CRUISE REPORT

SOCIB Canales AUTUMN 2019:

26th to 28th November 2019

SOCIB_ENL_CANALES_NOV2019_AUTUMN

Document type:	Cruise report
Date:	2019-11-16

Description:	A repeat seasonal hydrographic survey of the Balearic Sea, monitoring the Ibiza and Mallorca Channels. 14 CTD stations were carried out over 2 days; the stations forming one transect across the Mallorca Channel (MC) and 4 stations across the Ibiza Channel (IC). One SVP and two SV**P-**B surface drifters were also deployed in the Ibiza Channel. ICES-SeaDataNet Cruise Summary Report BSH-RefNo: **20193300.**
Authors:	E. Alou, J. Allen, A. Cabornero
Supervision:	E. Alou
Keywords:	Mediterranean; Ocean Circulation; Balearic Sea; Ibiza Channel; Mallorca Channel; Northern Current;

DOCUMENT VERIFICATION LIST

Date:	Checked by (name)	SOCIB division	Ref.
2019-11-16	E. Alou	SOS	

DOCUMENT DISTRIBUTION LIST

Date:	Distribution to:
2019-11-18	public domain

CHANGE RECORD

ver	Date	Description	Author	Checked by
1.0.0	2019-11-16	v1.0 of document	A.Cabornero/ E.Alou	E. Alou
2.0.0	2019-11-10	Add links to CSR	A. Cabornero	E. Alou
3.0.0	2020-01-23	Lagrangian platforms update	I.Ruiz	

Index of contents

Objectives

The **Canales cruises** have the following objectives:

1. To make two complete SOCIB-Canales CTD sections across the Ibiza Channel (IC) and a RADMED CTD section across the Mallorca Channel (MC). The purpose of these sections are seasonal calibration points for the near continuous Glider monitoring of the IC. Measurements are made with the SeaBird SBE9 + instrument and the oceanographic Niskin bottle rosette for water samples at different depths.
2. To make continuous current profile sections of the IC and MC using the vessel mounted acoustic Doppler current profiler (VM-ADCP). These sections are for comparison with model forecasts and to support depth averaged velocity (DAV) calculations from glider data.
3. Perform a synchronized CTD cast with the current operating G2 glider in Ibiza channel if possible.
4. Deployment and recovery of Canales gliders as and if necessary.
5. Deployment of lagrangian platforms as necessary.

Onboard personnel

ID	Name	Role	Affiliation
1	Eva Alou	Principal Scientist	SOCIB
2	N.Wirth	Lead ETD Technicians/CTD/ADCP with remote support (J. Allen)	SOCIB
3	Andrea Cabornero	Biogeochemical sampling and analyses lead	SOCIB
4	Josep Baeza	ETD Technicians/CTD	SOCIB
5	P.Balaguer	ETD Technician/CTD	SOCIB
6	Helena Antich	Student Salinity/ETD & Biogeochemical support	(student)

			IMEDEA
7	Sara Viéitez	Biogeochemical sampling	(student) UIB/SOCIB
8	Noemi Calafat	Student Salinity/ETD & Biogeochemical support	(student) IMEDEA
9	Sebastian Poveda	Student Biogeochemical support	(student) UIB/SOCIB

Contents

List of figures

List of tables

Station plan

14 CTD stations were carried out over a period of 3 days; one complete transect in the Mallorca Channel (MC) and 4 stations in the northern line of the Ibiza Channel (IC) . Figure 1 shows the station CTD and drifter deployment locations .

The ADCP did not work throughout the entire duration of the cruise, probably related to the GPS communication.

A ship activity log detailing actions carried out during the cruise is provided in Appendix 1.

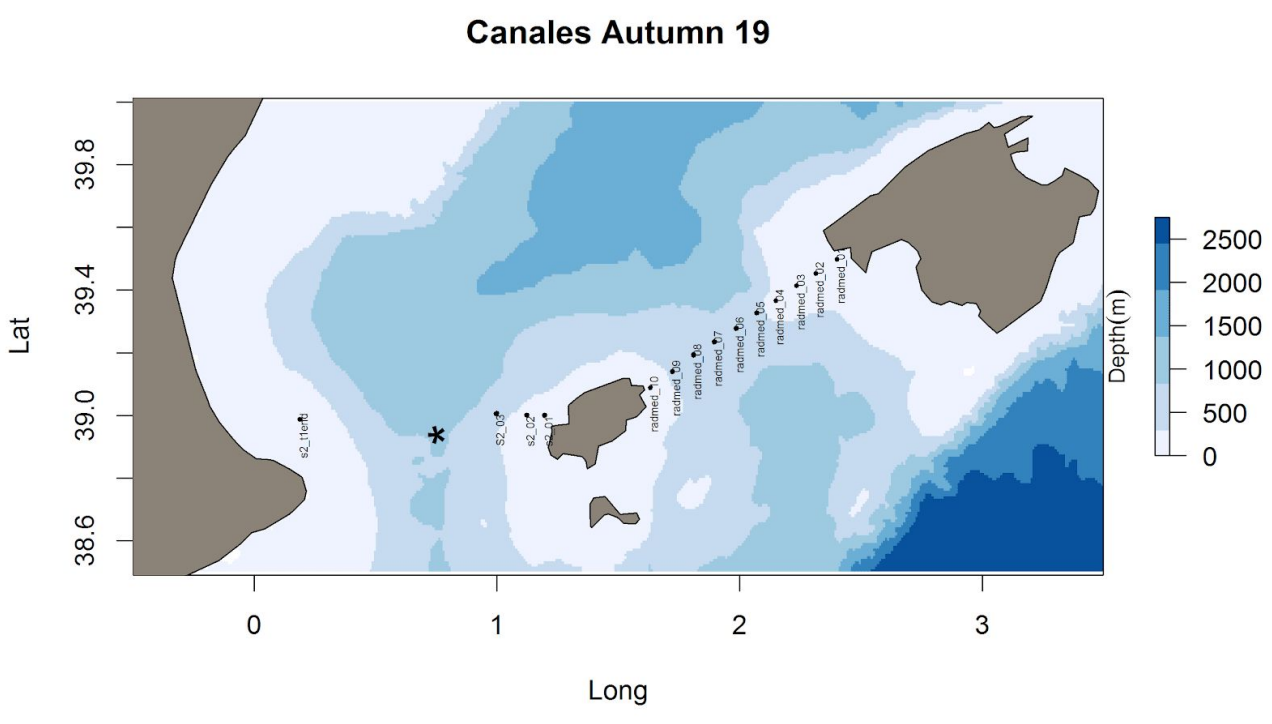

Fig. 1: Station plan. * Surface drifters launching point.

Cruise diary

DAY 1 - 26th NOVEMBER 2019

RV SOCIB slipped from her berth in Puerto de Palma a few minutes after 7:00 GMT. The weather looked unsettled and cloudy. The ADCP had problems most likely related with the GPS communication. As we headed to the beginning of the Mallorca Channel line and station RadMed_01 we tried to solve the problem with John (connected remotely) but we couldn't.

Station RadMed_01 started at 08:26 GMT. With the CTD safely recovered, SOCIB left station at ~ 08:55 GMT. The manual control of the winch from the lab was lost but we continue with the crew having the control of the winch. The differences between the 2 conductivity sensors 0.009 -0.012. Temperature sensors looks ok.

SOCIB arrived at station RadMed_02 at ~ 09:25 GMT. The CTD was safely recovered at 09:35. The differences between the conductivity sensors as in RadMed 01.

Station RadMed_03 began at 09: 59 GMT and the CTD was safely recovered by 10:10 GMT. Clear and sunny sky-

Station RadMed_04 began at 10:42 GMT. The CTD was safely recovered at 10:51 GMT.

Station RadMed_05 began at 11:16 GMT. The CTD was recovered at 11:48 GMT (Radmed 05, see the profile attached). Uncomfortable sailing to RadMEd _06.

SOCIB arrived on station RadMed_06 at 12:20 GMT. The station was finished and the CTD recovered by 12:48. Differences between the 2 conductivity sensors 0.007-0.008 and a max difference of 0.011.

