agriculture,
forestry & fisheries

Department:
Agriculture, Forestry and Fisheries
REPUBLIC OF SOUTH AFRICA

CRUISE REPORT

Voyage 181

R.S. ELLEN KHUZWAYO

PROJECT NAME: Cold Ridge Mooring Deployment - SOLSTICE

PERIOD:
Departure 16th October 2018
Return 18th October 2018

PERSONNEL:

Chief scientist: Margaux Noyon
Mooring and drifter deployment: Lisa Martinengo, Bradley Blows, Patrick Vianello
CTD operation: Patrick Foley, Margaux Noyon
Phytoplankton team: Sixolile Mazwane, Nwabisa Malongweni
Zooplankton team: Nokubonga Mbandzi, Margaux Noyon
SOLSTICE PI: Mike Roberts

AREA OF OPERATION: Offshore Mossel Bay, central Agulhas Bank

RATIONALE

This Cold Ridge Mooring Deployment Cruise is part of a multi-disciplinary project SOLSTICE-WIO (Sustainable Oceans, Livelihoods and food Security Through Increased Capacity in Ecosystem research in the Western Indian Ocean), funded by the Global Challenges Research Fund (GCRF). The South African case study (others in Kenya and Tanzania) focuses on the reasons for the collapse of the squid fishery in 2013 that resulted in dire circumstances for the fishery and fishers. DAFF is a major partner of SOLSTICE, and the main beneficiary of the project results which will be assimilated

into future management plans through the Squid Working Group forum. Similarly, SASMIA is a partner and beneficiary.

The South African case study has three hypotheses for the collapse of the squid fishery:

1. Abnormally high benthic turbidity events on the squid spawning grounds between Plettenberg Bay and Port Alfred thwarted successful spawning in the summer of 2011-12
2. Abnormally low production on the Central and Eastern Agulhas Bank, linked to the absence of Cold Ridge in the summer of 2011-12, lead to starvation and high mortality of squid paralarvae.
3. Abnormal Agulhas Current boundary activity such as Natal pulses and meanders, caused offshore advection of the squid paralarvae, and removal from the ecosystem.

The moorings deployed during this cruise will be used to study the mechanism and dynamics of the Cold Ridge (hypothesis 2). They will be recovered in the 2nd SOLSTICE cruise in March 2019. These data form a major component of a PhD student.

OBJECTIVES

1. The main aim of this cruise was to deploy four sub-surface moorings offshore of Mossel Bay, along a transect crossing the central Agulhas Bank and in principle the Cold Ridge when formed. The instruments will measure currents and temperature throughout the water column. We intend to measure these parameters over a 5-month period with a recovery scheduled for end of March 2019.
2. Deployed satellite-tracked surface drifters (SVP) at the mooring locations.
3. Test all scientific equipment and instrumentation in readiness for the main survey in March 2019.
4. Train NMU students on data and sample collection at sea, as well as lab analysis back at NMU. Ideally, these limited data and samples will be contributions to student's research projects. Students will also be able to assess their responsiveness to being at sea.

Cruise Summary

The RV Ellen Khuzwayo left Cape Town harbour at 18:00, on 15 October 2018, with 8 scientists from the Nelson Mandela University's team and one electronic technician from DAFF onboard. We sailed towards station CR1, offshore Mossel bay, for approximately 28 hours.

A "test" station was done in the afternoon of 16 October 2018 to test the ADCP instrument at 7 knots and 5 knots. The CTD winch was also tested, first with a weight and then with the CTD rosette.

The ship arrived on site around 22:00 on 16 October 2018. We started the ADCP transect overnight (red line, Fig. 1) and completed the transect around 6:00 on 17 October 2018.

The work at each station started at 8:00 on 17 October 2018, with the most offshore station CR4, going towards CR1. At each station, a CTD rosette cast, a 200 µm vertical bongo net, a mooring and a SVP drifter were deployed. The work at each station was successful and completed on 17 October 2018.

The R.V. Ellen Khuzwayo sailed back towards Cape Town around 17:00 on 17 October 2018 and reached Cape Town at 16:00 on 18 October 2018.

