

CRUISE REPORT

SOCIB Canales Winter 2017:

14th to 17th February 2017

SOCIB_ENL_CANALES_FEB2017_WINTER

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Description:	A repeat seasonal hydrographic survey of the Balearic Sea, monitoring the Ibiza and Mallorca Channels. 23 CTD stations were carried out over 3 days; the stations forming three transects across the Ibiza Channel (IC). Normally a fourth day involves 10 CTD stations across the Mallorca Channel (MC); these stations were skipped and the ship steamed back to Palma de Mallorca during the evening on the 17 th February. An additional stop was made for maintenance of the Ibiza Channel buoy, where surface samples were taken for comparison with the buoys sensors.
Authors:	C.Muñoz, E. Alou, G.Rogers
Supervision:	B. Casas & John Allen
Keywords:	Mediterranean; ocean circulation; Balearic Sea; Ibiza Channel; Mallorca Channel; Northern Current;

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Objectives

1. Complete repeat hydrographic survey of the Ibiza Channel (IC) and Mallorca Channel (MC) through deployment of a CTD instrument frame (SeaBird SBE911*plus*) with extra mounted sensors and rosette equipped with 12 10l Niskin bottles.
2. Discrete water sample collection at various depths for the purpose of:
 - a. Sensor field correction with the *in situ* discrete water samples for salinity, dissolved oxygen and chlorophyll a (chl a) concentration.
 - b. Biogeochemical sampling of nutrients and phytoplankton community (through pigment signatures and microscopic post-cruise analyses).
3. Collection of VM-ADCP (vessel-mounted Acoustic Doppler Current Profiler) data throughout the cruise to gain knowledge about the current structure of the upper 100-400 m of the water column.
4. Maintenance of the Ibiza Channel Buoy.
5. Collection of surface water samples for comparison purposes with the Ibiza Channel buoy, for salinity, dissolved oxygen and chlorophyll a (chl a) concentration.
6. Compare some CTD profiles with Slocum glider profiles attached on the same frame.

Onboard personnel

E. Alou	Biochemical
B. Casas	CTD (Chief Scientist)
C. Castilla	CTD
M. Simonet	Biochemical
I. Lizarán	CTD
A. Cabornero	Biochemical
L. Díaz	Biochemical
C. Muñoz	ADCP
G. Rogers	ADCP
P. Balaguer	CTD

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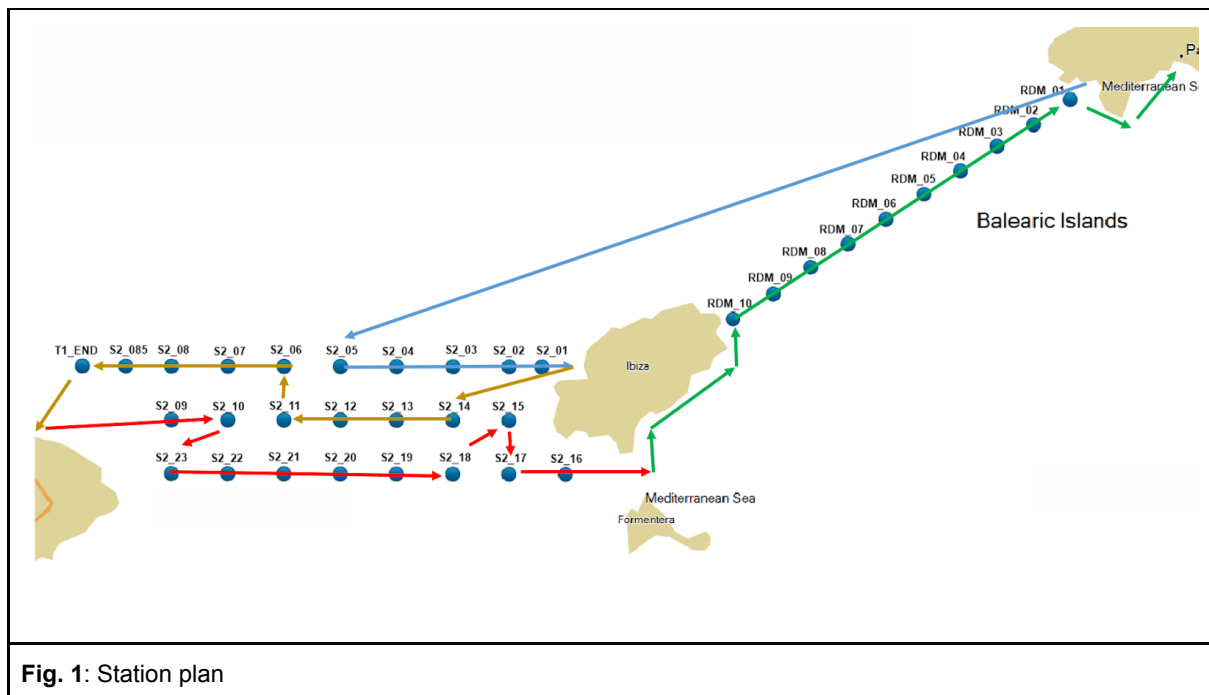
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Station plan

25 CTD stations were carried out over a period of 4 days; all 3 transects in the IC; no stations were carried out in the MC. The ADCP was collecting data throughout the entire duration of the cruise, from the moment the ship left the port to the moment the ship arrives at port. Figure 1 shows the station locations and the order in which stations were carried out.

A ship activity log detailing actions carried out during the cruise is provided in Appendix 1. Note none of the Radmed stations in the Mallorca channel were carried out.



Cruise diary

Day 1 - 14th February 2017

We left the port of Palma at 07:00 UTC, steaming westwards out of Palma Bay. The first ADCP run was in water tracking mode, as we were just heading off the Mallorca shelf into deeper waters. We stopped at 07:45 in order to mount and assemble the deck crane. At 12:27 UTC we had troubles with the graphical card of the ADCP PC and all the comm ports

lost the configuration. We recovered normal situation at 13:10 UTC.

So far the conditions are acceptable; the sun is shining and the sea is <1.5m. We reached the first station of the day (S2_05) at 14:43 UTC. After S2_05, the ship steamed eastwards to return to Ibiza - carrying out four more stations before reaching the port of San Antonio. At 19:31 UTC the ADCP was switched off coinciding with our arrival at Sant Antoni harbor.

This cruise campaign is the third time we have used a prototype nutrient sensor SUV51, mounted on the CTD frame and connected to the one serial input port of the SeaBird 9/11 breakout unit. This instrument is a Valeport Ltd derivative of the SUV6 prototype developed in parallel with the University of Southampton (Pidcock et al., 2010). It operates on the basis of the small absorbance of 200-220 nm UV light by dissolved nitrate in seawater.