SOCIB arrived on station RadMed_07 at 13: 20 GMT. The CTD was safely

recovered by 13: 50 GMT. Turbidimeter with lots of spikes in the upcast (see picture).

SOCIB arrived on station RadMed_08 at 14: 22 GMT. The CTD was recovered at 14: 48 GMT. Turbidimeter with spikes again in the upcast, checked connection seemed ok. Differences between conductivity sensors 0.006.

SOCIB arrived on station RadMed_09 at 15: 25 GMT. The CTD was recovered at 15: 45 GMT. Turbidity showed spikes in the upcast- Niko +ETD team carefully checked the cable + connections again.

SOCIB arrived on station RadMed_10 at 16: 20 GMT. The CTD was recovered at 16: 27 GMT. Seems that the turbidity sensor worked better but we'll need to check again tomorrow.

Completed Mallorca Channel Line, overnight in Sant Antoni (Ibiza).

Fig. 2: Canales Autumn 2019 cruise participants.

DAY 2 -27th NOVEMBER 2019

SOCIB slipped from the port of San Antonio at exactly 06:58 GMT, and headed out towards the Ibiza Channel northern line station, S2_01. Sunny Sky, forecast sea rough conditions (> 1 m waves).

SOCIB arrived on station S2_01 at ~ 07:30 GMT. The CTD was safely recovered at 07:45 , as this was a shallow ~100 m CTD. The R/V SOCIB engineer fixed the problem before leaving Sant Antoni and in this station we had the control of the winch from the lab, however still the transfer from lab to crew was not smooth. The turbidity sensor works bad in the up cast only-still, it seems something is interfering with this sensor, we haven't figured out what is happening yet- Biogeochem water sampling team worked very organized and all good in the lab.

SOCIB arrived on station S2_02 at 08: 15 GMT. The CTD was safely recovered at 08: 25 GMT. Spike in Turbidity and chl a fluorescence, seems the cable has a problem and ETD will check on the way to S2_03.

SOCIB arrived on station S2_03 at 09: 20 GMT. In this station we crossed a trawl fishing ship so we performed the CTD cast 200 m from the waypoint in order to avoid any interference. Conductivity sensor differences of 0.005- 0.006. CTD on the way up but at 125 m to surface the computer PC lab1 screen freeze with no connection at all. We need to repeat the cast again files are going to be named as S2_03bis. This second cast started at 09:59 GMT. The CTD was safely recovered at 10: 30. Noise in turbidity continues, heading for S2_04.

SOCIB arrived on station S2_04 at 11:51 GMT. Problem operating the cable and cable damaged. Everything needs to stop and the cable needs to be checked and fixed. Decision is made to go to Denia and fix the cable.

On our way to Denia, in station S2_05 we deployed 4 surface drifters, 3 SVP-B (with barometer) and one SVP at 13:11 UTC (see Figure 4).

Tonight busy night in the lab, water sampling, cable fixing, dissolved oxygen determination (see Fig. 3).

Tomorrow the idea is to perform the complete northern line of the Ibiza Channel.

Fig. 3: CTD cable repairing, laboratory clearing and dissolved oxygen analyses.

DAY 3 - 28th NOVEMBER 2019

SOCIB leaving Denia at 7:00 GMT. Everybody busy, lab getting ready, ETD checking CTD cable condition. ADCP is not running, Niko tried to fix the problem yesterday and this morning but unfortunately the problem hasn't been solved yet.

At around 7:15 GMT -just when leaving Denia Port- the captain communicated that he wants to cancel the cruise due to weather conditions.

However he agrees we go to the first station and see sea conditions. The sea was rough with 1.3 m waves, from west sailing to north, but sailing speed 9 knots. In this direction later on at the station we continue in the line with having the waves and wind from the stern.

We reached the first point at 9: 15 GMT , everything is ready for deployment and at this moment the capitan comes to deck and communicates he wants to cancel the cruise. He is not willing to do any CTD for safety reasons. The first reason was because of the safety of the scientific team. We checked and anybody had any doubts on this subject, everybody felt comfortable and ready to do the deployment.
He mentioned that this ship shouldn't be worked under this conditions and he felt responsible if anything would go wrong. He mentioned that in the past a cruise was cancelled with better conditions and also referred to things he observed from the previous day in the deck that he didn't like concerning safety, without any details. When we asked about this, he only mentioned the movement of the rosette and the lack of previous training of the R/V SOCIB crew which has nothing to do with safety reasons of the scientific crew.

We talked to him (myself and Niko) to see if a deployment of the CTD in order to check the cable on station S2_T1_End was possible and he agreed to do so. However we performed the deployment 2 miles East-Southeast from the waypoint. The deployment began at 9: 15 GMT and it was fine. The recovery was however difficult because of the problems with the winch managed in coordination with the A-frame and the lack of coordination with the weather conditions, waves etc, the frame was maintained up too long and without control with the consequent risks. CTD was finally safely recovered at 9: 26 GMT. The weather conditions 1 m wave, westerlie wind (4-5 s period). Wind speed 7 knots, West- see video for sea

conditions.

~ 9: 35 I went to speak with the captain again and his final decision was to cancel the cruise. I suggested to him to come back through the Northern line of the Ibiza Channel to see if the conditions would change so he would feel more comfortable to deploy CTD and perform the casts and he agreed. We sailed stations S2-85, S2-08, and S2-07 with ~10.9 knots quite stable having the waves from the stern with stable conditions to work both in the lab and outside. He considered still this were not right conditions to work and have the idea to cancel.

On our way back, between stations S2-07 and S2-06 ~ 11 GMT we communicate with the glider team to see if they were ready to perform a profile and I went to talk with the captain to see if he was willing to perform this one cast at least, but he refused. He said the sailing conditions were good but not for working so I asked him if he would consider at any point that the conditions were going to improve enough and his response was negative, then I checked with Niko and the team and we decided that if we were not able to do any work we better come back to Palma with no reason to go to Sant Antoni.

~ 12 GMT Niko called Albert and John to let them know about this final decision. I checked with the captain once again and asked him if we could do a cast for the glider but he refused.

The Catamaran is sailing well enough to go at 13 knots

Fig. 4: Preparation for surface drifters launching.

Instrumentation description and configuration

In this section are described the instrumentation and the configuration used during the cruise

CTD-Probe

Manufacturer:	SeaBird
Model:	SBE9+
S/N:	1023
SOCIB Inventory:	SCB-SBE9001
Deck Unit:	SBE11
SOCIB Inventory:	SCB-SBE11001

Sensor	Model	S/N	Calibration date
Temperature	SBE 3P	03P5391	31/10/2018
Temperature 2	SBE 3P	03P5425	31/10/2018
Conductivity	SBE4C	043718	27/09/2018
Conductivity 2	SBE4C	043907	18/10/2018
Pressure		1023	28/09/2018
Oxygen	SBE 43	2119	19/10/2018
Transmissometer	WET Labs C-Star 25-650	CST-1419DR	16/11/2018

Turbidity	STM Sea Point	12182	07/11/2018
Fluorometer	Seapoint 6000m	3259	07/11/2018
Irradiance	PAR Biospherical QCP-2300L-HP	70364	02/11/2018
Surface Irradiance	SPAR Superficie Biospherical QSR2200	20519	02/11/2018
Altimeter	Datasonics PSA-916D	69894	12/2018

Configuration

For controlling the CTD the following file was used:

- RADMED_01.xmlcon.

Thermo-salinometer

Manufacturer:	SeaBird
Model:	SBE21
S/N:	3370
SOCIB Inventory:	SCB-TSL001
Calibration date:	2018/07/03

Configuration

The data were collected using the NEREIDAS system and acquisition backup was performed using seasave software. The data were stored directly in the vessel server and processed processed through the SOCIB-DC system.

Weather Station

Manufacturer:	Geonica
Model:	Meteodata 2000
S/N:	
SOCIB Inventory:	SCB-MET009
Calibration date:	2011

Configuration

The data were collected using the NEREIDAS System. The data were stored directly in the vessel server and processed processed through the SOCIB-DC system.