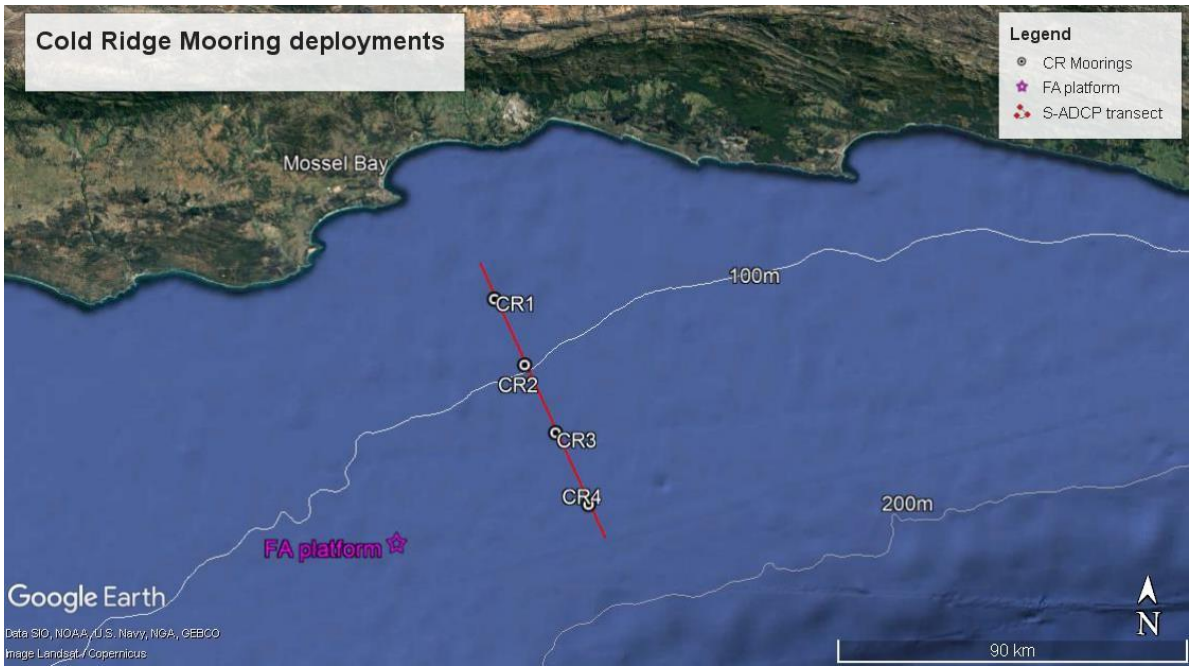


Fig. 1: Map of the ADCP transect (red line) and the position of the 4 moorings (CR1 to CR4)

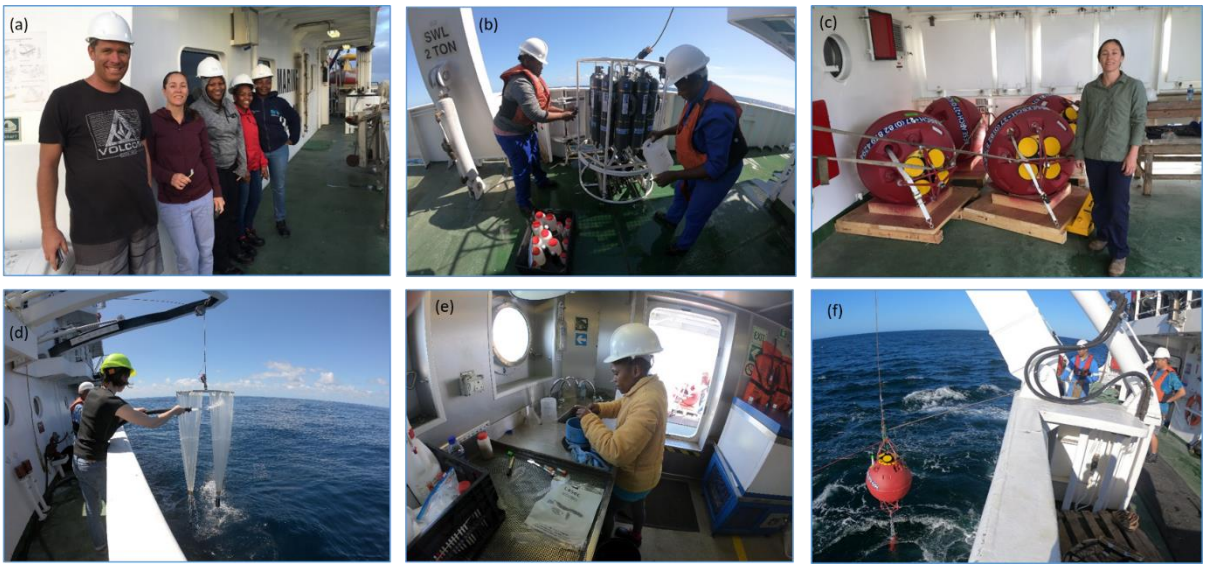


Fig. 2: NMU students and activities

RESULTS AND ASSESSMENT

1. ADCP transect

The ship ADCP RD Instruments Ocean Surveyor II collected current data along a 40 nm transect, starting 5nm inshore of CR1 and ending 5nm offshore of CR4. The survey was conducted during the night of the 16 October, prior to the mooring deployments at a speed of 6 knots, to insure good quality data.

The S-ADCP data collected during this survey will be sent to Teledyne RDI for quality assessment before it can be used. It is still uncertain if the S-ADCP is functional and if the data quality is good enough for scientific purposes. Please refer to Patrick Foley's technical report on the S-ADCP for further details on the instrument (*i.e.* one of the 4 beams was not working,…).

ACTION: Patrick Foley to correspond with Teledyne RDI to determine correct functioning of S-ADCP Ocean Surveyor and data quality.

2. CTD profiles

The CTD 911+ seabird rosette was equipped with 12 Niskin bottles of 8L each of which one was not operational (tap missing). The sensors on the CTD were the following: temperature, conductivity, pressure, dissolved oxygen (SBE), 2 transmissometers (WET Labs C-Star), turbidity (WET Labs ECO), fluorometer (WET Labs ECO-AFL/FL) and a PAR. The CTD deck unit has a channel for a surface PAR sensor that is usually fitted on the ship. The surface sensor however was missing which meant we could not determine *in situ* light penetration at the surface.

ACTION: Service CTD-rosette *i.e.* fix tap, check bungees, check and clean pump (the pump did not have a syringe and water), install missing surface PAR sensor

The sensors on the CTD were last calibrated in 2014 (March to July). This gives us some doubt in the quality of the data and will require additional calibration and caution with the data analyses.

During one deployment, the CTD winch stopped working and could not pull the frame back onboard. The problem was fixed by the Chief Engineer but requires testing to 1000 m.

ACTION: Patrick Foley to arrange for the 1000 m test as soon as possible to be able to fix it before the March 2019 Cruise.

Below are the coordinates of the 4 CTDs (Table 1) as well as some preliminary results on 7 of the parameters acquired using the CTD (Fig. 3). See appendix 1 for the detailed CTD profiles for all the parameters and stations.