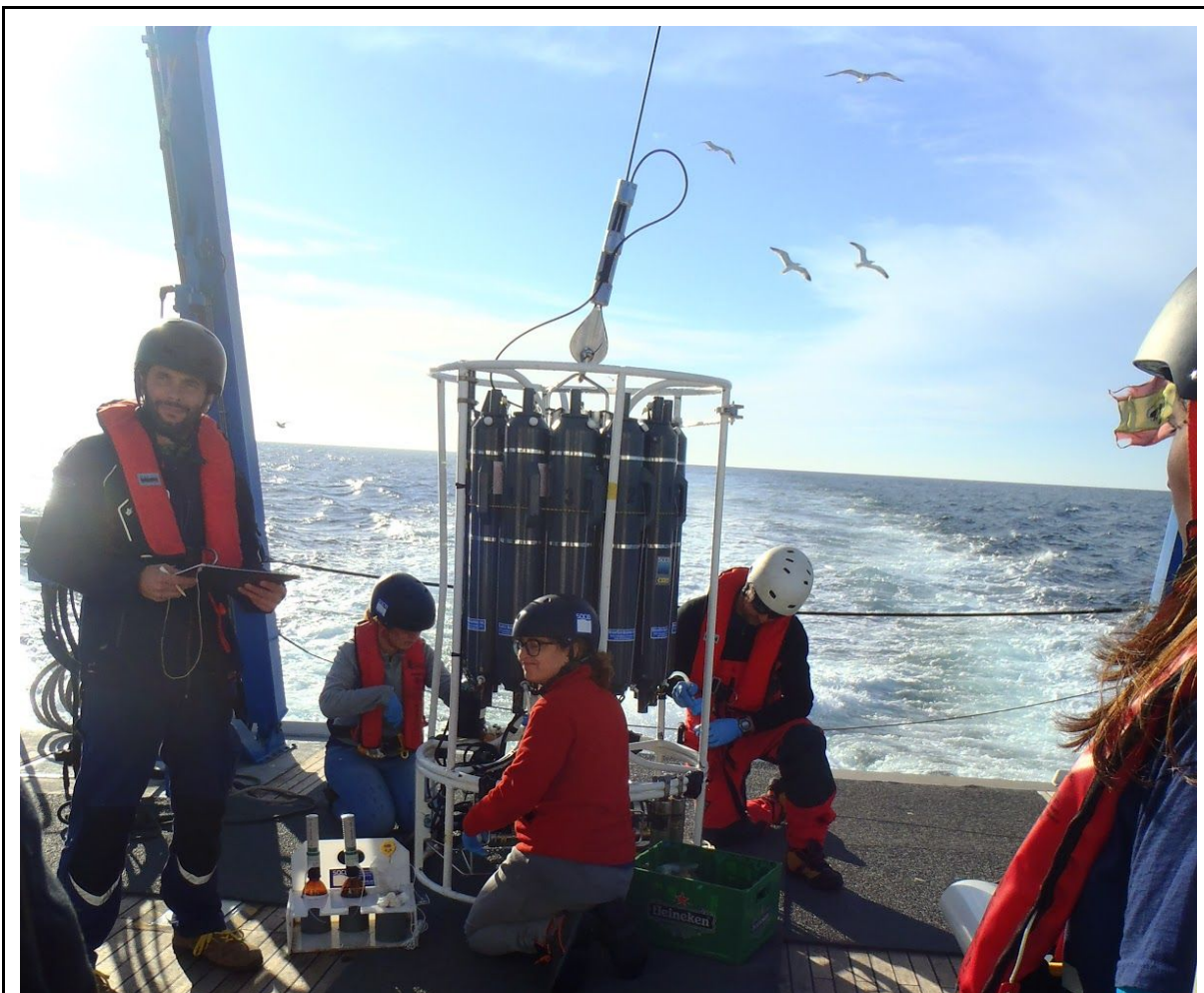


Fig. 2: Water sampling process

DAY 2 - 15th February 2017

We left the port of San Antonio, Ibiza, at 07:21 UTC. We steamed south westwards at a general speed of 12 knots towards the first station of the day, station S2_14. The ADCP was set up in bottom tracking mode (file 006) over the shallow shelf of Ibiza. It was then switched into water tracking mode (file 007) at 08:21 UTC, half an hour prior to arriving at station S2_14.

We continue performing the following stations with normality, sea around 1m. Glider SCB-SLDEEP004 was attached during profiles S2_13 and S2_12. The ADCP was set up in bottom tracking mode (file 009). After S2_09, at 16:38 UTC, we change our direction to recover the glider unit SCB-SLDEEP001 that presented some troubles due to a disfunction with the altimeter.

At 17:30 UTC, after recovering the glider unit, we start heading towards S2_08. The ADCP was set up in water tracking mode (file 010) at 17:40 UTC. We arrive at 18:05 UTC at S2_08. The ADCP was set up in bottom tracking mode (file 011) over the shallow shelf of Denia at 18:37 UTC. Arriving at the port of Denia on the Iberian Peninsula at 19:28 UTC.

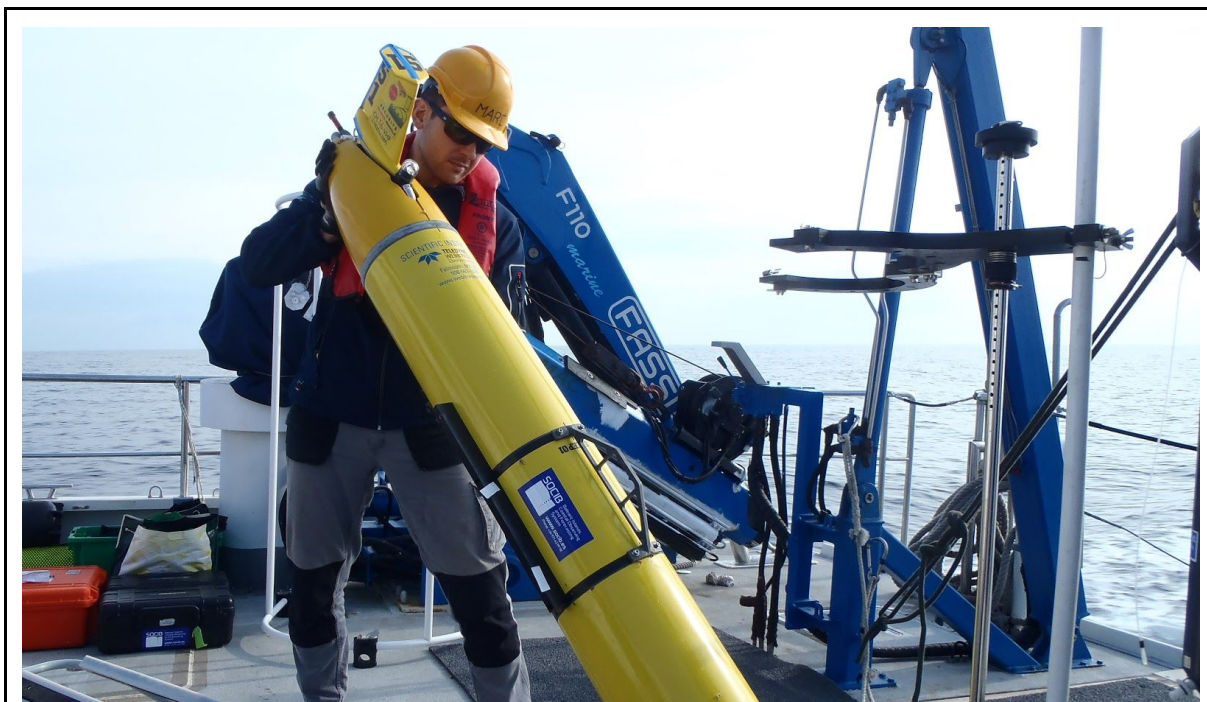


Fig. 3: GARICAST assembly operation

DAY 3 - 16th February 2017

We left the port of Denia at 06:55 UTC, steaming north towards the first station of the day, T1_END. Conditions are still acceptable, with clear cloud cover. We set up the ADCP and started running it in bottom tracking mode (file 012).

T1_END was performed at 07:53 UTC. At 08:27 UTC we perform S2_085. At 08:43 UTC we start heading towards S2_23 where we arrive at 09:39 UTC. At 10:03 UTC, the ADCP was set up in water tracking mode (file 013). Sea rised to 1.5m. S2_22 was performed at 10:09 UTC.

After this station, Valeport SUV51 sensor was uninstalled from the CTD frame to avoid being used during the following deep profiles and was assembled again in S2_18, S2_15, S2_17 and S2_16. Glider SCB-SLDEEP001 was attached during profiles S2_21, S2_20, S2_19, S2_18, S2_15, S2_17 and S2_16. S2_20 was performed at 12:26 UTC. At 13:00 UTC we were heading to the IC buoy for inspection, that was performed at 13:30 UTC.

During the inspection the divers discovered that the shackle between the buoy and the mooring line was open. They couldn't fix it and decided to return to the buoy the following day with the aid of other ETD members and support from the hurricane boat. At 16:09 UTC, after performing S2_15, the ADCP was set up in bottom tracking mode (file 014). S2_17 was performed at 16:50 UTC and S2_16 was performed at 17:40 UTC. At 17:55 UTC we start heading to Formentera port, where we arrive at 19:30 UTC.



Fig. 4: Loose schackle discovered during the Ibiza Channel buoy inspection

DAY 4 - 17th February 2017

We left the port of Formentera at 07:00 UTC. The ADCP was set up in bottom tracking mode (file 015) at 07:30 UTC. At 08:22 UTC the ADCP was set up in water tracking mode (file 016).

At 09:15 UTC we arrive to the IC buoy to fix the shackle. Diving operations finish at 11:35 UTC, when we start heading to Palma, where we arrive at 13:00 UTC.




Fig. 5: Hurricane support boat arriving to the RV SOCIB position close to the Ibiza Channel buoy

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:	1031	
SOCIB Inventory:	SCB-SBE9002	
Deck Unit:	SBE11	
SOCIB Inventory:	SCB-SBE11+001	

Sensor	Model	S/N	Calibration date
Temperature	SBE 3P	03P5427	2013/12/19
Temperature 2	SBE 3P	03P5449	2013/12/19
Conductivity	SBE4C	043872	2014/01/14
Conductivity 2	SBE4C	043877	2014/01/14
Pressure		119076	2014/02/03
Oxygen	SBE 43	432117	2014/01/18
Transmissometer	WET Labs C-Star 25-650	CST-1413DR	2014/03/05
Turbidity	STM Sea Point	12181	2014/01/23

Fluorometer	Seapoint 6000m	3258	2014/01/23
Irradiance	PAR Biospherical QCP-2300L-HP	70363	2011/03/25
Surface Irradiance	SPAR Superficie Biospherical QCR2200	20395	2011/03/28
Altimeter	Datasonics PSA-916D	52712	
SUV51 (via serial port)	Valeport Ltd	-	-

Configuration

For controlling the CTD the following file was used: S2_01.xmlcon. The information contained in that file is located in Appendix 2: CTD Configuration File

Acoustic doppler profiler

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

Configuration

Thermo-salinometer


Manufacturer:	SeaBird	
Model:	SBE21	
S/N:	3370	
SOCIB Inventory:	SCB-TSL001	
Calibration date:	2011/12/21	

Configuration

The data are collected using the UTM - Termosal.exe software. The data are stored directly in the main desktop and are processed through the SOCIB-DC system.


