that it could be a problem with the fish connection with the sbe4 sensor, we've changed the fish (we have been using these two ctd units without any remarkable issue until June) without success.

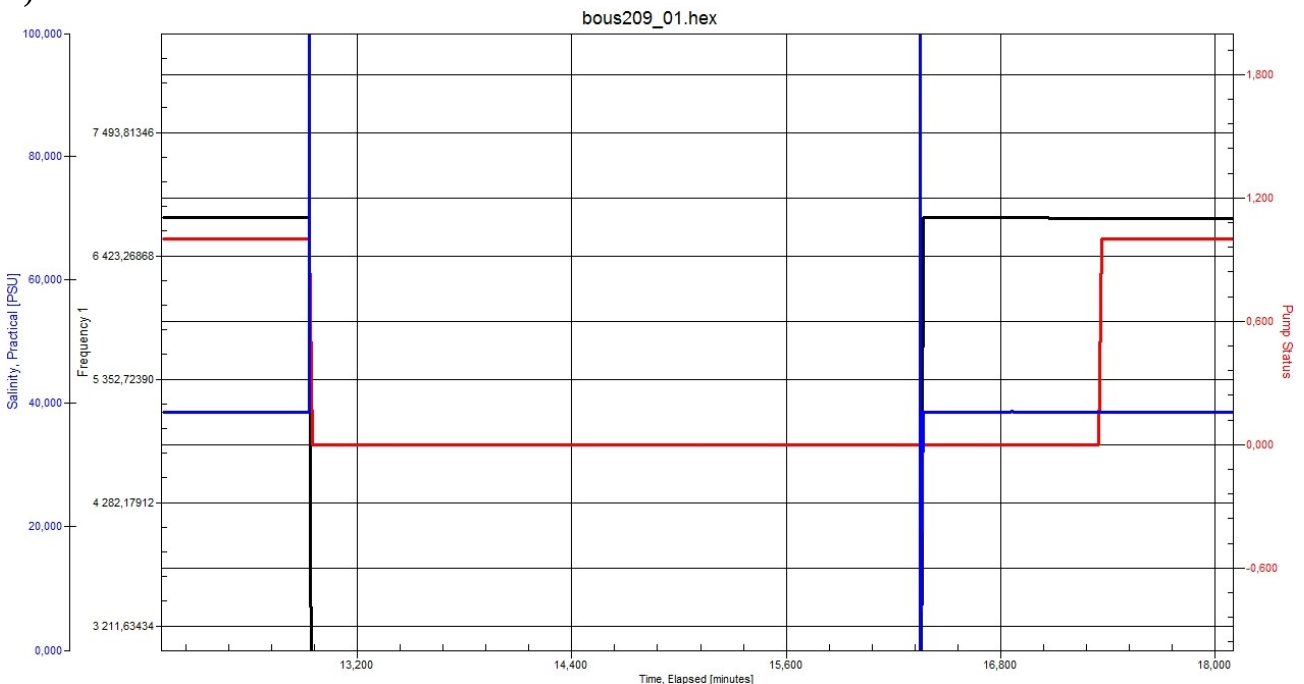
Then, we turned our attention to the vessel electronic cable. The ship chief engineer made all the tests with us about the cable continuity and isolation, obtaining normal values in all cases (the vessel and the electronic cable hasn't change, at least, since last year). We also change the cable between the deck unit and the ship elec. cable.

So, we're still wondering which could be the cause of this issue. It seems an obvious alimentation issue, but we can't find its origin or how to address it.

Here there are some plots we made with these profiles to analyze this breakdown.