Acoustic doppler profiler

Manufacturer:	RDI
Model:	Ocean Surveyor 150 kHz
S/N:	1878
SOCIB Inventory:	SCB-RDi001

SVP and SVP-B Surface Drifters

Manufacturer:	Data Buoy Instrumentation, LLC (DBi)
Model:	SVP and SVP-B
IMEI / WMO:	30023406748320 / 6202685 30023406748330 / 6202686 30023406748560 / 6202687 300234066319040 / 6102739
SOCIB Inventory:	SCB-SVPB001 SCB-SVPB002 SCB-SVPB003 OGS-SVP006
Calibration date:	Testing SCB-SVPB001 Testing SCB-SVPB002 Testing SCB-SVPB003

Scientific Reports

Physical data report

The following contains an overview of the physical data collected from the CTD.

Unfortunately, no valuable WM-ADCP data were recorded during this cruise.

CTD and water bottle sampling

Data acquisition: CTD casts were carried out at 14 stations encompassing 1 transects across t the MC and 4 stations in the IC. At each station, water samples were collected with the rosette at various depths for measuring *in situ* salinity, dissolved oxygen and

fluorescence in order to apply corrections to the conductivity, oxygen and fluorescence sensors. Refer to the available logbook generated during the cruise for more details on sampling depths, replicates and parameters sampled at each station.

Data preprocessing and visualization: The sensor data were processed using SBE (Sea-Bird Electronics) Data Processing Version V7 23.2 (for details refer to SBE Web site). The resulting data are then processed in Matlab in order to provide the figures in the following section. Post cruise processing will involve the correction of the salinity data based on calibration with in situ water samples analysed in the lab with a Guildline Portasal model 8410A salinometer. The biogeochemical sampling will be discussed in the next section: the biogeochemical report.

Biogeochemical data report

As mentioned in the general objectives, the primary objective of the biogeochemical data collection during this cruise is to compare the CTD oxygen (SBE-43) and fluorescence (wetlabs) sensors against the *in situ* discrete water samples of these parameters.

Secondary field objectives are:

1. To estimate chl *a* concentration and distribution (as a proxy for phytoplankton biomass).

2. To study phytoplankton community composition.

Since the nitrate sensor SUV-51 was not available for this cruise, nutrient samples were not taken.

The sampling was carried out on 3 days from the 26th to the 28th November 2019 and followed the established R/V SOCIB protocols.

Dissolved oxygen

Discrete water samples (Winkler's method, Langdon 2010, see protocols) for comparison were taken at each station aat a maximum of 3 depths. We chose depths of varying oxygen concentrations (in order to sample the full spectrum of oxygen concentrations). Refer to the available logbook generated during the cruise for more details on sampling depths, replicates and parameters sampled at each station.

Samples were analyzed on board after an 8-12 h period in darkness with a titration procedure with potentiometric endpoint detection (Metrohm 888 Titrator).

The final dissolved oxygen dataset will be produced post-cruise following the analysis of the data.

Chl *a* concentration

Samples for chl *a* concentration were taken at all stations at 4 depths (see logbook for details). Post-cruise chl *a* determination will be carried out at the IMEDEA by fluorometry (Turner 10 AU fluorometer, see available protocol).

Phytoplankton community composition

Samples were taken on each station at the deep chlorophyll maximum (DCM, see logbook) for general cell identification (cells preserved in Lugol's solution, Utermöhl 1958). Samples for microscopy will be analyzed post-cruise at the IMEDEA.

Preliminary results

Preliminary physical results

1. Hydrography: Theta-S diagram

Figure 5, shows the potential temperature – salinity distribution of all stations of the entire water column, where colour indicates the longitude of the corresponding station.

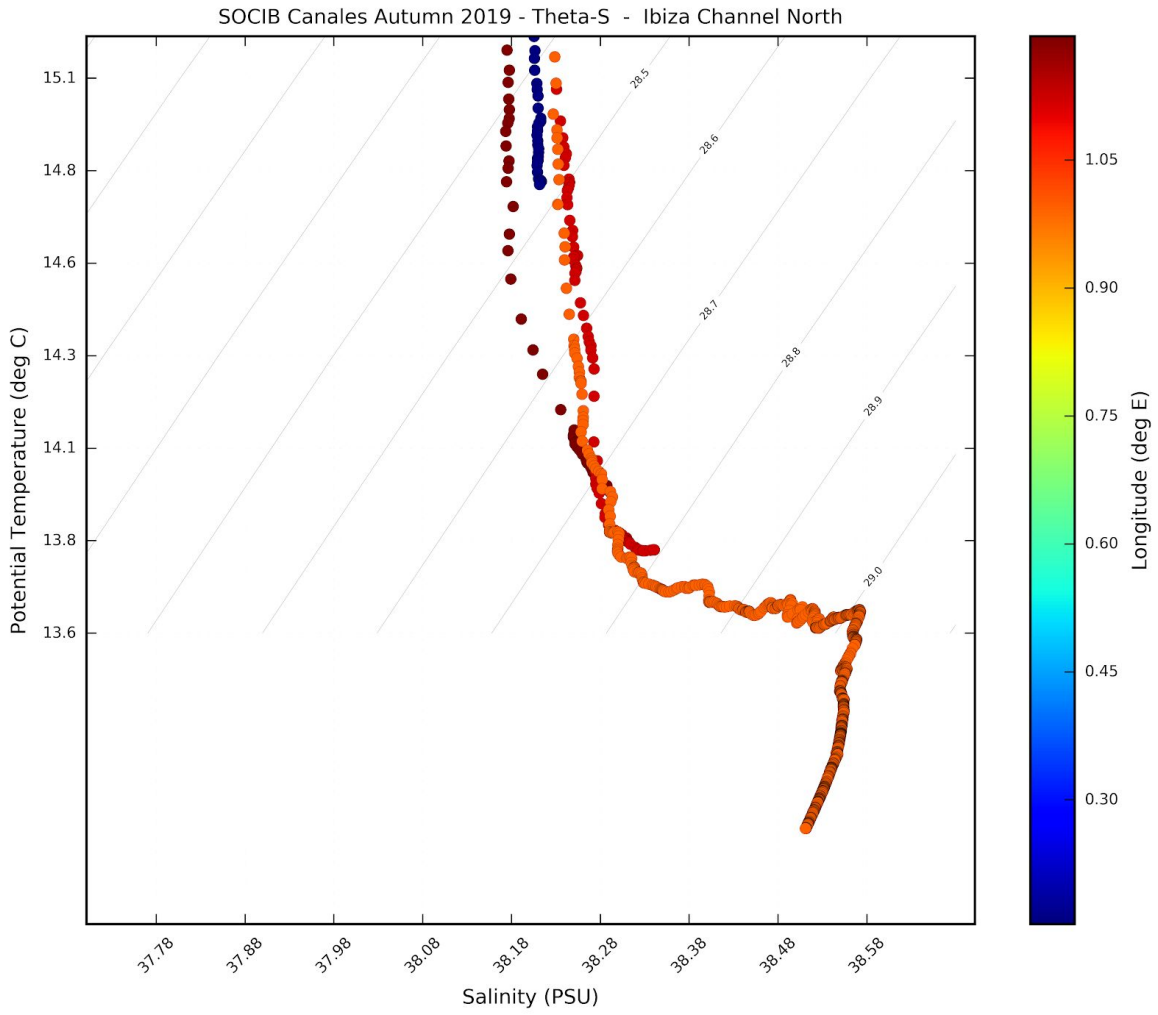

Fig 5a. T-S diagram of the 4 stations sampled in the IC; the colour bar indicates the longitude of the station; thus the colour spectrum from red to blue corresponds to the IC transect, from East to West.