Fluorometer

The instrument was not installed therefore data from this instrument were not collected during this cruise

Manufacturer:	Turner	
Model:	10 - AU	
S/N:	1100195	
SOCIB Inventory:		
Calibration date:	2015/09/17	

Weather Station

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



Configuration


The data are collected using the UTM - SADO System. The data are stored directly in the main desktop and are processed through the SOCIB-DC system.


SUV-51 - prototype nutrient sensor (Valeport limited)

This cruise campaign is the second time we have used a prototype nutrient sensor SUV51 (manufactured by Valeport limited). This instrument was connected to the serial input port of the seabird 911 breakout box, and provided a serial data stream to be viewed at the deck unit. It appears to be working fine, although there is no visualization of the data - a method of data processing will need to be established. Seeing as the instrument has only been tested for 500 m profiling work, the SUV51 was only attached to the rosette frame for stations less than 500 m depth.

Glider Slocum

Many CTD profiles were taken with a glider attached on the same CTD rosette. The gliders used in such profiles are the following ones:

Manufacturer:	Teledyne	
Model:	Slocum G2 Deep	
S/N:	567	
SOCIB Inventory:	SCB-SLDEEP004	
Calibration date:		

Manufacturer:	Teledyne	
Model:	Slocum G2 Deep	
S/N:	244	
SOCIB Inventory:	SCB-SLDEEP001	
Calibration date:		

Configuration

The data are collected by the gliders. The data are stored in each glider unit until the GF technician downloads them to be processed through the SOCIB-DC system.

Scientific Reports

Physical data report

The following contains an overview of the physical data collected from the CTD and the VM-ADCP on board the R/V SOCIB catamaran from the 14th to the 17th February 2017. The first section is a technical description of the VM-ADCP data processing and visualization, and a calibration report, while the second section briefly outlines the steps followed in order to process the CTD data. The next section provides a brief biogeochemical data report, after which some results are presented from both the VM-ADCP and CTD, drawing attention to any particularly interesting features.

VM-ADCP

There was a lack of Real Time Kinematic correction on the ADCP data during the whole cruise due to a miss function in the ADU800 Antenna 1.

Throughout the entire cruise (i.e. both during sections and during transits), a VM-ADCP was recording data about the movement of the upper 100-400 m of the water column. Generally penetration range was less than 200 m. The R/V SOCIB is equipped with a 150 kHz, RDI Ocean Surveyor, VM-ADCP (vessel-mounted Acoustic Doppler Current Profiler) transducer located in the port hull just forward of the accommodation bulkhead in front of the fuel tanks. Data is recorded and displayed real-time using the RDI developed software VmDas (RDI's data acquisition and playback software) and WinADCP (RDI's visualisation software). Log sheets detailing the ADCP files can be found in [here](#).

Data processing: The basic data processing was carried out to SOCIB's [VM-ADCP standard operating procedures](#) (SOPs) within VM-DAS and WinADCP (refer to these documents for further details).

The initiation files for both bottom-tracking and water-tracking mode included the following settings:

- Transducer depth = 2 m
- Blank distance = 8 m
- Number of Bins = 50
- Bin thickness = 8 m
- Max range for bottom tracking = 400 m
- STA files (short term averaging) = 120 s
- LTA files (long term averaging) = 600 s

Calibration: The EA Heading alignment was set to -45.5° while the velocity scale factor for profile velocities was initially set to 1.020. These values correct for misalignment between the VM-ADCP instrument and the ship. Throughout the cruise, a total of 7 transects were carried out in bottom-tracking mode for the purpose of misalignment calibration checks (as described in the SOPs). Due to the issues with the PC, BT03 bottom-tracking mode file was short and choppy. The bottom track STA files were read into excel and sections of data were then copied into a VM-ADCP calibration spreadsheet. These data sections were subjectively chosen on the basis of relatively constant ship velocity, heading and bottom depth. The calibration spreadsheet follows the standard theory for VM-ADCP installation calibration from bottom track information as described in Joyce (1989) and Pollard and Reed (1989).

The mean misalignment angle was -0.3136 which is accurate enough, though the fact of having no ashtec causes a big standard deviation. The velocity scale factor was set as 1.02. Across the bottom tracking file, the amplitude factor ranged from 1.0105 to 1.0309. The accuracy of the ship direction was fully dependant on the gyro that varied very slowly due to its inertia and ship oscillation, causing a major oscillation on the gyro and a big standard deviation at the same time.

CTD and water bottle sampling

Data acquisition: CTD casts were carried out at 25 stations encompassing 3 transects across the IC; no stations were carried out in the MC. 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

(Seapoint) 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 assess nutrient concentration distribution: Nitrate (NO_3^-), nitrite (NO_2^-), silicate (SiO_4^{2-}) and phosphate (PO_4^{3-}).
3. To study phytoplankton community composition.

The sampling was carried out on 3 days from the 14th February to the 17th February 2017 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 along each transect at 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 Trilogy fluorometer, see available protocol).

Nutrients

Samples for inorganic nutrient concentrations were taken at all stations at a maximum of 9 depths. Additional nutrient samples were taken at certain stations and depths to check the new nutrient sensor, SUV51 (see [logbook](#) for detailed information on sampling depths and protocols). Samples will be kept frozen at -20°C at the IMEDEA until analysis.

Phytoplankton community composition

Samples were taken on each station at the deep chlorophyll maximum (DCM) for general cell identification (cells fixed in Lugol's solution, Utermöhl 1958). Samples for microscopy will

be analyzed post-cruise at the IMEDEA. Additionally surface samples were taken at a few selected stations (see [logbook](#)).

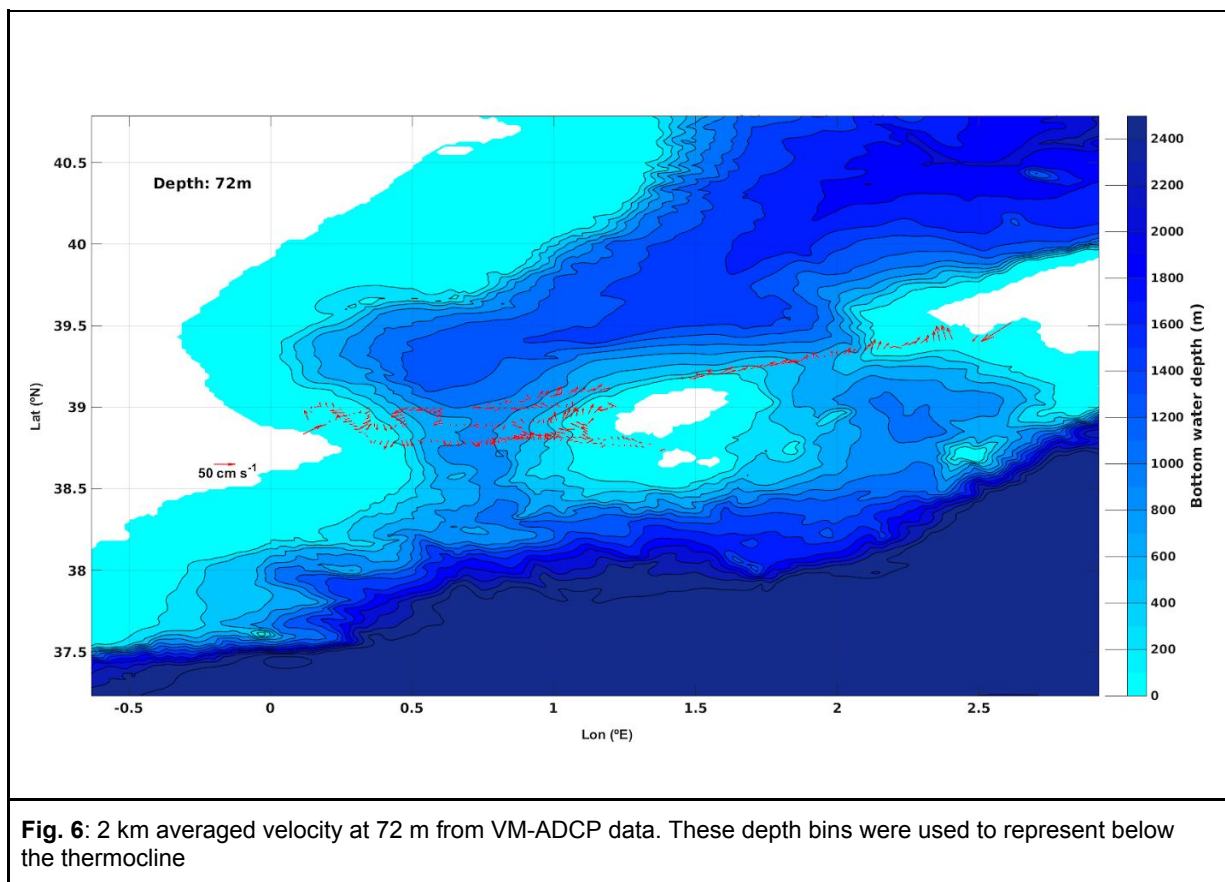
Samples for High Performance Liquid Chromatography (HPLC) analyses were taken on each station at 2 depths (surface and DCM). The total fraction was collected and a volume of 2 L filtered through a GF/F filter (retaining microorganisms larger than the nominal pore size of 0.7 μm). Samples are stored at the IMEDEA (-80°C) until analysis.