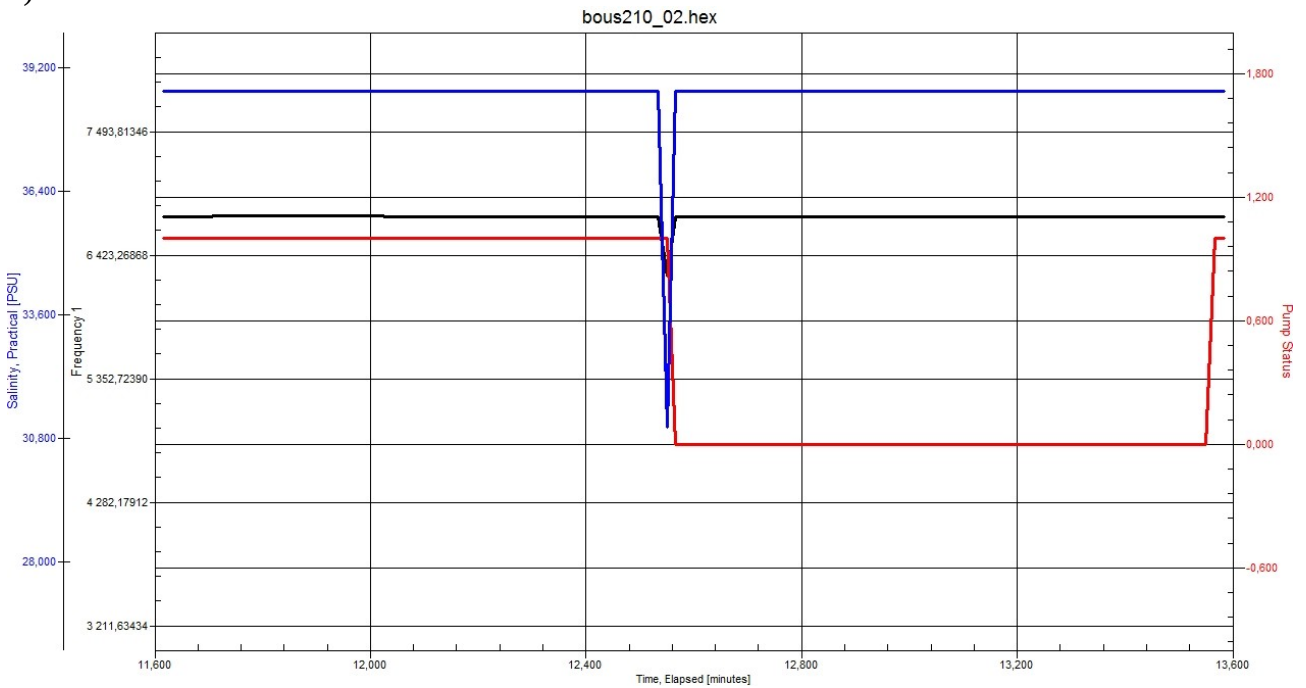
X-axis shows time and y-axis salinity (blue), pump status (red) and C frequency (black).

1)



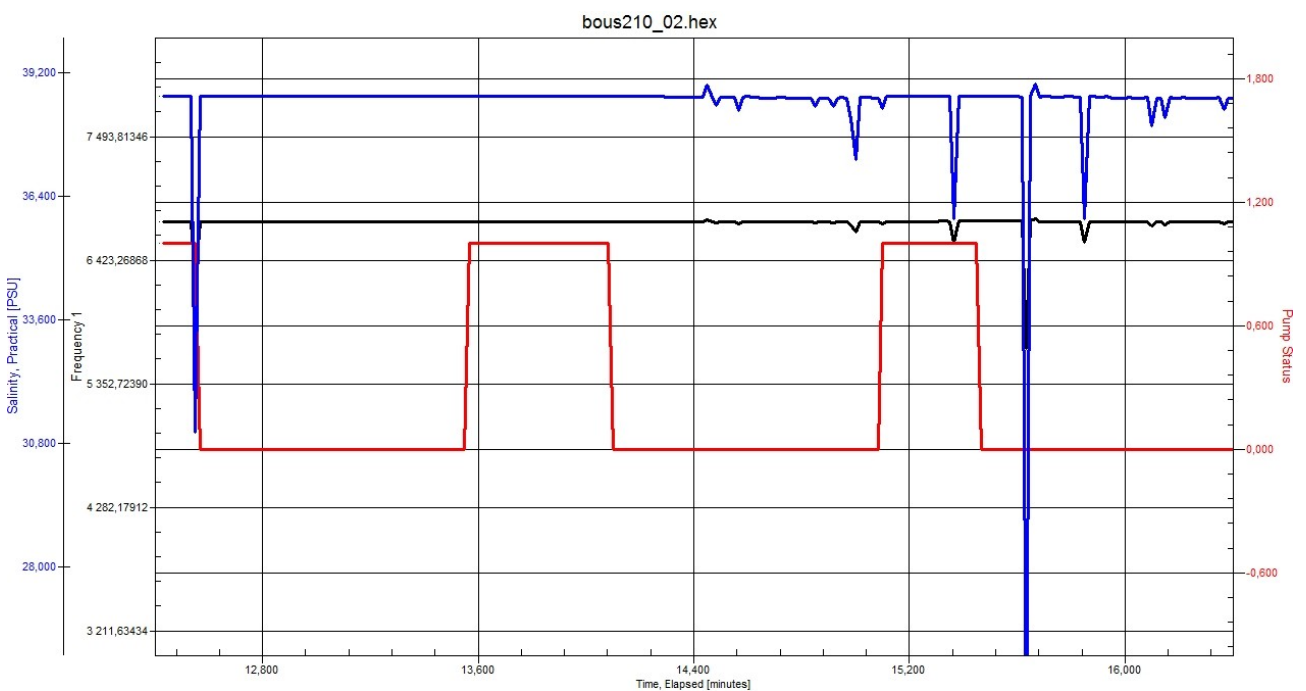
This first image shows how the frequency drops to zero at certain point, the salinity increase to absurd values and the pump stops working until 1 minute after the values of frequency and salinity go back to expected ones.