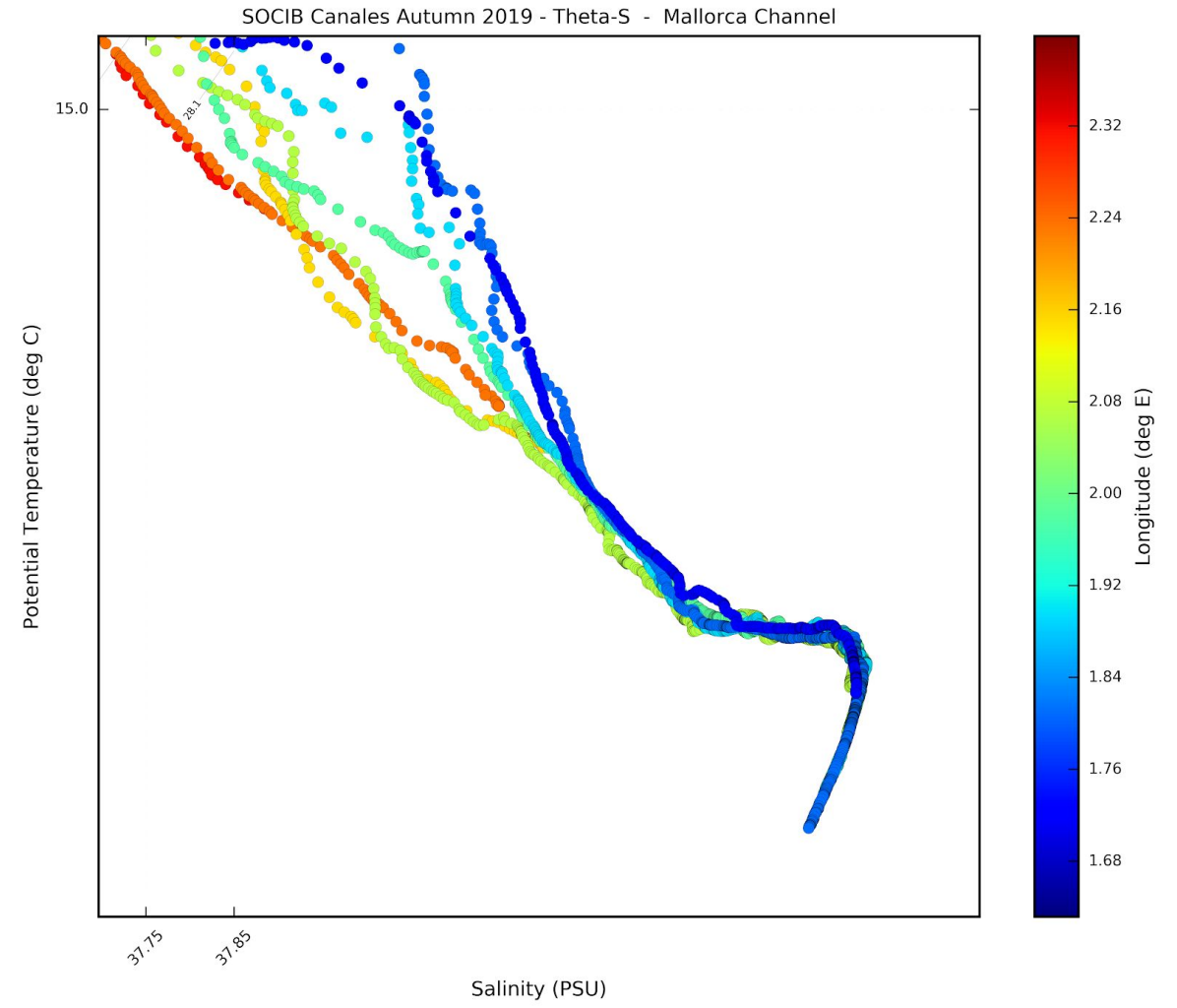

Fig 5b. T-S diagram of all MC stations; the colour bar indicates the longitude of the station; thus the colour spectrum from red to blue corresponds to the MC transect, from East to West.

2. Ibiza Channel: North

The Ibiza Channel section is not shown since only 4 stations were sampled previous to cancel the cruise.

3. Mallorca Channel

The figures presented in this section are showing the transect of the MC.

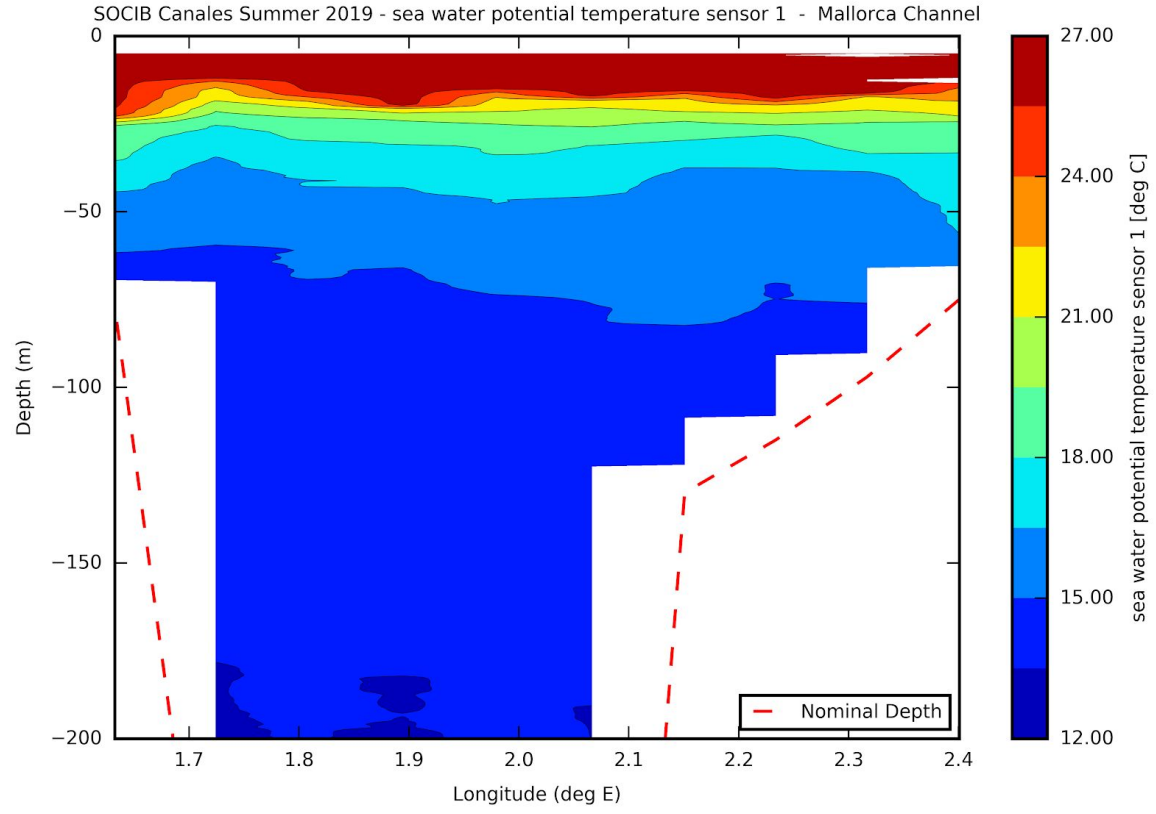

Fig. 6a. Temperature (ºC) of the MC cross-section (upper 200m section).