Table 1: stations sampled during the Cold Ridge deployment cruise

Station	Grid	Latitude (DD° MM.MMM)	Longitude (DD° MM.MMM)	Bottom depth (m)	Time deployment (UTC)
03968	CR4	34° 52.162' S	22° 42.230' E	128	06:20
03969	CR3	34° 42.360' S	22° 36.487' E	111	10:19
03970	CR2	34° 33.380' S	22° 31.012' E	97	12:18
03971	CR1	34° 24.449' S	22° 25.717' E	84	13:59

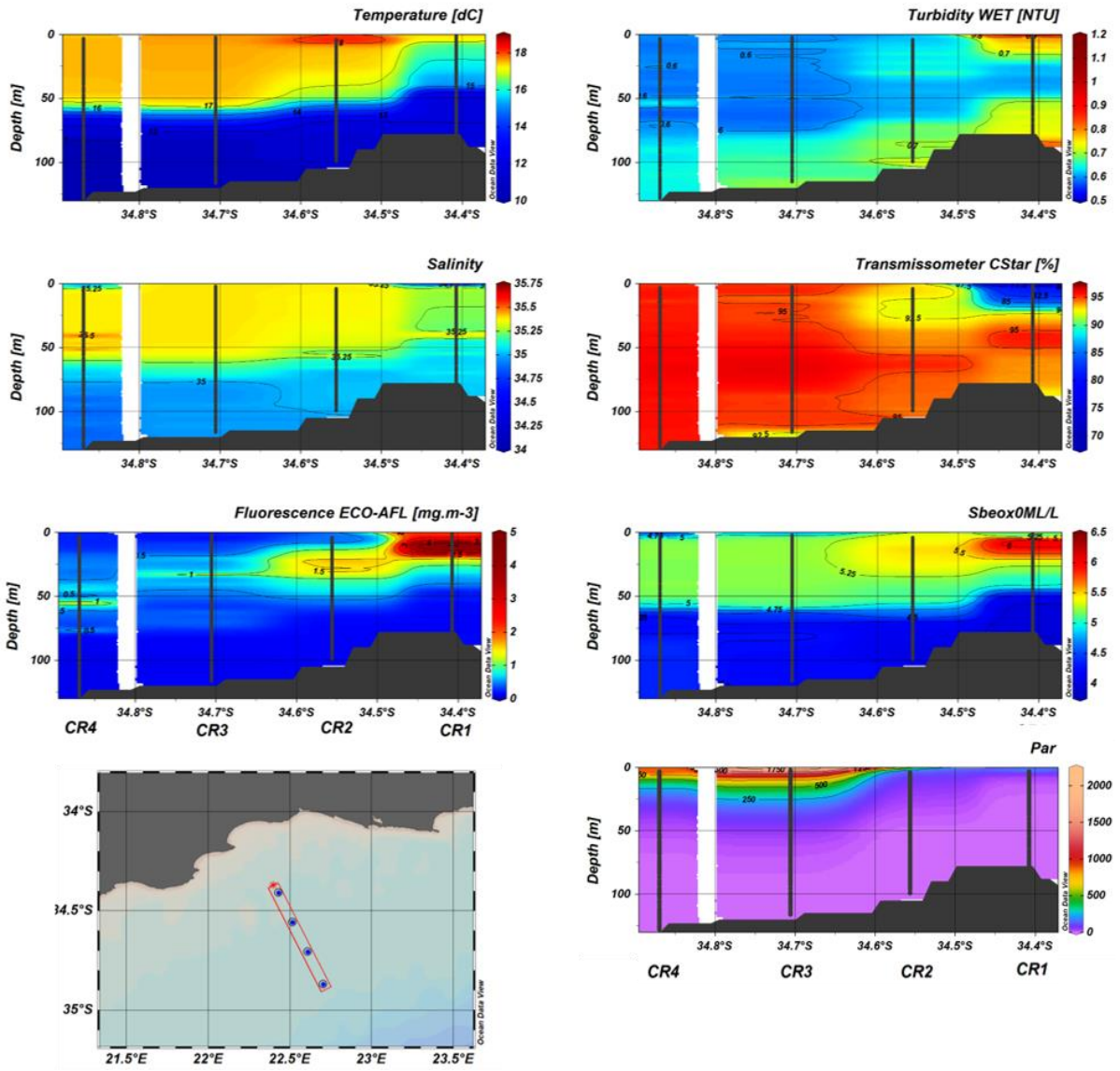


Fig. 3: Profiles of temperature (°C), salinity (PSU), Fluorescence (mg Chl *a* m^{-3}), turbidity (NTU), transmissometer (%), dissolved oxygen (mL L^{-1}) and PAR

3. Phytoplankton

Seawater samples were collected to determine nutrients, chlorophyll *a* (Chl *a*), biogenic silica and phytoplankton composition.

- Nutrients were collected at 6 or 7 depths evenly distributed in the water column. Samples were stored in 15 mL falcon tubes and preserved at -80°C for later analyses.
- 200 mL of seawater was filtered through a 0.7 µm GF/F filters (25 mm diameter) for Chl *a* concentration measurements. Filters were placed into 2 mL cryotubes and stored at -80 °C. In the laboratory, Chl *a* was extracted using 6 mL 90% acetone for 24 h in the dark and cold (4 °C) environment. A Turner A10 fluorometer was then used to measure the fluorescence from the Chl *a* and phaeopigments extracted, using standards methods (Strickland and Parsons, 1972).
- Biogenic silica (a proxy for diatoms) was sampled by filtering 500 mL of seawater at 4 to 5 depths onto 25 mm diameter 0.8 µm polycarbonate filters and rinsed with Milli-Q water to

remove extra salts. Filters were then transferred in falcon tubes and stored at -80°C until further analysis.

- Phytoplankton composition will be investigated using two different technics i.e. Scanning Electron Microscopy and normal Microscopy. For the former, 1 L of seawater was filtered onto 25 mm diameter 0.8 µm polycarbonate filters, rinsed with Milli-Q water to remove extra salts and air dried in a petri-dish until further analysis. 200 mL of seawater was also collected into glass amber bottles, preserved with acidic Lugol's solution (2% final concentration) and kept in a cold environment (4°C approximately). These samples will be settled in settling chambers and counted using an inverted microscope.