Preliminary results

Preliminary physical results

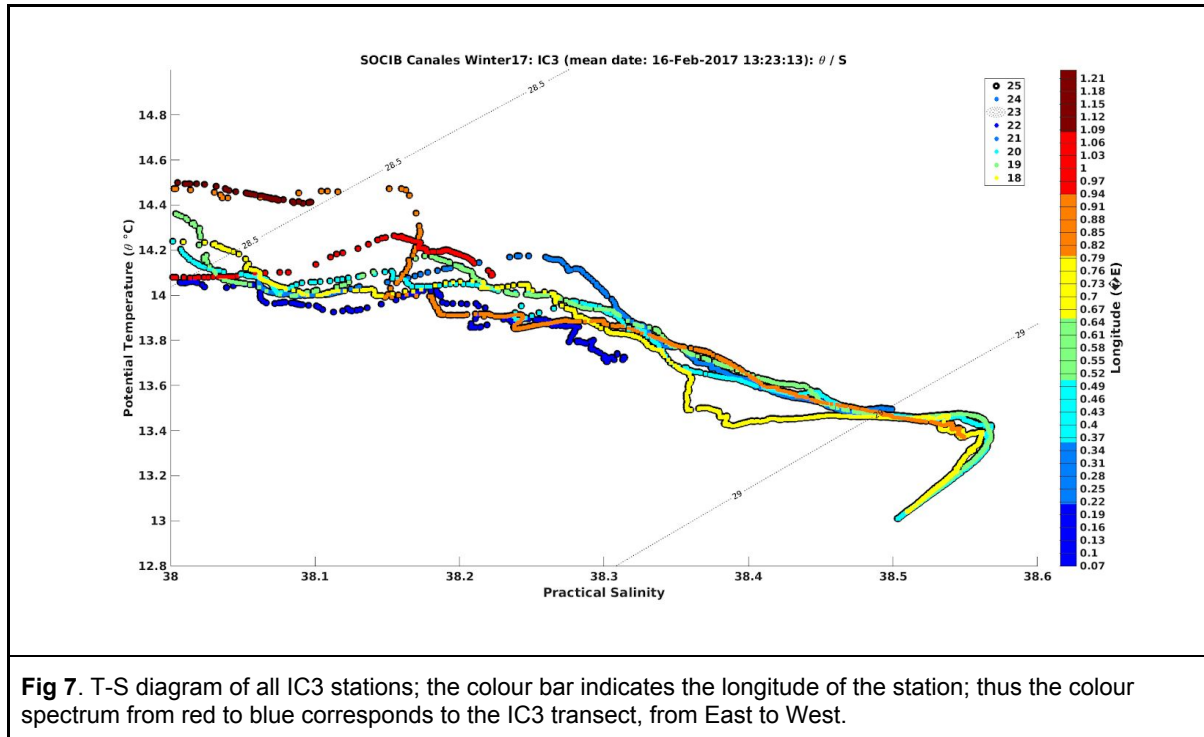
1. Velocity Vector Maps: 72 m

Figure 2 shows 2 km averaged VM-ADCP velocity at 72 m.



2. Hydrography: T-S diagram

Figure 7 shows the potential temperature – salinity distribution of all stations of the entire water column, where colour indicates the longitude of the corresponding station. The most saline surface water is typically found in the western part of the Ibiza Channel, where flow is southward on the shelf of the Iberian Peninsula ([fig. 2](#)). In contrast the eastern part of the Ibiza Channel shows some of the freshest surface water signals.



3. Ibiza Channel: North

The figures presented in this section are showing the third, most northerly transect of the IC. Figure 8 shows the velocities u and v from the ADCP. The subplot c shows a plot of the distance covered by the ship against the distance between each ensemble ping; where the distance between each ensemble ping reduces to almost 0 we can identify periods where the ship is on station. By plotting against distance covered instead of ensemble number, the pixels where the ship is stationary have been compressed, providing a more uniform picture of the spatial structure of the Ibiza Channel.

Flow is predominantly northward in the eastern section (Ibiza shelf), and southwards in the western area over the shelf edge of the Iberian Peninsula. The east-west component of velocity is less well defined; in general there is a weak net eastward component, and a peak westward component between 0.50 and 0.60 deg E, which occurs at the deepest section of the Ibiza Channel. The flow is generally uniform throughout the upper 200 m of the water column.

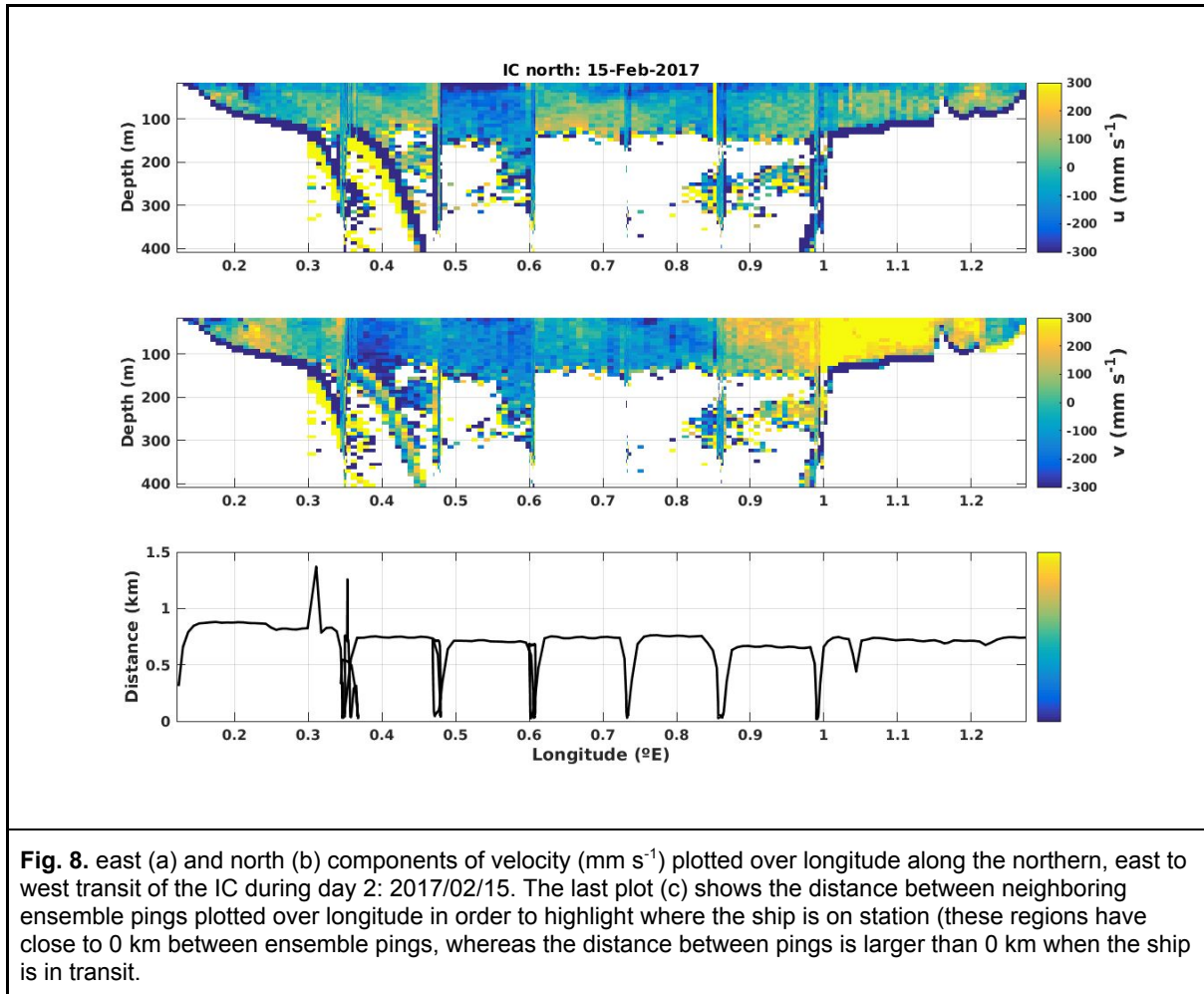


Figure 9 shows the different variables acquired through the CTD profiles across the northern IC covering from 0.1° E (peninsula shelf) til 1.2° E (Ibiza shelf). Profiles are shown only in the upper section $\sim 300\text{m}$ depth.