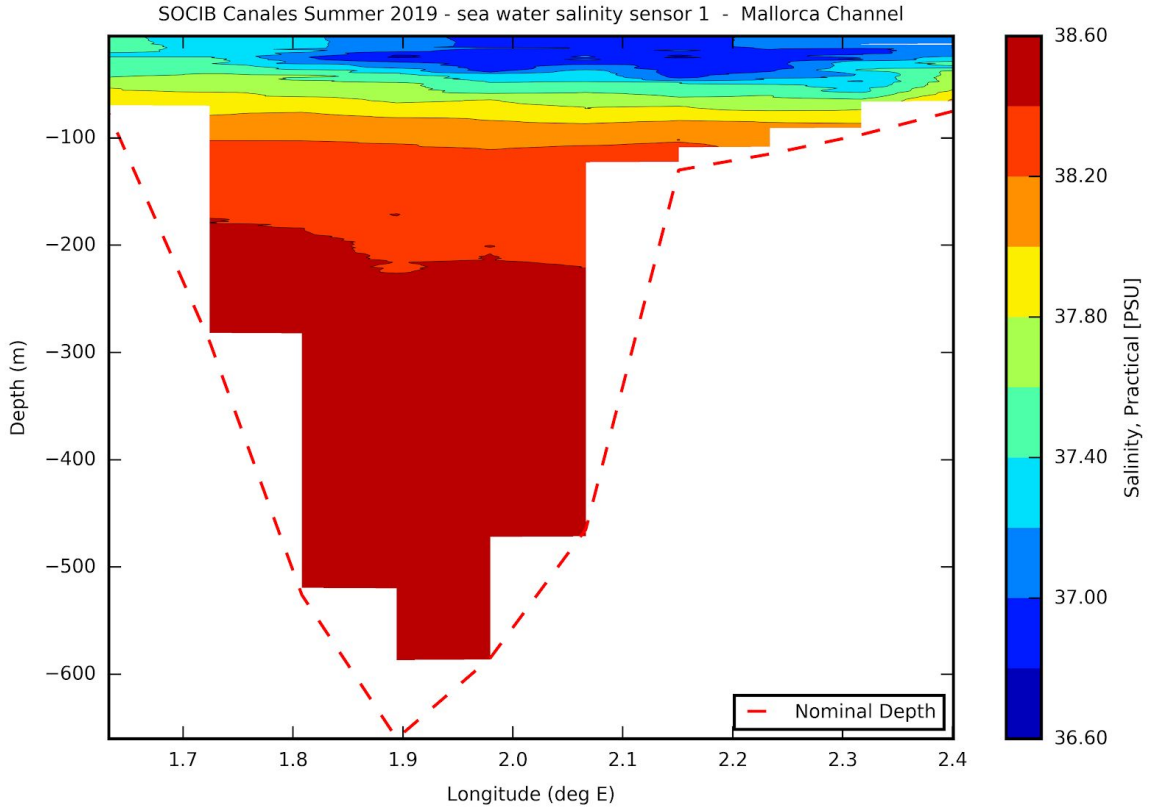

Fig. 6b. Salinity of the MC cross-section (upper 200m section).

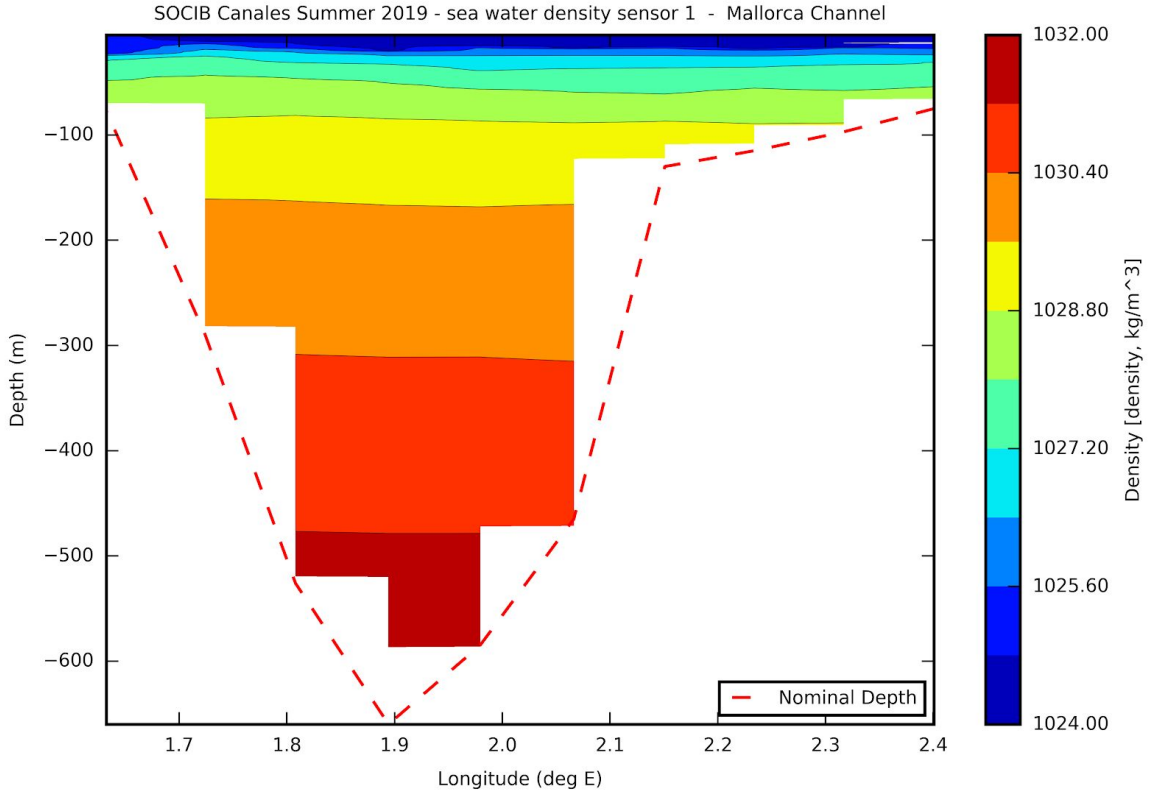

Fig. 6c. Density (kg m^{-3}) of the MC cross-section.

Preliminary biogeochemical results

The final biogeochemical dataset will be produced in due course following post-cruise analysis of the data.

1. Mallorca Channel

Below we present some preliminary results obtained with the CTD sensors for dissolved oxygen (Fig. 8a) and *in vivo* fluorescence (Fig. 8b). The chlorophyll fluorescence maximum depth is present at around 50 m, similarly to what we encountered in past years (see other reports). This distribution relates to the maximum values encountered for dissolved oxygen (up to 7 mg/l). These preliminary results show higher fluorescence related to the shelves.