The numbering on the first CTD cast did not match the closing sequence. The bottles were swapped afterwards and put back in the correct sequence. At station CR1, the surface bottle closed but did not collect seawater for some unknown reason.

The CTD rosette had to be lashed onto the ship railing which made access to some of the bottles very difficult.

ACTION: It would be necessary for future to have a system to secure the CTD away from the side of the ship to ease access to all the bottles

The Chl *a* extracted and measured from discrete samples against the Chl *a* measured with the fluorometer from the CTD is presented in figure 4. The correlation is not high with only $R^2 = 0.011$, but it increases up to $R^2 = 0.57$ when one sample is removed. This average correlation might be due to the limited number of samples collected but it may also due to the out-dated calibration (i.e. 2014). The range of the CTD fluorescence sensor is very small compared to in situ data.

ACTION: A high number of seawater samples will need to be taken to post-calibrate the fluorescence sensor

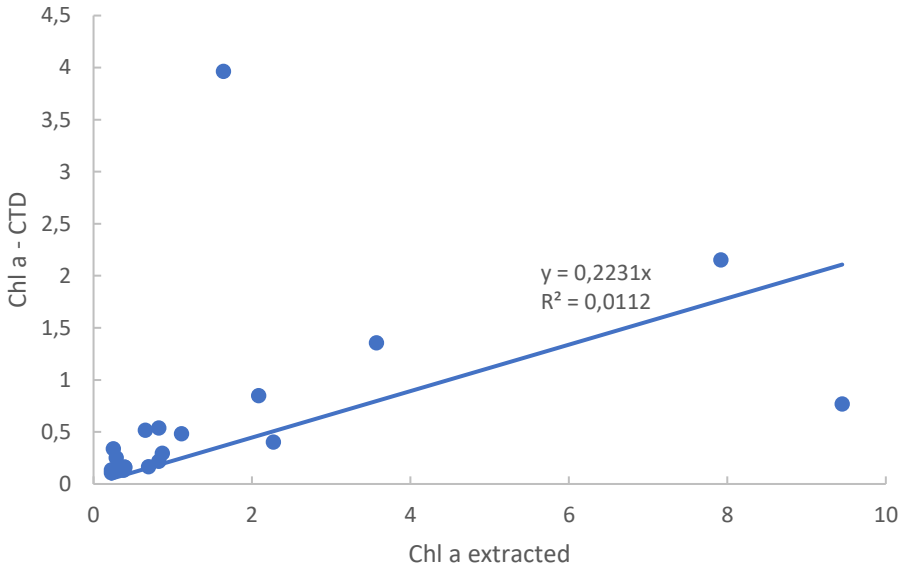


Fig 4: Chlorophyll *a* extracted against Chl *a* from the CTD

4. Zooplankton

At each station, zooplankton samples were collected using a 200 µm mesh size Bongo net, equipped with a flowmeter, towed vertically from just above the bottom to the surface. One net sample (with flowmeter) was preserved with buffered formaldehyde (4% final concentration) to determine zooplankton settled volume and species composition. The second net was used for secondary production. For this, 3 replicates of 1.5 mL cryovial was filled with zooplankton and preserved at -80°C for later analysis.

The plankton winch (aft starboard) display, in the ops room, was not operational at first. We eventually managed to modify the settings to get the correct readings.
ACTION: It would be a good idea to test the display again and make sure we selected the correct settings

The first zooplankton tow (CR4) had to be lowered down as the wire was going underneath the ship, towards the propeller. The volume filtered might have been altered.
ACTION: The net should not be pulled up and down. The net should be hauled in as steadily as possible to ensure a good sample collection. This should have been better explained to the crew.

We observed a relatively high amount of what looked like *Trichodesmium* in the plankton nets. The settled volumes are presented in figure 5. It seems that CR4 has the lowest biovolume but also had the highest volume filtered (almost 2.5 times higher than at the other stations). This is most likely due to the problem that occurred during the net deployment (*i.e*. we had to lower the net back down to avoid damaging it in the propeller). This sample should most likely not be taken into consideration and it should be noted that in future, the net tow should be repeated.

Table 2 provides a summary of all the seawater and zooplankton samples collected for all the stations.

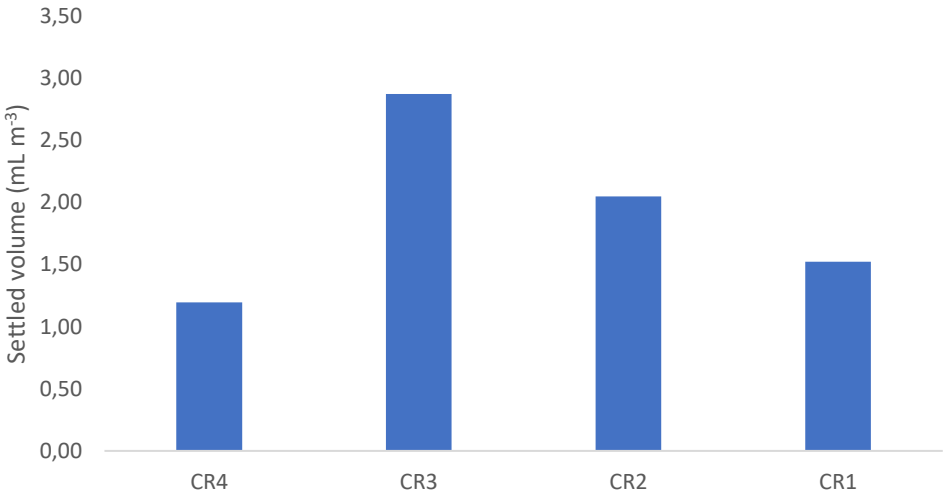


Fig. 5: Zooplankton settled volume (mL m^{-3}) for all four stations

5. Echo-sounder

The EK60 was recording data all along the cruise at 38 and 120 kHz frequencies. The data will be looked at a later stage.
ACTION: Johan Rademan to review data and provide feedback on quality