Potential temperature (figure 9a) has an almost uniform vertical distribution presenting a weak temperature gradient between 13°C and 15°C . There is a stronger horizontal gradient in the western area (Ibiza shelf) from 0.7°E until 1.2°E .

Salinity (figure 9b) presents typical horizontal gradients on the continental shelves that are wider distributed around the Ibiza shelf than in the peninsula shelf. Salinity vertical distribution range is $37.6 \text{ psu} - 38.6 \text{ psu}$.

Potential density (figure 9c) also presents a typical winter vertical distribution characterized by weak vertical gradients. Like the other variables mentioned, it does exist a horizontal gradient in the Ibiza shelf side from 0.7°E to 1.2°E .

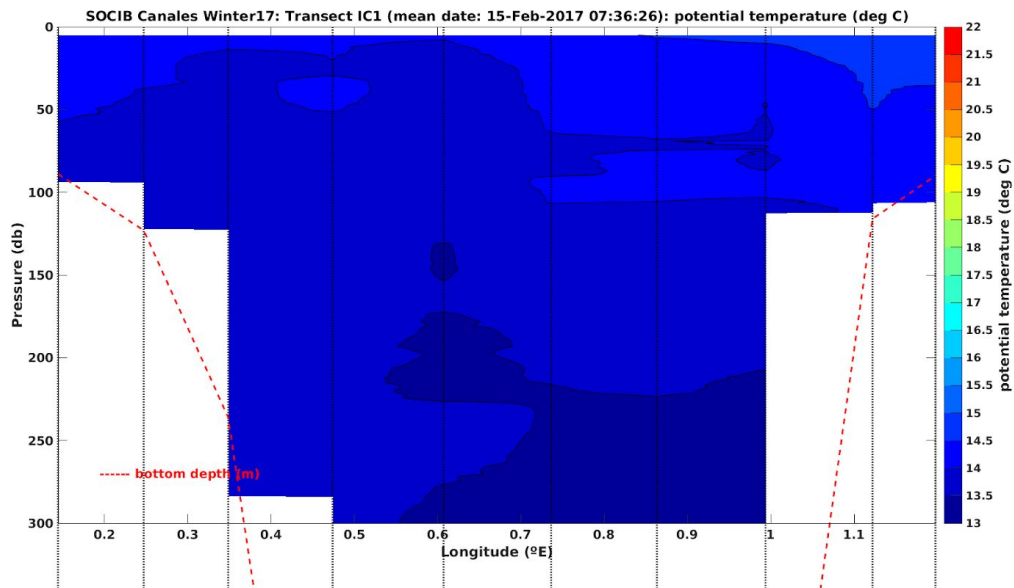


Fig. 5a. Potential temperature (°C) of the first (most northerly) transect of the IC (only the upper 300 m of the water column is shown in order to highlight the subsurface lense centred at 0.6° E).

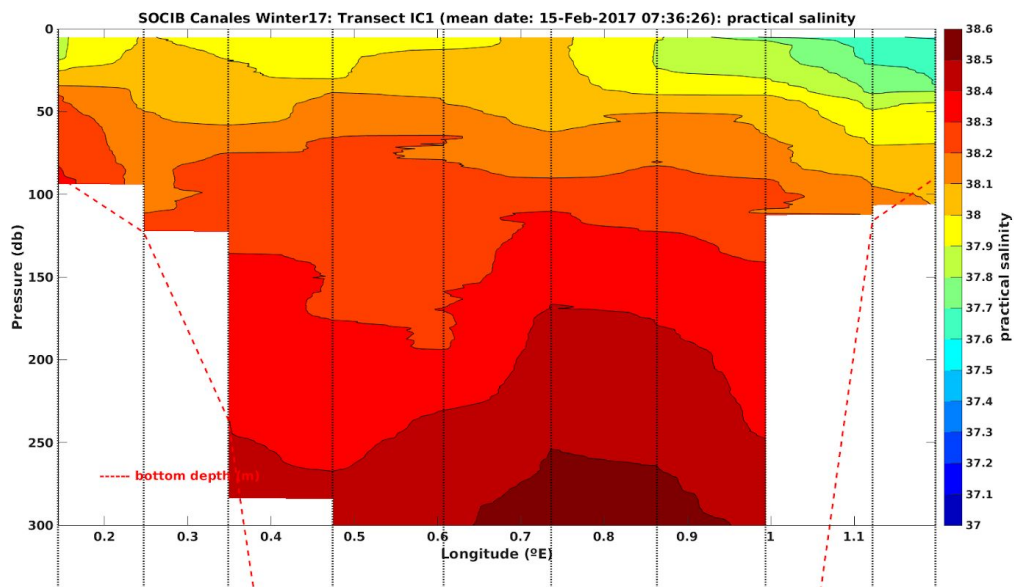
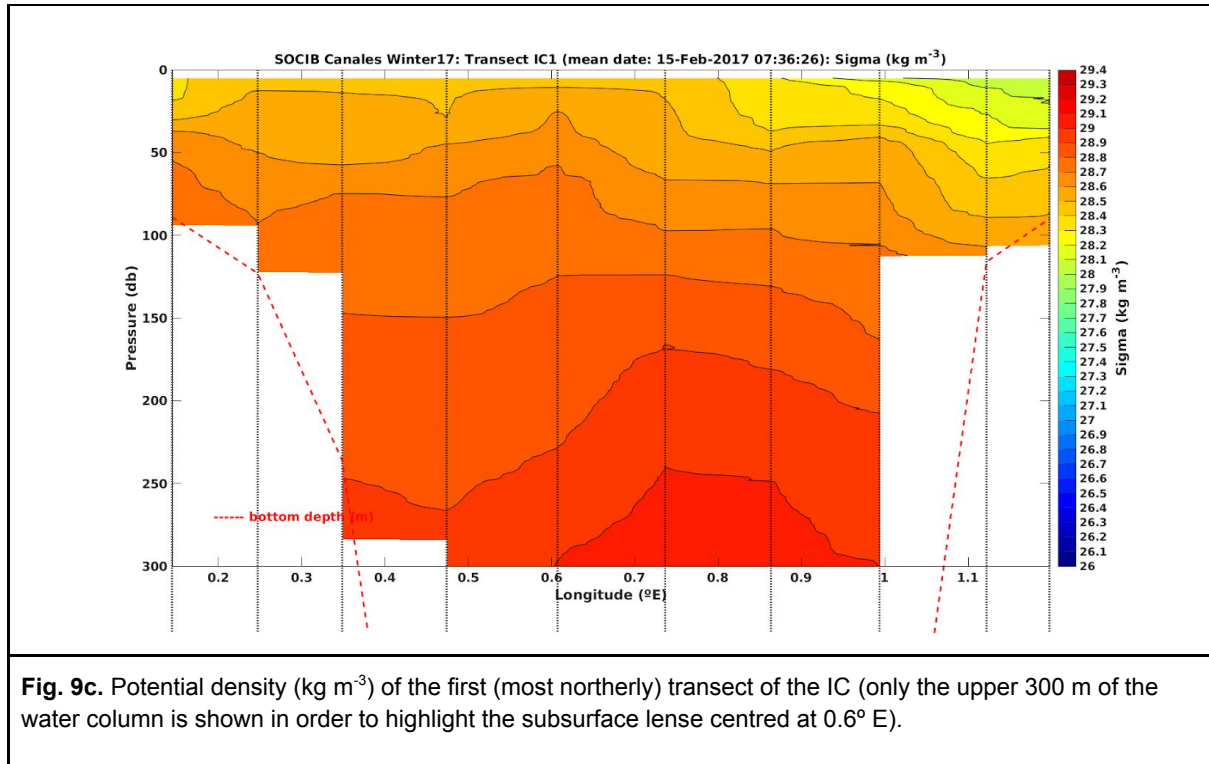


Fig. 9b. Salinity of the first (most northerly) transect of the IC (only the upper 300 m of the water column is shown in order to highlight the subsurface lense centred at 0.6° E, most pertinent in density in fig. 5c).



4. Ibiza Channel: South

Figure 10 Shows the east and north components of velocity across the southern IC

Flow is predominantly northward in the eastern section (Ibiza shelf), and southwards in the western area over the shelf edge of the Iberian Peninsula. The east-west component of velocity is less well defined; in general there is a weak net eastward component, and two well defined peaks with westward component between 0.20 and 0.30 deg E, which occurs in the middle of the iberian peninsula continental shelf and another occurring on the edge of the Ibiza shelf in a depth range between $50\text{-}100\text{m}$. The flow is generally uniform throughout the upper 200 m of the water column.