2)



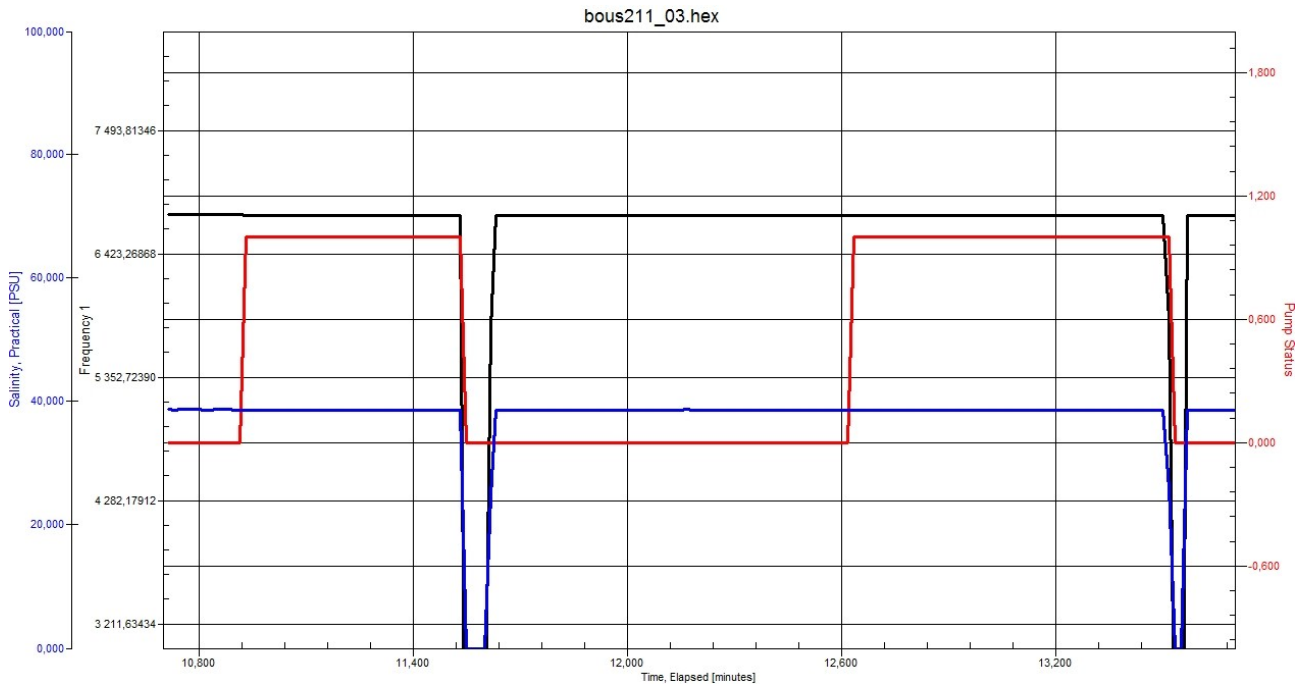
In this case, the frequency didn't drop to zero, just a short decrease cause the same result and this time the salinity also drops.