Table 2: Table summary of the phytoplankton and zooplankton samples collected

Cruise	Station #	Grid #	Date	Lat [°S]	Lon [°E]	Depth (m)	Nutrient	Chl a	Biogenic Silica	Phyto - Lugols	Phyto - SEM	200µm bongo net	AARS	Comments
EllenK181	03971	CR1	17/10/2018	34.4075	22.4286	0.0	x	x	x	x	x			Bucket water - bottle was empty
EllenK181	03971	CR1	17/10/2018	34.4075	22.4286	8.4	x	x	x	x	x			
EllenK181	03971	CR1	17/10/2018	34.4075	22.4286	28.7	x	x	x	x	x	x	x	
EllenK181	03971	CR1	17/10/2018	34.4075	22.4286	44.9	x							
EllenK181	03971	CR1	17/10/2018	34.4075	22.4286	60.3	x							
EllenK181	03971	CR1	17/10/2018	34.4075	22.4286	83.4	x	x	x	x	x			
EllenK181	03970	CR2	17/10/2018	34.5563	22.5169	1.5	x	x	x	x	x			
EllenK181	03970	CR2	17/10/2018	34.5563	22.5169	27.6	x	x	x	x	x			
EllenK181	03970	CR2	17/10/2018	34.5563	22.5169	38.6	x	x	x	x	x	x	x	
EllenK181	03970	CR2	17/10/2018	34.5563	22.5169	59.3	x	x	x	x	x			
EllenK181	03970	CR2	17/10/2018	34.5563	22.5169	79.6	x							
EllenK181	03970	CR2	17/10/2018	34.5563	22.5169	97.7	x	x	x	x	x			
EllenK181	03969	CR3	17/10/2018	34.7060	22.6081	4.0	x	x	x	x	x			
EllenK181	03969	CR3	17/10/2018	34.7060	22.6081	31.6	x	x	x	x	x			
EllenK181	03969	CR3	17/10/2018	34.7060	22.6081	56.2	x	x	x	x	x	x	x	
EllenK181	03969	CR3	17/10/2018	34.7060	22.6081	80.8	x	x	x	x	x			
EllenK181	03969	CR3	17/10/2018	34.7060	22.6081	91.5	x	x	x	x	x			
EllenK181	03969	CR3	17/10/2018	34.7060	22.6081	116.2	x							
EllenK181	03968	CR4	17/10/2018	34.8693	22.7038	4.3	x	x	x	x	x			
EllenK181	03968	CR4	17/10/2018	34.8693	22.7038	23.6	x	x	x	x	x			
EllenK181	03968	CR4	17/10/2018	34.8693	22.7038	55.2	x	x	x	x	x			
EllenK181	03968	CR4	17/10/2018	34.8693	22.7038	74.9	x	x	x	x	x	x	x	
EllenK181	03968	CR4	17/10/2018	34.8693	22.7038	90.0	x	x	x	x	x			
EllenK181	03968	CR4	17/10/2018	34.8693	22.7038	110.8	x							
EllenK181	03968	CR4	17/10/2018	34.8693	22.7038	124.7	x							

6. Mooring deployment

Figure 6 shows the mooring diagrams with instrumentation for each location. The instruments are measuring current speed, current direction and temperature at regular intervals throughout the water column for a period of approximately five months. Each mooring is weighted with an 400kg anchor that will be released from the mooring upon recovery.

Mooring depths were confirmed with the ship's echo sounder during the overnight ADCP transect. All four moorings were successfully deployed according to the procedures agreed upon by the ship's captain and the mooring team at a safety meeting. Moorings were deployed from the stern using the anchor last method. First, the mooring line and small floats were let out by hand while the ship steamed dead slow towards the predetermined location. Once all the mooring line was in the water and streaming behind the ship, the large bottom float and anchor assembly were lifted over the stern using the A-frame and stern winch. The mooring was released using a quick release mechanism as the ship steamed over the deployment position. GPS coordinates and time were recorded from the stern of the vessel using a hand-held GPS. No triangulations were done, because a deck box was not available.

Table 3 gives the deployment details for each mooring. Note that the depth at CR1 was 5m deeper than anticipated. The depth at the other three locations were as expected.

A navigational warning was submitted to the Hydrographic Office South Africa to warm ships traffic to avoid traveling directly over the mooring locations for the duration of the deployment.

Table 3: Mooring deployment details

Name	Latitude	Longitude	Deployment date and time	Mooring design depth	Depth at location
CR1	34° 24.480' S	22° 25.719' S	17/10/2018 16:38	80m	86m
CR2	34° 33.363' S	22° 30.993' S	17/10/2018 14:53	100m	101m
CR3	34° 42.347' S	22° 36.429' S	17/10/2018 13:06	115m	115m
CR4	34° 52.250' S	22° 42.240' S	17/10/2018 10:06	130m	128m