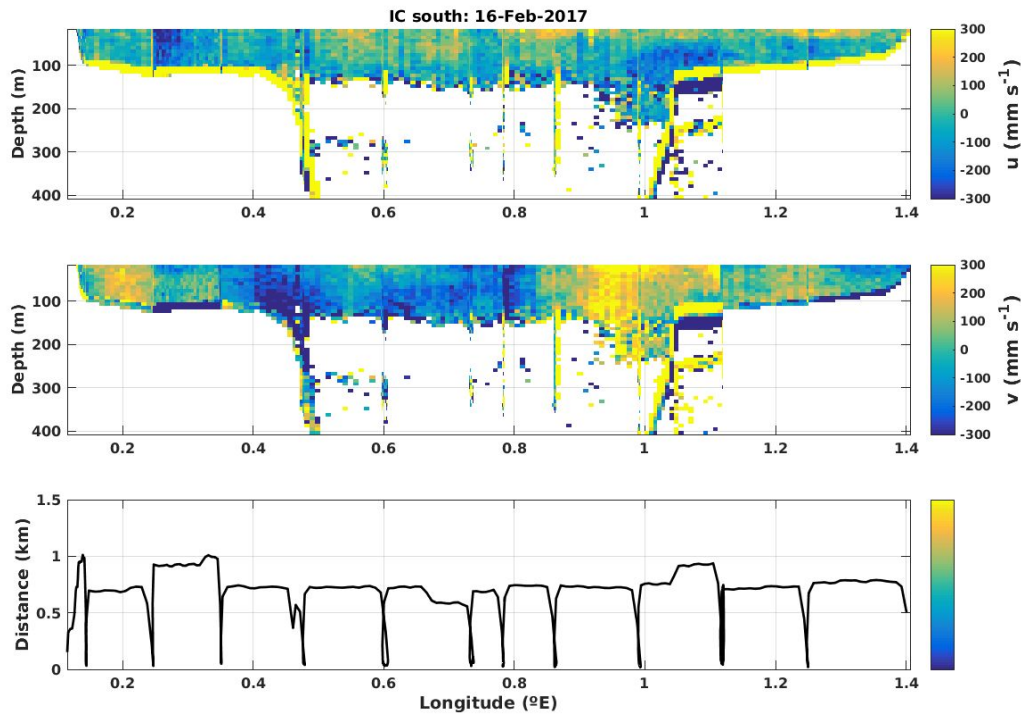


Fig. 10. east (a) and north (b) components of velocity (mm s^{-1}) plotted over longitude along the southern, west to east transit of the IC during day 3: 2017/02/16. The last plot (c) shows the distance between neighboring ensemble pings plotted over longitude in order to highlight where the ship is on station (these regions have close to 0 km between ensemble pings, whereas the distance between pings is larger than 0 km when the ship is in transit).

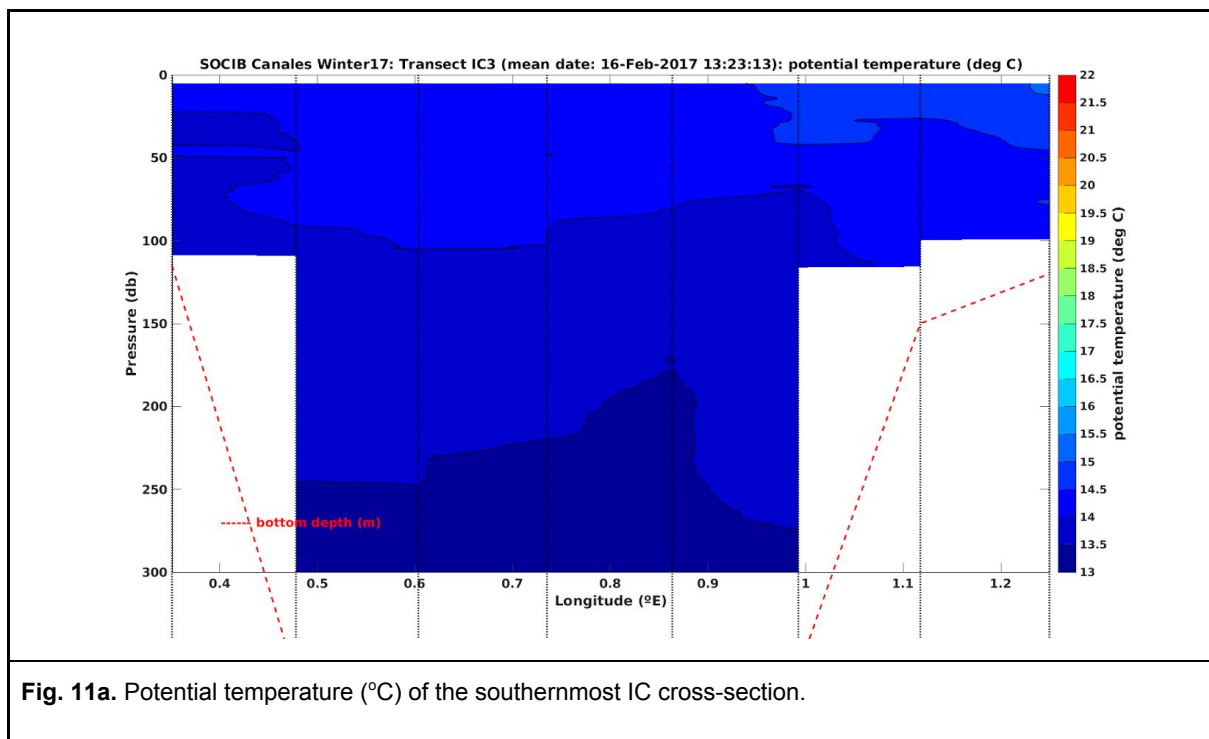
Figure 11 shows the different variables acquired through the CTD profiles across the northern IC covering from 0.1° E (peninsula shelf) til 1.2° E (Ibiza shelf). Profiles are shown only in the upper section $\sim 300\text{m}$ depth.

Potential temperature (figure 11a) has an almost uniform vertical distribution presenting a weak temperature gradient between 13°C and 15°C . There is a stronger horizontal gradient in the western area (Ibiza shelf) from 0.7°E until 1.2°E .

Salinity (figure 11b) presents typical horizontal gradients on the continental shelves that are wider distributed around the Ibiza shelf than in the peninsula shelf. Salinity vertical distribution range is $37.6 \text{ psu} - 38.6 \text{ psu}$.

Potential density (figure 11c) also presents a typical winter vertical distribution characterized by weak vertical gradients. Like the other variables mentioned, it does exist a horizontal gradient in the Ibiza shelf side from 0.7°E to 1.2°E.

For both salinity and potential density, the plots present spike situated around 95m depth in a longitude range of 0.9°E to 1.1°E, probably due to a miss-function in the conductivity cell.



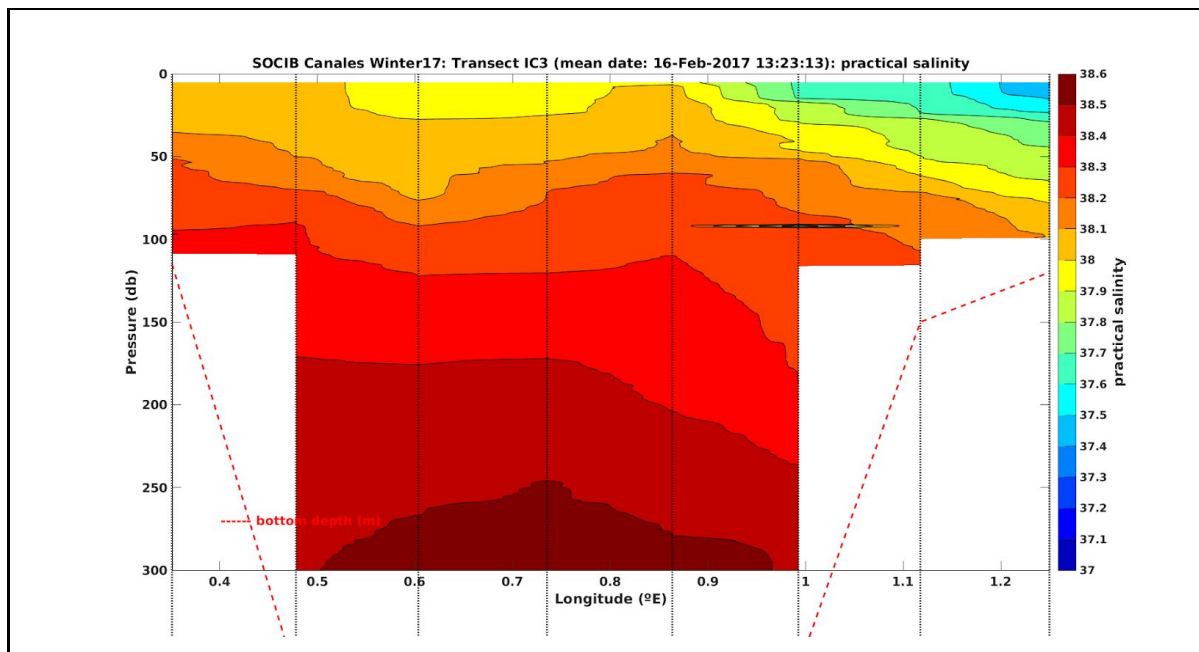


Fig. 11b. Salinity of the southernmost IC cross-section.