3) With the same profile, but widening the x-axis (time)



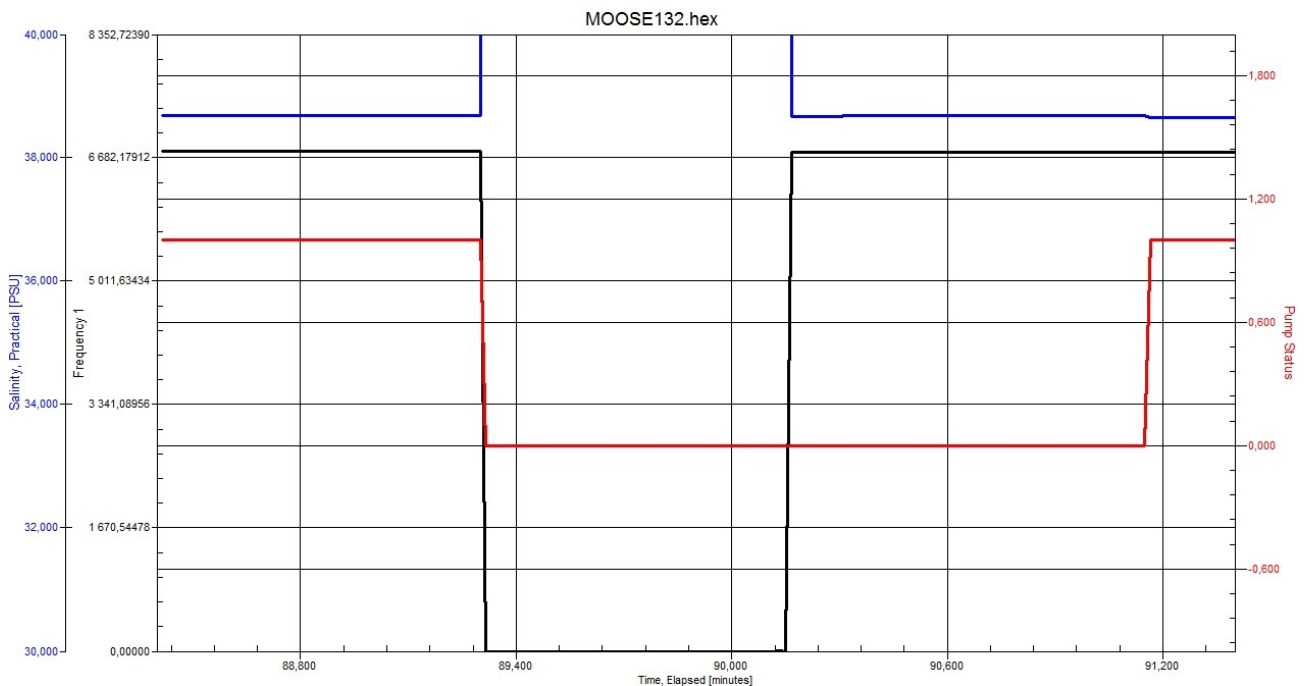
Here we see three different stops of the pump but the behaviour of the frequency and salinity is not the same in each case.