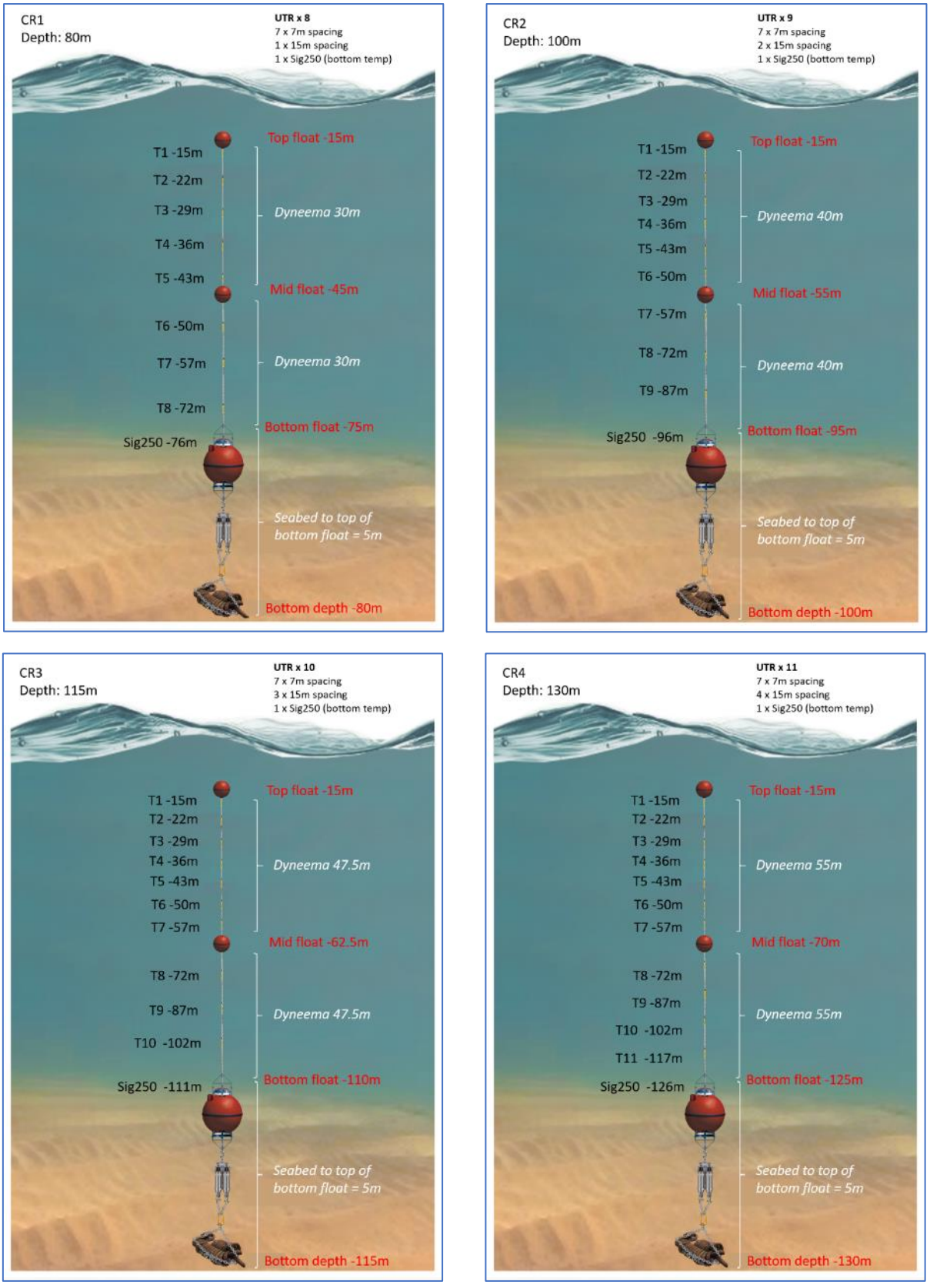


Fig. 6: Mooring diagrams showing depth in instrument layout

7. Drifters deployment

Four satellite tracked drifters were deployed, one at each of the mooring locations. The drifters were supplied by South African Weather Service and forms part of NOAA Surface Velocity Programme. Drifter data can be downloaded at http://osmc.noaa.gov/erddap/tabledap/OSMC_30day.html. Drifter deployment details are given in Table 4 and Figure 7 shows the trajectories up to 30 October 2018.

Table 4: Drifter deployment details

Deployment reference	Drifter WMO ID	Date Time	Latitude	Longitude
CR1	7101501	17/10/2018 16:40	34° 24.535' S	22° 25.738' E
CR2	7101502	17/10/2018 14:55	34° 33.435' S	22° 30.994' E
CR3	1701538	17/10/2018 13:12	34° 42.370' S	22° 36.450' E
CR4	1701541	17/10/2018 10:14	34° 52.140' S	22° 42.180' E

Fig. 7: Map showing the mooring deployment positions, drifter trajectories and the S-ADCP transect conducted during the cruise.

8. TSG

During the whole cruise, sea surface temperature and salinity were recorded with the underway thermosalinograph and logged into the NDS (Fig. 7 and appendix 2).

Relative wind direction and speed were also logged in the NDS system. No true wind direction and speed were calculated and logged on the NDS.

A small difference was observed between the salinity from the TSG and the CTD which suggests that one of the two instruments, or both, might need calibration.
Appendix 2 shows detailed plot of the TSG in order to see the variability of the sensors.

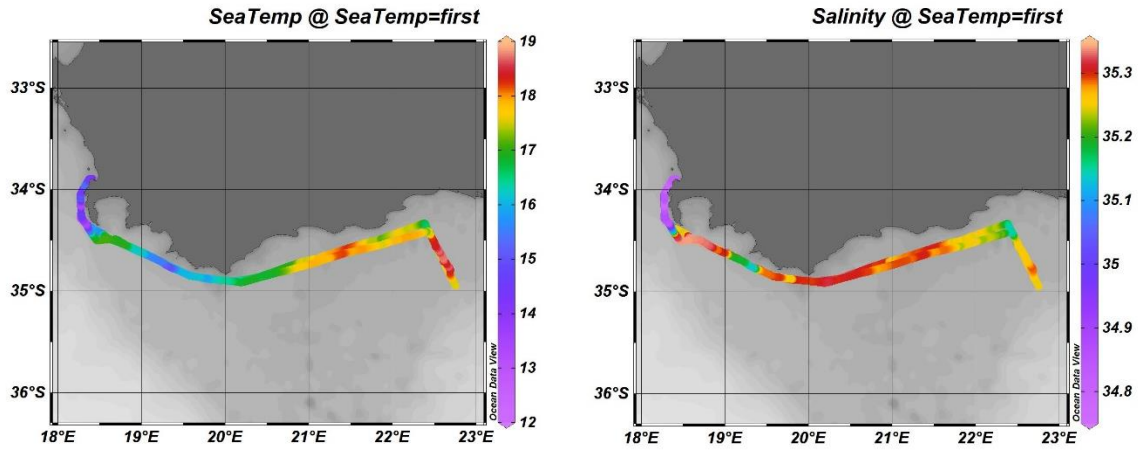


Fig. 7: Sea surface temperature (left) and salinity (right) from the TSG data for the whole cruise