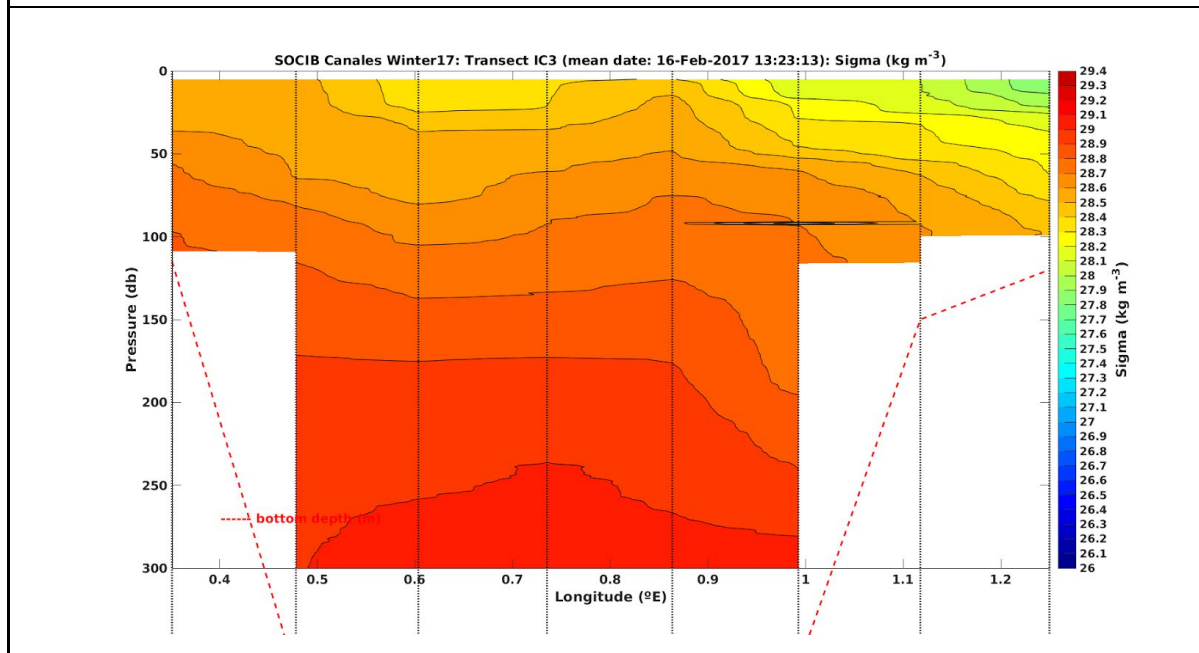


Fig. 11c. Potential density (kg m^{-3}) of the southernmost IC cross-section.

Preliminary biogeochemical results

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

Below we present some preliminary results obtained with the CTD sensors for dissolved oxygen (Fig. 12a, 13a) and *in vivo* fluorescence (Fig. 12b, 13b) of northernmost and southernmost transects of the IC respectively.

1. Ibiza Channel: North

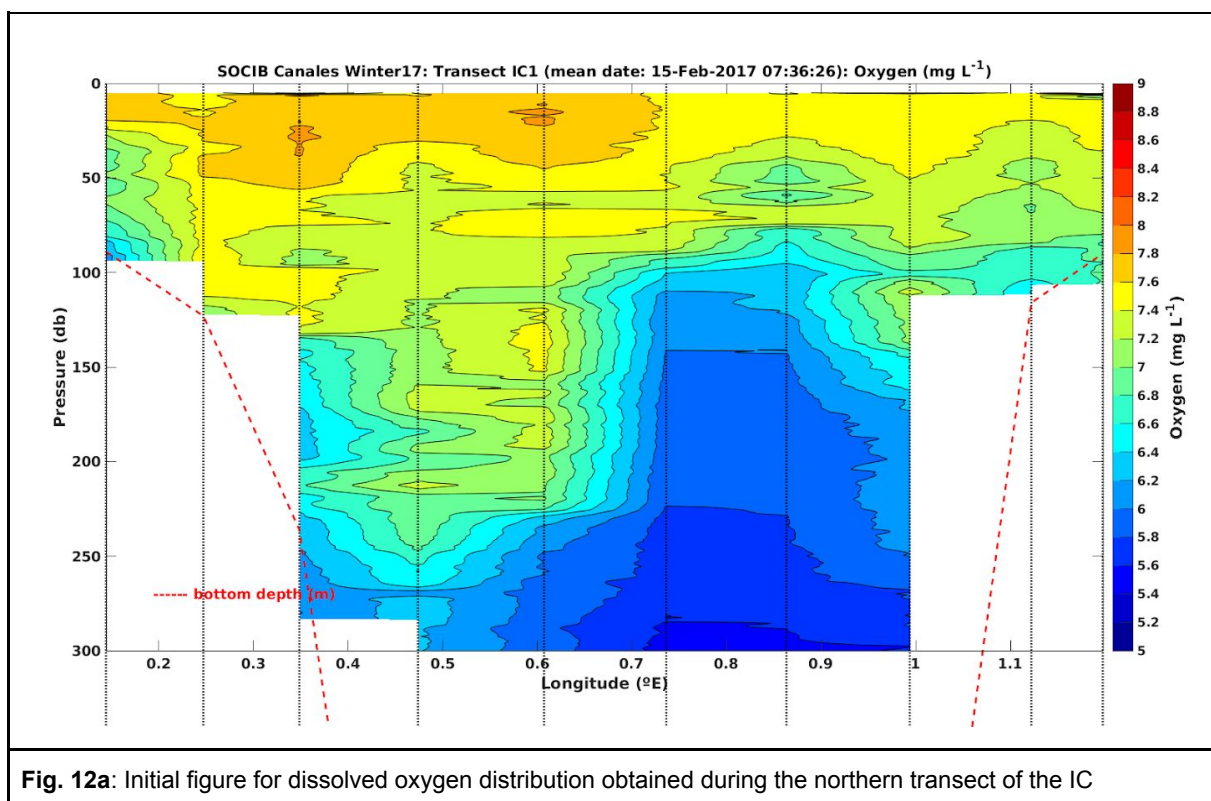
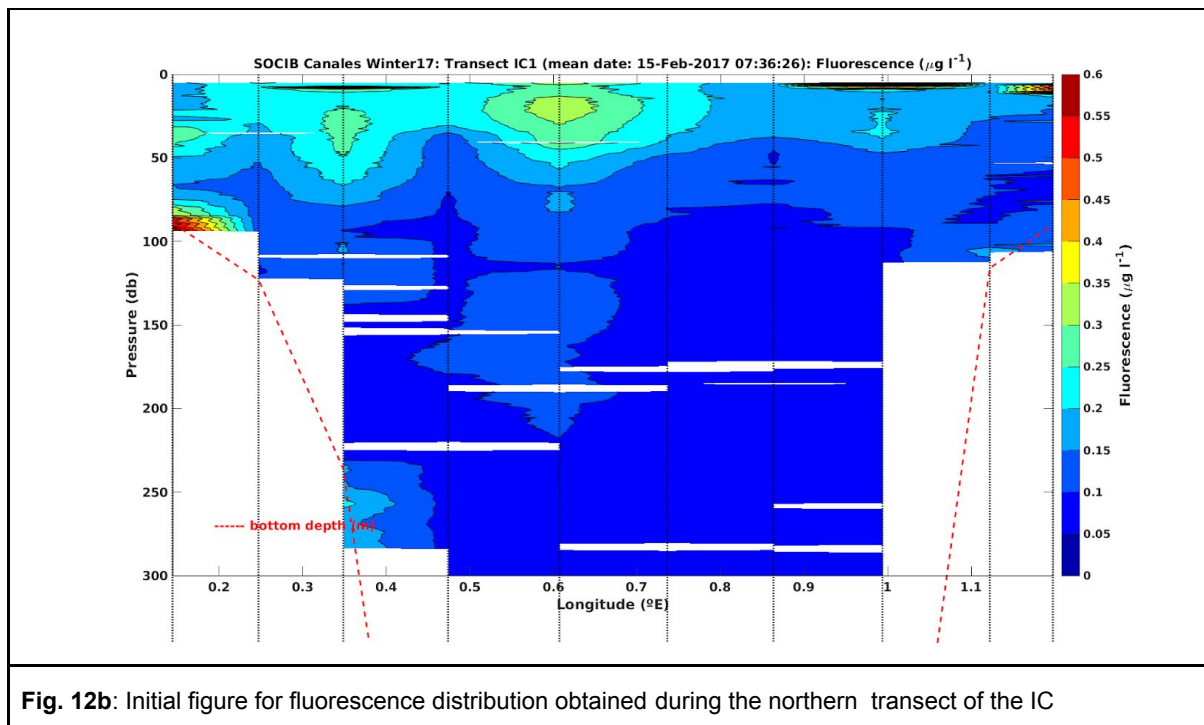