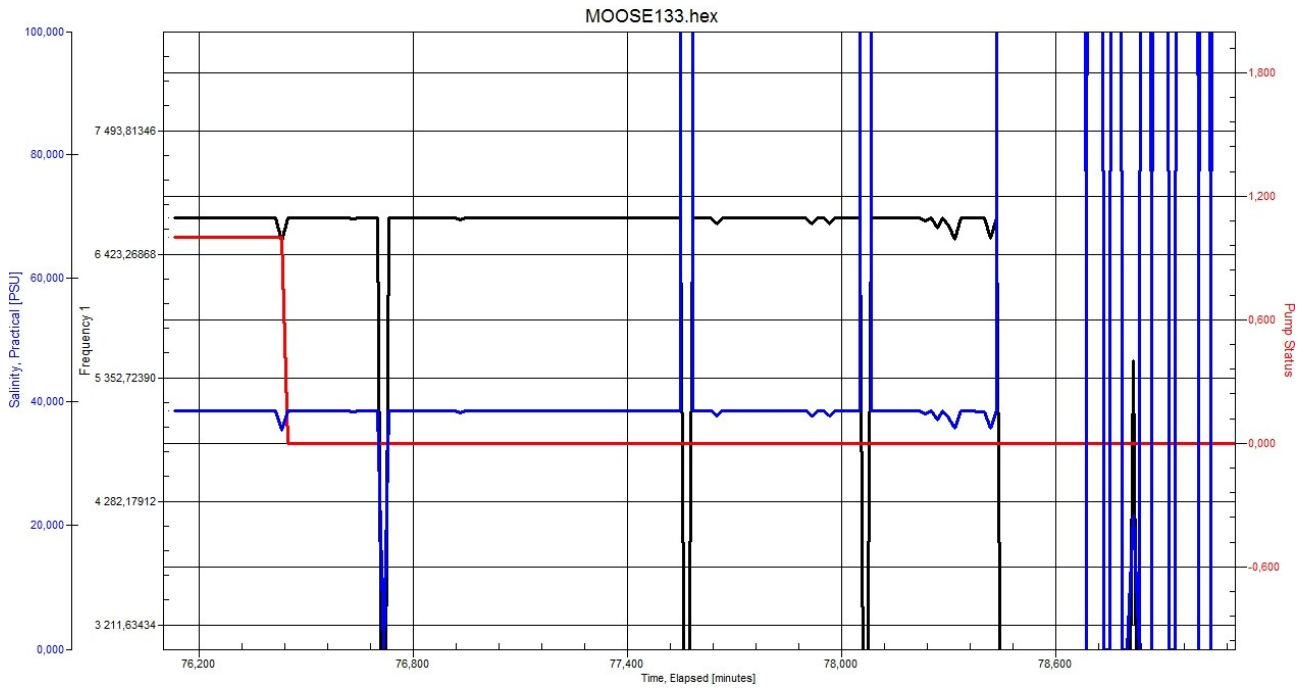
4) One example from August 20-21



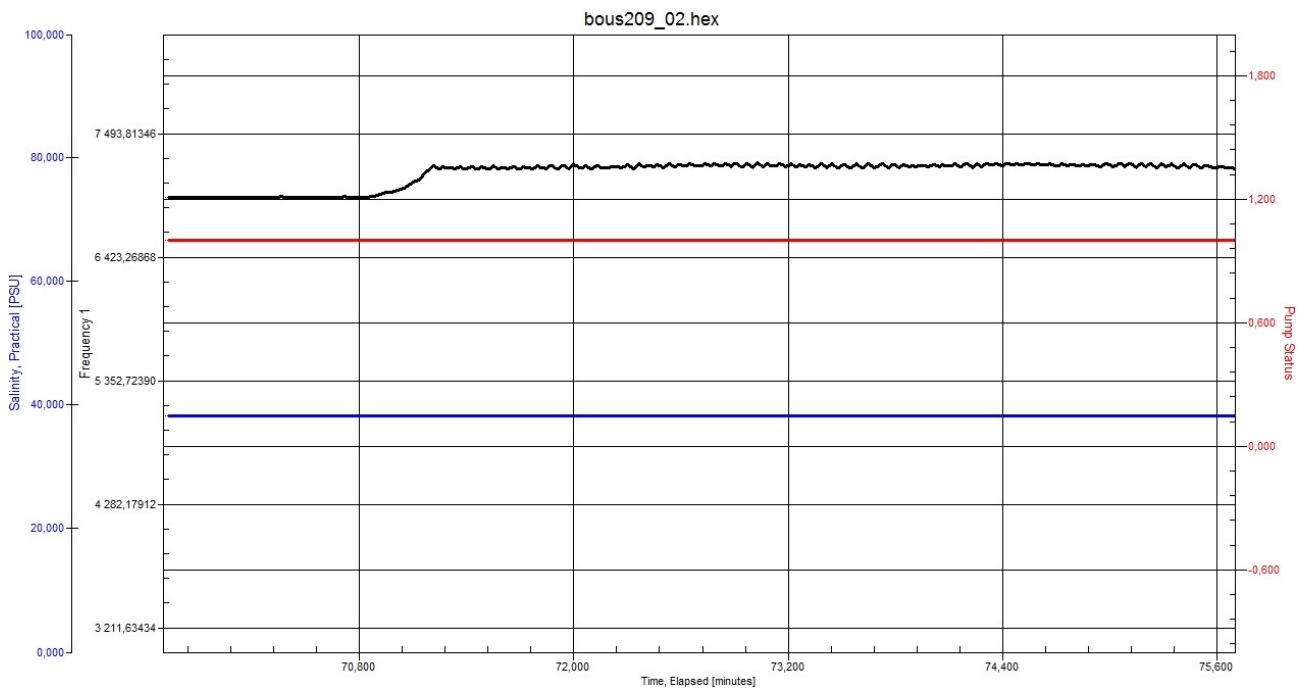
All these profiles were made between 0 and 400 m. of depth, and the problem have appeared, generally, between 400 and 200 m. (up or/and down).

5 and 6) Two deep profiles, 0-2350 m. (July and August) ; in both cases we've obtained perfect downcasts, but the issue reappeared in upcasts (from 600 m aprox. up)





7) And a last one where something happens with the frequency without changing the pump status



In the email where this report is attached it could be find some of .hex and .xmlcon files from our profiles for further analyse.