9. Satellite Observations

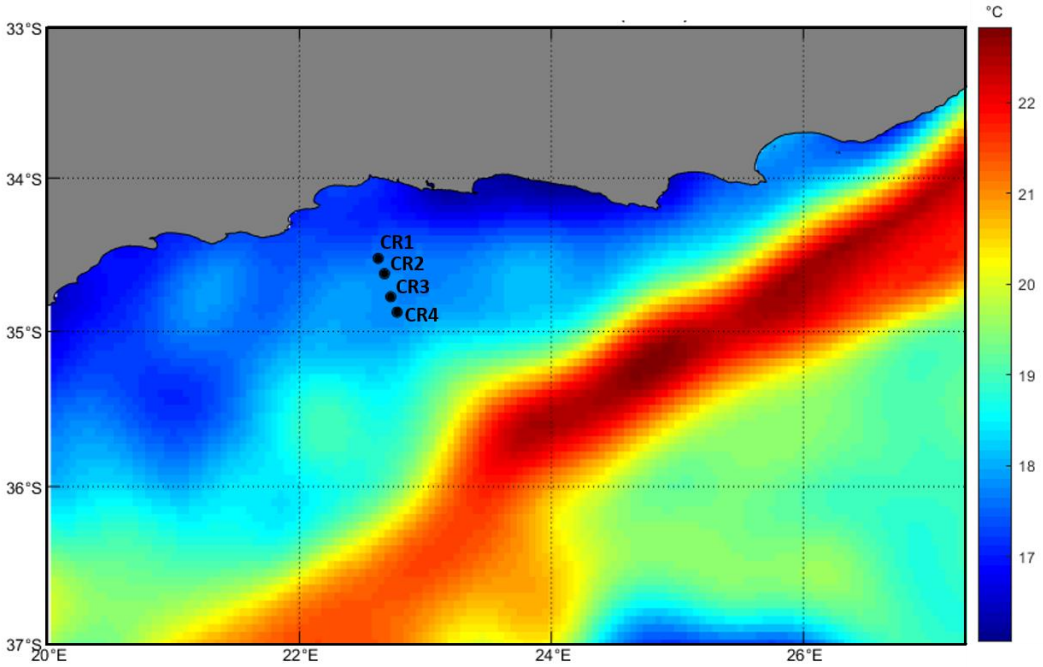


Fig 8: Sea surface temperature for 17/10/2018, from OSTIA, showing the position of the 4 stations sampled. Daily images at 6km spatial resolution.
ftp://podaac.jpl.nasa.gov/allData/ghrsst/data/L4/GLOB/UKMO/OSTIA/2018/