Fig. 12a: Initial figure for dissolved oxygen distribution obtained during the northern transect of the IC



3. Ibiza Channel: South

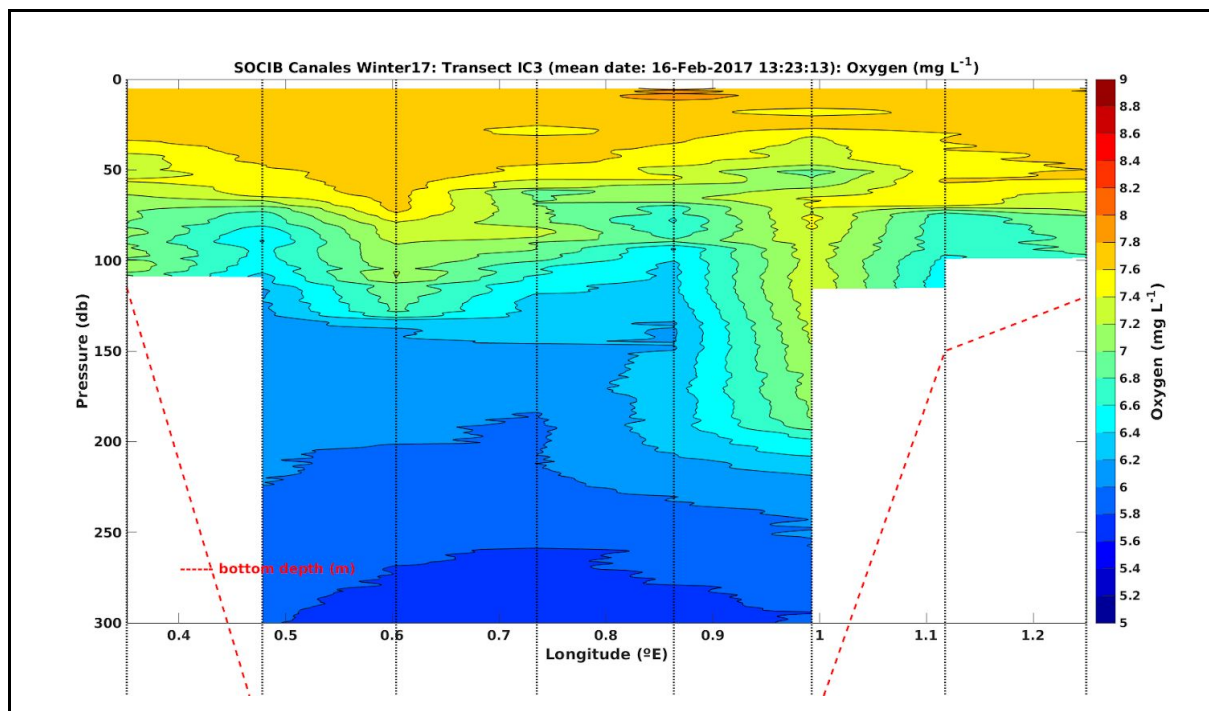


Fig. 13a: Initial figure for dissolved oxygen concentration distribution obtained on the southernmost IC cross-section.

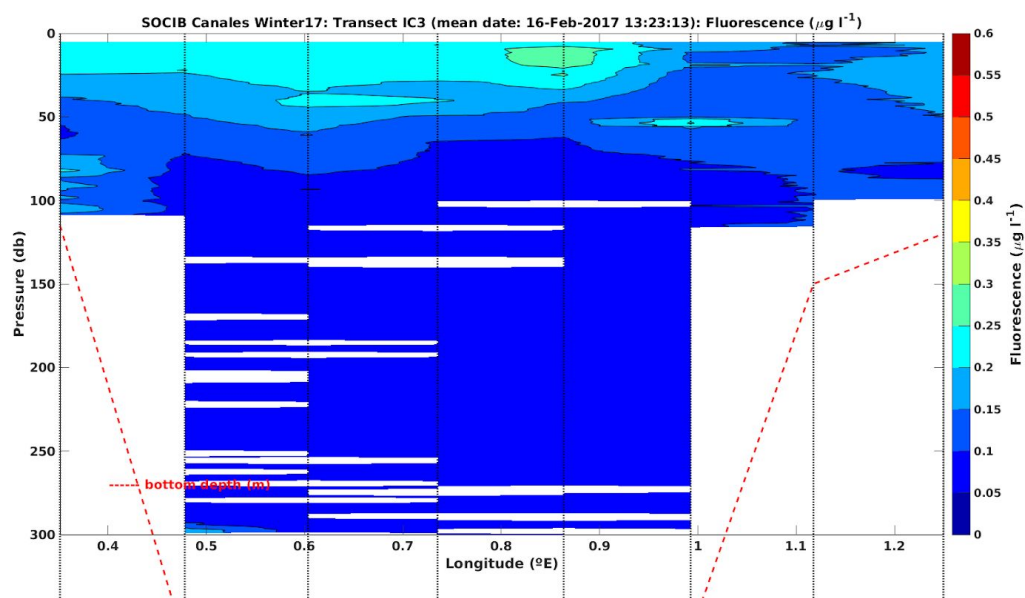


Fig. 13b: Initial figure for fluorescence distribution obtained on the the southernmost IC cross-section.

Problems encountered

No additional problems to be highlighted.

Seadatanet Cruise Summary Report Link

The SDN-ICES Cruise Summary Report that references to this cruise is available through the following link:

http://seadata.bsh.de/Cgi-csr/retrieve_sdn2/csrreport.pl?project=SDN&session=44522&v1=10&v2=11&pcode=

Processed Data Repository

Data Source	Thredds URL
Position	http://thredds.socib.es/thredds/catalog/research_vessel/gps/socib_rv-scb_pos001/L1/2017/02/catalog.html?dataset=research_vessel/gps/socib_rv-scb_pos001/L1/2017/02/dep0039_socib-rv_scb-pos001_L1_2017-02-14.nc
Thermosal	http://thredds.socib.es/thredds/catalog/research_vessel/thermosalinometer/socib_rv-scb_tsl001/L1/2017/02/catalog.html?dataset=research_vessel/thermosalinometer/socib_rv-scb_tsl001/L1/2017/02/dep0037_socib-rv_scb-tsl001_L1_2017-02-14.nc
Weather Station	http://thredds.socib.es/thredds/catalog/research_vessel/weather_station/socib_rv-scb_met009/L1/2017/02/catalog.html?dataset=research_vessel/weather_station/socib_rv-scb_met009/L1/2017/02/dep0040_socib-rv_scb-met009_L1_2017-02-14.nc
CTD	http://thredds.socib.es/thredds/catalog/research_vessel/ctd/socib_rv-scb_sbe9002/L1/2017/catalog.html?dataset=research_vessel/ctd/socib_rv-scb_sbe9002/L1/2017/dep0027_socib-rv_scb-sbe9002_L1_2017-02-14.nc
VM-ADCP	http://thredds.socib.es/thredds/catalog/research_vessel/current_profiler/socib_rv-scb_rdi001/L1/2017/catalog.html?dataset=research_vessel/current_profiler/socib_rv-scb_rdi001/L1/2017/dep0014_socib-rv_scb-rdi001_L1_2017-02-14.nc

References

Joyce T.M. (1989). On in situ “calibration” of shipboard ADCPs. *Journal of Atmospheric and Oceanic Technology* 6:169–172.

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.

Pidcock R., Srokosz M., Allen J., Harman M., Painter S., Mowlem M., Hydes D., Martin A. (2010). Integration of an ultra-violet spectrophotometer on-board a towed vehicle for 3-D mapping of submesoscale nitrate variability. *Journal of Ocean and Atmospheric Technology* 27:1410–1416.

Pollard R., Read J. (1989). A method for calibrating shipmounted acoustic Doppler profilers and the limitations of gyro compasses. *Journal of Atmospheric and Oceanic Technology* 6:859–865.

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

APPENDIX 1: Activities through Canales Winter 2017 Cruise

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 Winter 2017

S2_01.XMLCON

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<SBE_InstrumentConfiguration SB_ConfigCTD_FileVersion="7.23.0.2" >
  <Instrument Type="8" >
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<VoltageWordsSuppressed>0</VoltageWordsSuppressed>
<ComputerInterface>0</ComputerInterface>
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<!-- 1 == SBE11plus Firmware Version < 5.0 -->
<!-- 2 == SBE 17plus SEARAM -->
<!-- 3 == None -->
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<NmeaDepthDataAdded>0</NmeaDepthDataAdded>
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<D>0.00000000e+000</D>
<F0_Old>0.000</F0_Old>
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<Coefficients equation="1" >
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<C3>1.292780e-002</C3>
<D1>3.845500e-002</D1>
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<Tcor>0.0000</Tcor>
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