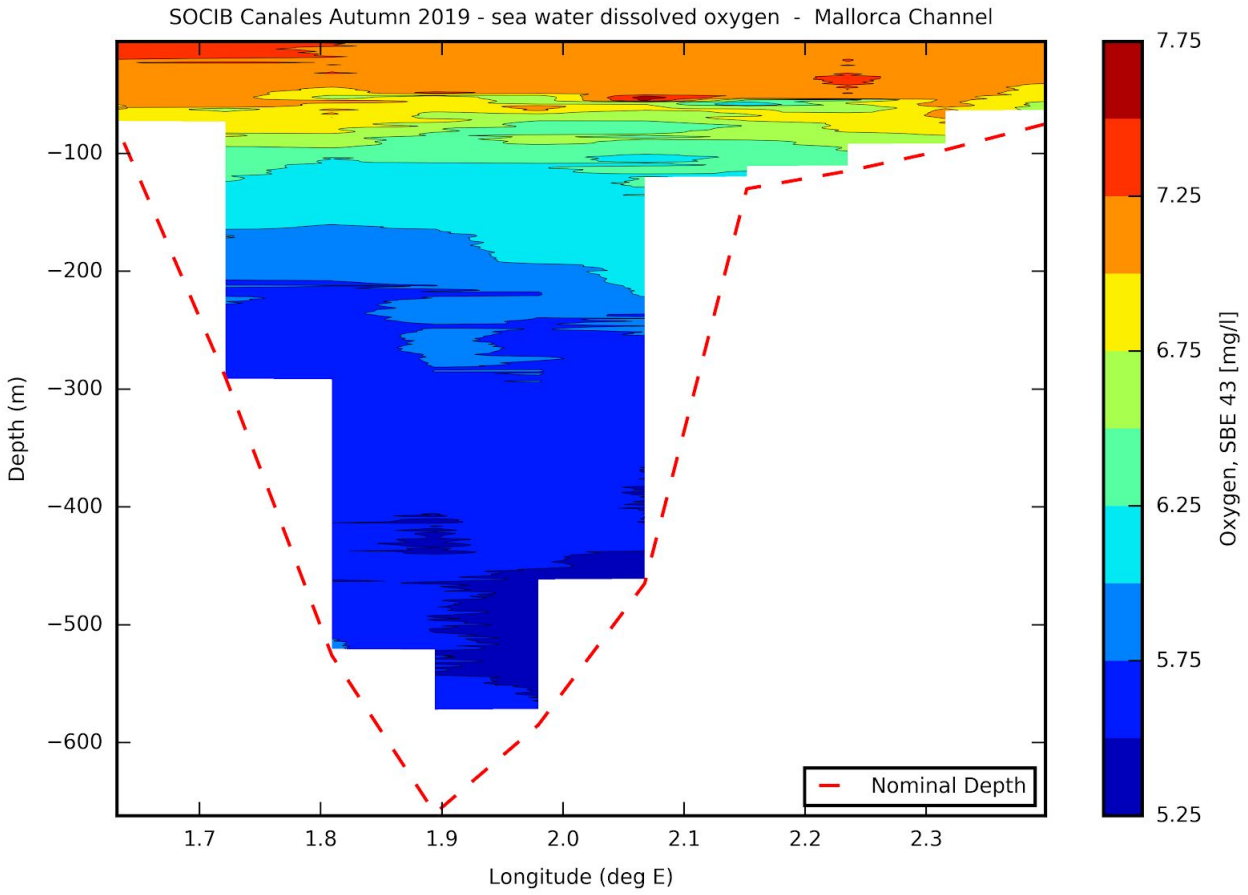

Fig. 7a: Initial figure for dissolved oxygen concentration distribution obtained on the Mallorca Channel cross-section.

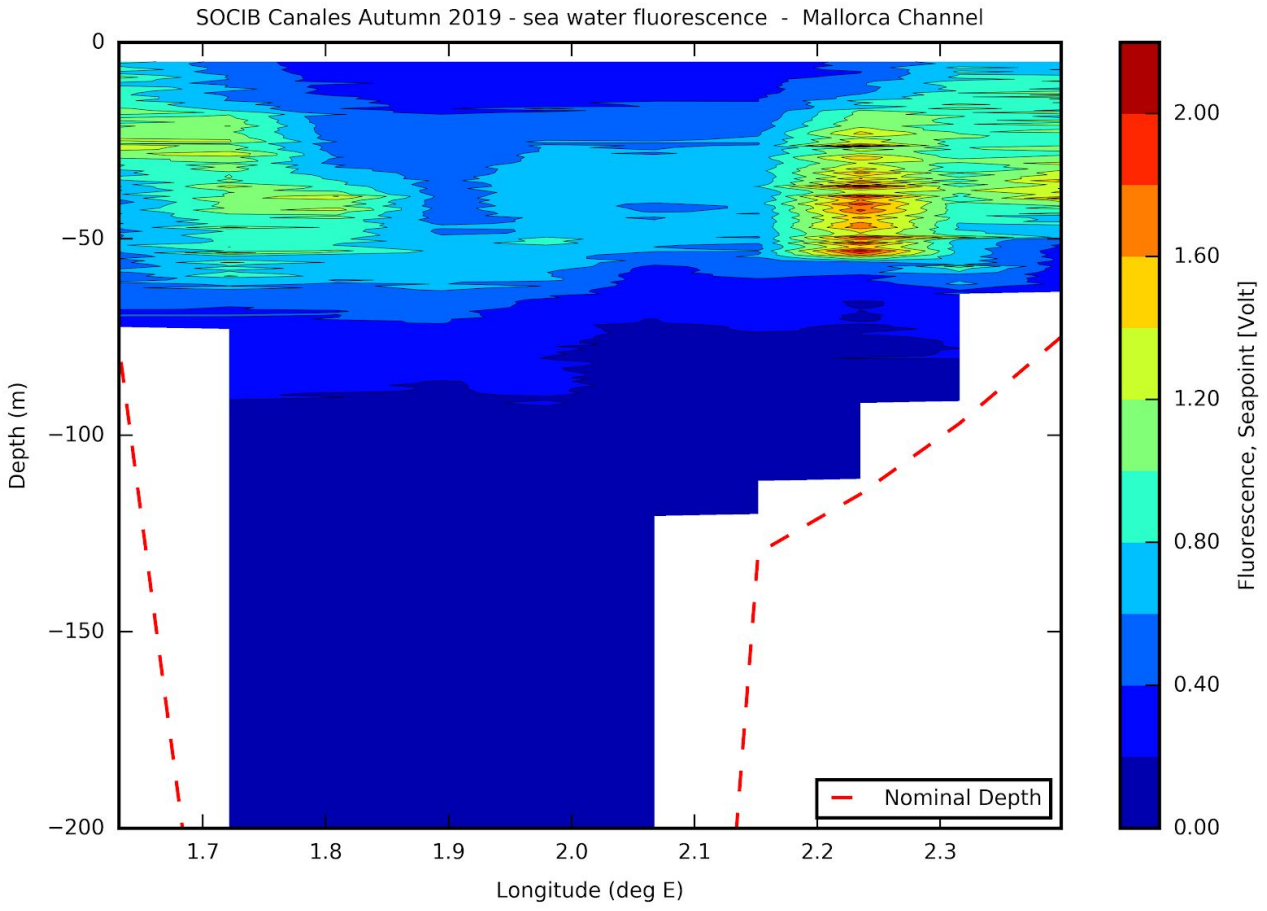

Fig. 7b: Initial figure for fluorescence distribution obtained on the the Mallorca Channel cross-section (upper section 200m).

Preliminary results from the Lagrangian platforms

During the Canales Autumn 2019, 3 SVP-B (surface drifters SVP with a barometer sensor) have been launched as part of the Global Drifter Program (NOAA, USA). Sea surface temperature and air pressure are shown in Figures 6a and 6b, respectively.

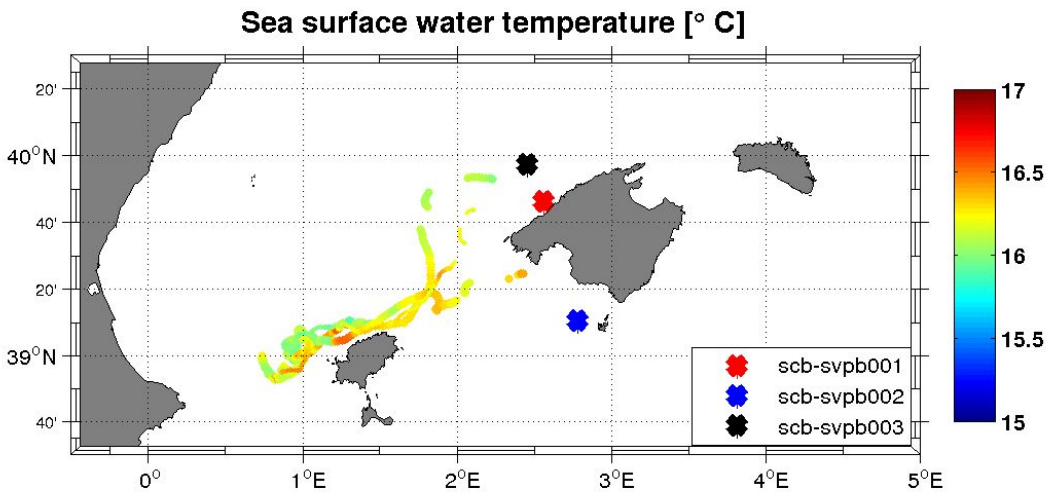

Fig 8a. Sea surface water temperature measured by the SVP-B's (with barometer sensor). Period represented: 27/11/2019-15/12/2019

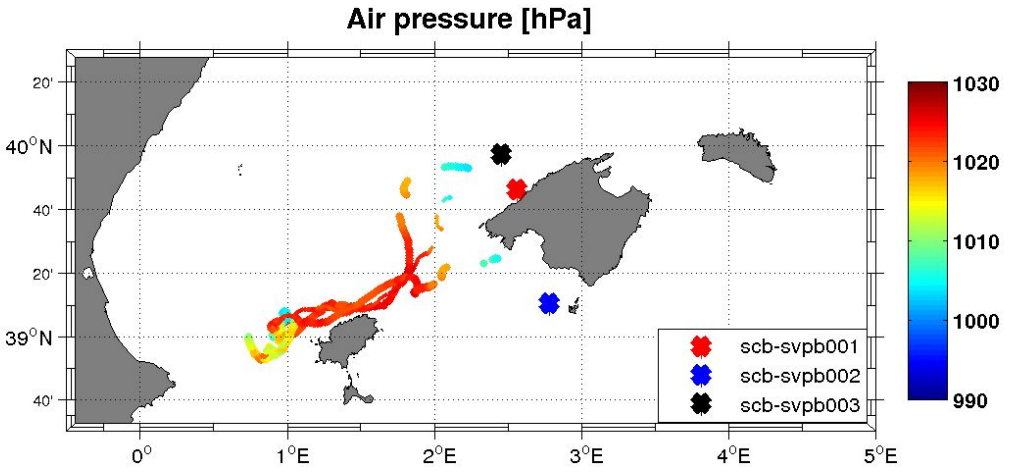

Fig 8b. Air pressure measured by SVP-B's (with barometer sensor). Period represented: 27/11/2019-15/12/2019

Problems encountered

Unfortunately -as previously mentioned- the ADCP did not collect valuable data during this cruise.

Only 4 stations of the IC were sampled since the Captain cancelled the cruise.

The surface drifter SVP (OGS-SVP006, OGS organization) launched in S2_05 stopped transmitting data after a few hours in the water.

Seadatanet Cruise Summary Report Link

The SDN-ICES Cruise Summary Report that references to this cruise is available through

the following link:

CSR Source	URL
BSH Ref-No.: 20193300	http://seadata.bsh.de/Cgi-csr/retrieve_sdn2/csrreport.pl?project=SDN&session=70168&v1=10&v2=1&pcode=

Processed Data Repository

Data Source	Thredds URL
Position	http://thredds.socib.es/thredds/catalog/research_vessel/gps/socib_rv-scb_pos001/L1/2019/07/catalog.html?dataset=research_vessel/gps/socib_rv-scb_pos001/L1/2019/07/dep0062_socib-rv_scb-pos001_L1_2019-07-30.nc
Thermosal	http://thredds.socib.es/thredds/catalog/research_vessel/thermosalinometer/socib_rv-scb_tsl001/L1/2019/07/catalog.html?dataset=research_vessel/thermosalinometer/socib_rv-scb_tsl001/L1/2019/07/dep0058_socib-rv_scb-tsl001_L1_2019-07-30.nc
Weather Station	http://thredds.socib.es/thredds/catalog/research_vessel/weather_station/socib_rv-scb_met009/L1/2019/07/catalog.html?dataset=research_vessel/weather_station/socib_rv-scb_met009/L1/2019/07/dep0059_socib-rv_scb-met009_L1_2019-07-30.nc
CTD	http://thredds.socib.es/thredds/catalog/research_vessel/ctd/socib_rv-scb_sbe9001/L1/2019/catalog.html?dataset=research_vessel/ctd/socib_rv-scb_sbe9001/L1/2019/dep0018_socib-rv_scb-sbe9001_L1_2019-11-26_data_dt.nc
VM-ADCP	No data
OGS-SVP006	http://thredds.socib.es/thredds/dodsC/drifter/surface_drifter/drifter_svp089-ogs_svp006/L1/2019/dep0001_drifter-svp089_ogs-svp006_L1_2019-11-27.nc
SCB-SVPB001	http://thredds.socib.es/thredds/dodsC/drifter/surface_drifter/drifter_svpb001-scb_svpb001/L1/2019/dep0001_drifter-svpb001_scb-svpb001_L1_2019-11-27.nc

SCB-SVPB002	http://thredds.socib.es/thredds/dodsC/drifter/surface_drifter/drifter_svpb002-scb_svpb002/L1/2019/dep0001_drifter-svpb002_scb-svpb002_L1_2019-11-27.nc
SCB-SVPB003	http://thredds.socib.es/thredds/dodsC/drifter/surface_drifter/drifter_svpb003-scb_svpb003/L1/2019/dep0001_drifter-svpb003_scb-svpb003_L1_2019-11-27.nc

References

Langdon C. (2010). Determination of dissolved oxygen in seawater by Winkler titration using the amperometric technique. In: Sloyan B.M., Sabine C. (Eds). GO–SHIP repeat hydrography manual: A Collection of Expert Reports and guidelines. IOC/IOCCP. Paris.

Utermöhl H. (1958). Zur Vervollkomnung der quantitativen Phytoplankton-Methodik. Mitteilungen der internationale Vereinigung für theorische und angewandte Limnologie 9:1–38.

APPENDIX 1: Activities through Canales Autumn 2019

For a table of all ship activities logged during the campaign, refer to the excel file, SHIP_LOGBOOK.

APPENDIX 2: CTD configuration files in Canales Autumn 2019

RADMED_01.XMLCON

```
<?xml version="1.0" encoding="UTF-8"?>
<SBE_InstrumentConfiguration SB_ConfigCTD_FileVersion="7.23.0.2" >
 <Instrument Type="8" >
  <Name>SBE 911plus/917plus CTD</Name>
  <FrequencyChannelsSuppressed>0</FrequencyChannelsSuppressed>
  <VoltageWordsSuppressed>0</VoltageWordsSuppressed>
  <ComputerInterface>0</ComputerInterface>
  <!-- 0 == SBE11plus Firmware Version >= 5.0 -->
  <!-- 1 == SBE11plus Firmware Version < 5.0 -->
  <!-- 2 == SBE 17plus SEARAM -->
  <!-- 3 == None -->
  <DeckUnitVersion>0</DeckUnitVersion>
  <ScansToAverage>1</ScansToAverage>
  <SurfaceParVoltageAdded>1</SurfaceParVoltageAdded>
  <ScanTimeAdded>0</ScanTimeAdded>
  <NmeaPositionDataAdded>1</NmeaPositionDataAdded>
  <NmeaDepthDataAdded>0</NmeaDepthDataAdded>
  <NmeaTimeAdded>0</NmeaTimeAdded>
  <NmeaDeviceConnectedToPC>0</NmeaDeviceConnectedToPC>
  <SensorArray Size="15" >
   <Sensor index="0" SensorID="55" >
    <TemperatureSensor SensorID="55" >
     <SerialNumber>5391</SerialNumber>
     <CalibrationDate>31-Oct-18</CalibrationDate>
     <UseG_J>1</UseG_J>
     <A>0.00000000e+000</A>
     <B>0.00000000e+000</B>
     <C>0.00000000e+000</C>
     <D>0.00000000e+000</D>
     <F0_Old>0.000</F0_Old>
     <G>4.33142500e-003</G>
     <H>6.26486476e-004</H>
     <I>1.94602726e-005</I>
     <J>1.42591432e-006</J>
     <F0>1000.000</F0>
     <Slope>1.00000000</Slope>
     <Offset>0.0000</Offset>
    </TemperatureSensor>
   </Sensor>
   <Sensor index="1" SensorID="3" >
    <ConductivitySensor SensorID="3" >
     <SerialNumber>3718</SerialNumber>
     <CalibrationDate>27-Sep-18</CalibrationDate>
     <UseG_J>1</UseG_J>
     <!-- Cell const and series R are applicable only for wide range sensors. -->
     <SeriesR>0.0000</SeriesR>
     <CellConst>2000.0000</CellConst>
     <ConductivityType>0</ConductivityType>
     <Coefficients equation="0" >
```

```
      <A>0.00000000e+000</A>
      <B>0.00000000e+000</B>
      <C>0.00000000e+000</C>
      <D>0.00000000e+000</D>
      <M>0.0</M>
      <CPcor>-9.57000000e-008</CPcor>
    </Coefficients>
    <Coefficients equation="1" >
      <G>-1.00651454e+001</G>
      <H>1.34538336e+000</H>
      <I>-2.21364165e-003</I>
      <J>2.13478237e-004</J>
      <CPcor>-9.57000000e-008</CPcor>
      <CTcor>3.2500e-006</CTcor>
      <!-- WBOTC not applicable unless ConductivityType = 1. -->
      <WBOTC>0.00000000e+000</WBOTC>
    </Coefficients>
    <Slope>1.00000000</Slope>
    <Offset>0.00000</Offset>
  </ConductivitySensor>
</Sensor>
<Sensor index="2" SensorID="45" >
  <PressureSensor SensorID="45" >
    <SerialNumber>1023</SerialNumber>
    <CalibrationDate>28-Sep-18</CalibrationDate>
    <C1>-4.979972e+004</C1>
    <C2>7.716754e-001</C2>
    <C3>1.594560e-002</C3>
    <D1>3.855600e-002</D1>
    <D2>0.000000e+000</D2>
    <T1>3.000011e+001</T1>
    <T2>-5.335740e-005</T2>
    <T3>4.057330e-006</T3>
    <T4>3.751370e-009</T4>
    <Slope>0.99998358</Slope>
    <Offset>-2.28428</Offset>
    <T5>0.000000e+000</T5>
    <AD590M>1.282500e-002</AD590M>
    <AD590B>-9.474780e+000</AD590B>
  </PressureSensor>
</Sensor>      <Sensor index="3" SensorID="55" >
  <TemperatureSensor SensorID="55" >
    <SerialNumber>5425</SerialNumber>
    <CalibrationDate>31-Oct-18</CalibrationDate>
    <UseG_J>1</UseG_J>
    <A>0.00000000e+000</A>
    <B>0.00000000e+000</B>
    <C>0.00000000e+000</C>
    <D>0.00000000e+000</D>
```

```
    <F0_Old>0.000</F0_Old>
    <G>4.32807175e-003</G>
    <H>6.26530273e-004</H>
    <I>1.95901261e-005</I>
    <J>1.48494602e-006</J>
    <F0>1000.000</F0>
    <Slope>1.00000000</Slope>
    <Offset>0.0000</Offset>
  </TemperatureSensor>
</Sensor>
<Sensor index="4" SensorID="3" >
  <ConductivitySensor SensorID="3" >
    <SerialNumber>3907</SerialNumber>
    <CalibrationDate>17-Oct-18</CalibrationDate>
    <UseG_J>1</UseG_J>
    <!-- Cell const and series R are applicable only for wide range sensors. -->
    <SeriesR>0.0000</SeriesR>
    <CellConst>2000.0000</CellConst>
    <ConductivityType>0</ConductivityType>
    <Coefficients equation="0" >
      <A>0.00000000e+000</A>
      <B>0.00000000e+000</B>
      <C>0.00000000e+000</C>
      <D>0.00000000e+000</D>
      <M>0.0</M>
      <CPcor>-9.57000000e-008</CPcor>
    </Coefficients>
    <Coefficients equation="1" >
      <G>-1.01290757e+001</G>
      <H>1.39010276e+000</H>
      <I>2.66199600e-005</I>
      <J>7.95984096e-005</J>
      <CPcor>-9.57000000e-008</CPcor>
      <CTcor>3.2500e-006</CTcor>
      <!-- WBOTC not applicable unless ConductivityType = 1. -->
      <WBOTC>0.00000000e+000</WBOTC>
    </Coefficients>
    <Slope>1.00000000</Slope>
    <Offset>0.00000</Offset>
  </ConductivitySensor>
</Sensor>
<Sensor index="5" SensorID="71" >
  <WET_LabsCStar SensorID="71" >
    <SerialNumber>CST-1419DR</SerialNumber>
    <CalibrationDate>16-Nov-18</CalibrationDate>
    <M>21.6970</M>
    <B>-1.7140</B>
    <PathLength>0.250</PathLength>
  </WET_LabsCStar>
```

```
</Sensor>
<Sensor index="6" SensorID="27" >
 <NotInUse SensorID="27" >
  <SerialNumber></SerialNumber>
  <CalibrationDate></CalibrationDate>
  <OutputType>2</OutputType>
  <Free>1</Free>
 </NotInUse>
</Sensor>
<Sensor index="7" SensorID="38" >
 <OxygenSensor SensorID="38" >
  <SerialNumber>2119</SerialNumber>
  <CalibrationDate>19-Oct-18</CalibrationDate>
  <Use2007Equation>1</Use2007Equation>
  <CalibrationCoefficients equation="0" >
   <!-- Coefficients for Owens-Millard equation. -->
   <Boc>0.0000</Boc>
   <Soc>0.0000e+000</Soc>
   <offset>0.0000</offset>
   <Pcor>0.00e+000</Pcor>
   <Tcor>0.0000</Tcor>
   <Tau>0.0</Tau>
  </CalibrationCoefficients>
  <CalibrationCoefficients equation="1" >
   <!-- Coefficients for Sea-Bird equation - SBE calibration in 2007 and later. -->
   <Soc>4.6176e-001</Soc>
   <offset>-0.4789</offset>
   <A>-4.7676e-003</A>
   <B> 2.1219e-004</B>
   <C>-2.9939e-006</C>
   <D0> 2.5826e+000</D0>
   <D1> 1.92634e-004</D1>
   <D2>-4.64803e-002</D2>
   <E> 3.6000e-002</E>
   <Tau20> 1.2400</Tau20>
   <H1>-3.3000e-002</H1>
   <H2> 5.0000e+003</H2>
   <H3> 1.4500e+003</H3>
  </CalibrationCoefficients>
 </OxygenSensor>
</Sensor>
<Sensor index="8" SensorID="27" >
 <NotInUse SensorID="27" >
  <SerialNumber></SerialNumber>
  <CalibrationDate></CalibrationDate>
  <OutputType>2</OutputType>
  <Free>1</Free>
 </NotInUse>
</Sensor>
```

```
<Sensor index="9" SensorID="33" >
 <OBS_SeapointTurbiditySensor SensorID="33" >
  <SerialNumber>12182</SerialNumber>
  <CalibrationDate>07-Nov-18</CalibrationDate>
  <!-- The following is an array index, not the actual gain setting. -->
  <GainSetting>0</GainSetting>
  <ScaleFactor>1.000</ScaleFactor>
 </OBS_SeapointTurbiditySensor>
</Sensor>
<Sensor index="10" SensorID="11" >
 <FluoroSeapointSensor SensorID="11" >
  <SerialNumber>3259</SerialNumber>
  <CalibrationDate>07-Nov-18</CalibrationDate>
  <!-- The following is an array index, not the actual gain setting. -->
  <GainSetting>1</GainSetting>
  <Offset>0.000</Offset>
 </FluoroSeapointSensor>
</Sensor>
<Sensor index="11" SensorID="0" >
 <AltimeterSensor SensorID="0" >
  <SerialNumber>69894</SerialNumber>
  <CalibrationDate>2018-12</CalibrationDate>
  <ScaleFactor>15.000</ScaleFactor>
  <Offset>0.000</Offset>
 </AltimeterSensor>
</Sensor>
<Sensor index="12" SensorID="42" >
 <PAR_BiosphericalLicorChelseaSensor SensorID="42" >
  <SerialNumber>70364</SerialNumber>
  <CalibrationDate>02-Nov-18</CalibrationDate>
  <M>1.00000000</M>
  <B>0.00000000</B>
  <CalibrationConstant>17575000000.00000000</CalibrationConstant>
  <Multiplier>1.00000000</Multiplier>
  <Offset>-0.05720214</Offset>
 </PAR_BiosphericalLicorChelseaSensor>
</Sensor>
<Sensor index="13" SensorID="27" >
 <NotInUse SensorID="27" >
  <SerialNumber></SerialNumber>
  <CalibrationDate></CalibrationDate>
  <OutputType>0</OutputType>
  <Free>0</Free>
 </NotInUse>
</Sensor>
<Sensor index="14" SensorID="51" >
 <SPAR_Sensor SensorID="51" >
  <SerialNumber>20395</SerialNumber>
  <CalibrationDate>02-nov-2018</CalibrationDate>
```

```
        <ConversionFactor>1443.22580000</ConversionFactor>
        <RatioMultiplier>1.00000000</RatioMultiplier>
       </SPAR_Sensor>
      </Sensor>
    </SensorArray>
  </Instrument>
</SBE_InstrumentConfiguration>
```