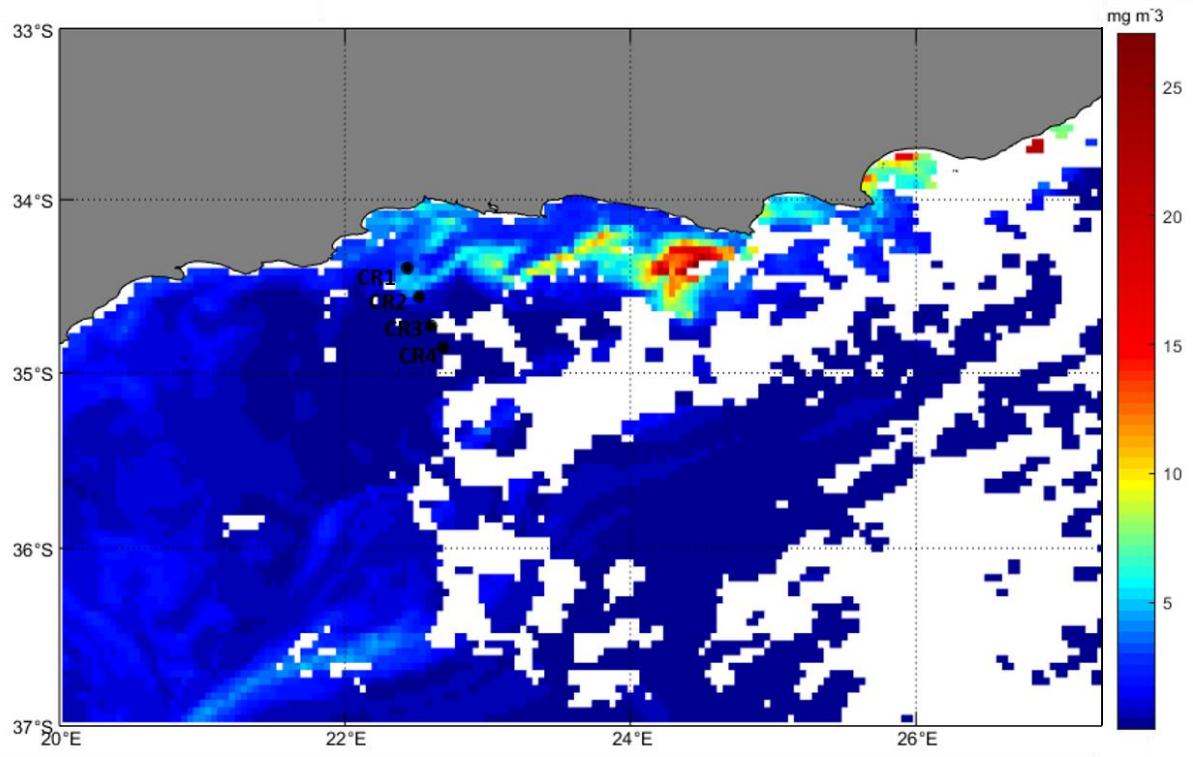


Fig 9: Sea surface Chlorophyll *a* for 17/10/2018, from GlobColor, showing the position of the 4 stations sampled. Daily images at 4km spatial resolution.
https://earth.esa.int/web/sentinel/technical-guides/sentinel-3-olci/level-2/ocean-processing

OVERALL OVERVIEW OF THE ECOSYSTEM

The CTD data showed a shallowing of the thermocline from 50 m deep at CR3 and CR4 to 30 m at the two inshore stations. A deep Chl *a* maximum was observed at the bottom of the upper mixed layer (UML) offshore (CR3/4), not exceeding 1 mg m^{-3}. At the most inshore station (CR1) though, Chl *a* was homogeneously distributed in a shallow UML, reaching high values of about 8 to 9 mg m^{-3}. These high values of Chl *a* were most likely associated with an upwelling of cold nutrient rich waters inshore. We could not observe this upwelling on the SST satellite data as it did not reach the surface, but the response of the phytoplankton could be seen with remote sensing. The high Chl *a* inshore was unsurprisingly associated with an increase in turbidity (*i.e.* decrease of transparency) and an increase in dissolved oxygen. The latter most likely due to the high concentration of photosynthesis cells in the area. Without considering CR4 which might have been improperly sampled, the zooplankton biovolume showed a contrasting pattern with higher concentration offshore and relatively low concentration inshore where phytoplankton was high. This mismatch could be explained by the age of the upwelled waters at the time of sampling. Phytoplankton respond rapidly to nutrient input (within few days), while zooplankton will need 10 to 15 days to respond to an increase of food availability which would explain the absence of zooplankton response if the upwelled waters were relatively new. By looking at the composition and size of the zooplankton, we might be able to answer this question. The relatively high zooplankton abundance offshore may also be the result of advection of zooplankton from further away.

Overall it seems, from the satellite data, that the area sampled was in a region of sea surface temperature of 17-18°C, isolated from the warm Agulhas Current (approx. 22°C).

We can see in the TSG data a very distinct pattern of the different water masses encountered during the cruise with the predominance of:

- Warm and saline water East of the Cape Agulhas
- Cold and less saline water West of Cape Point
- A transition zone between the Cape Agulhas and Cape Point with slightly warmer waters and variable salinity

It is highly possible that the 2 patches of high sea surface temperature (> 18°C) East of the Cape Agulhas were most likely due to daily warming because of high irradiance during these 2 days.

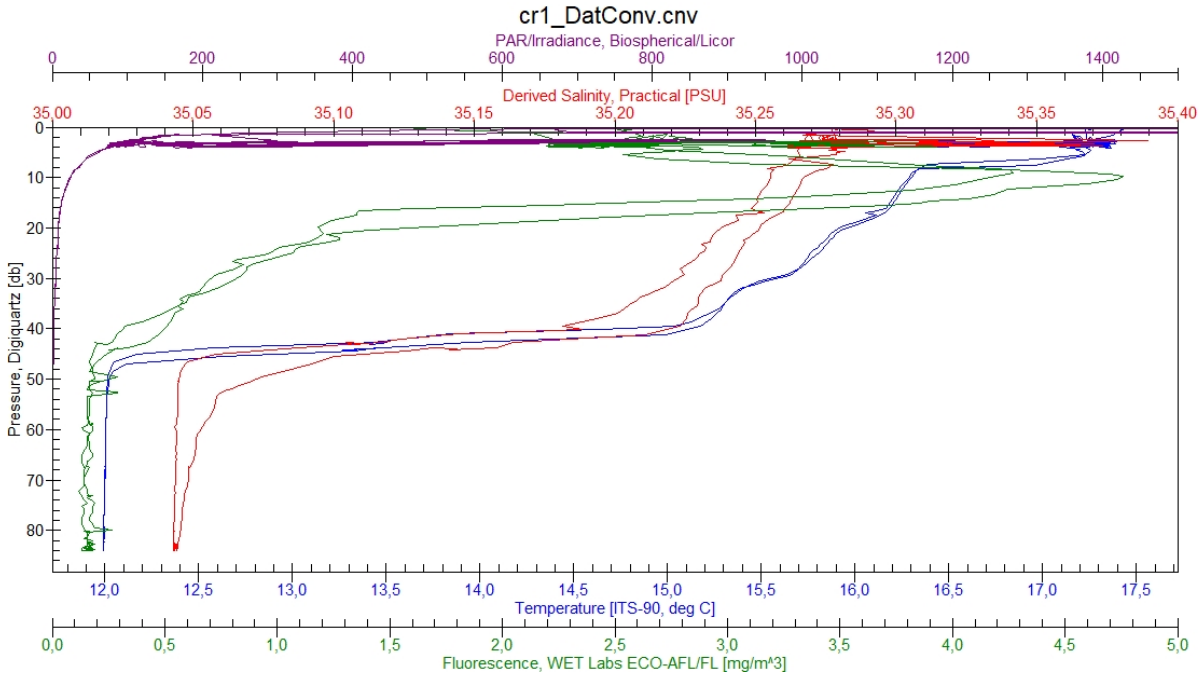
CONCLUSIONS AND RECOMMENDATIONS:

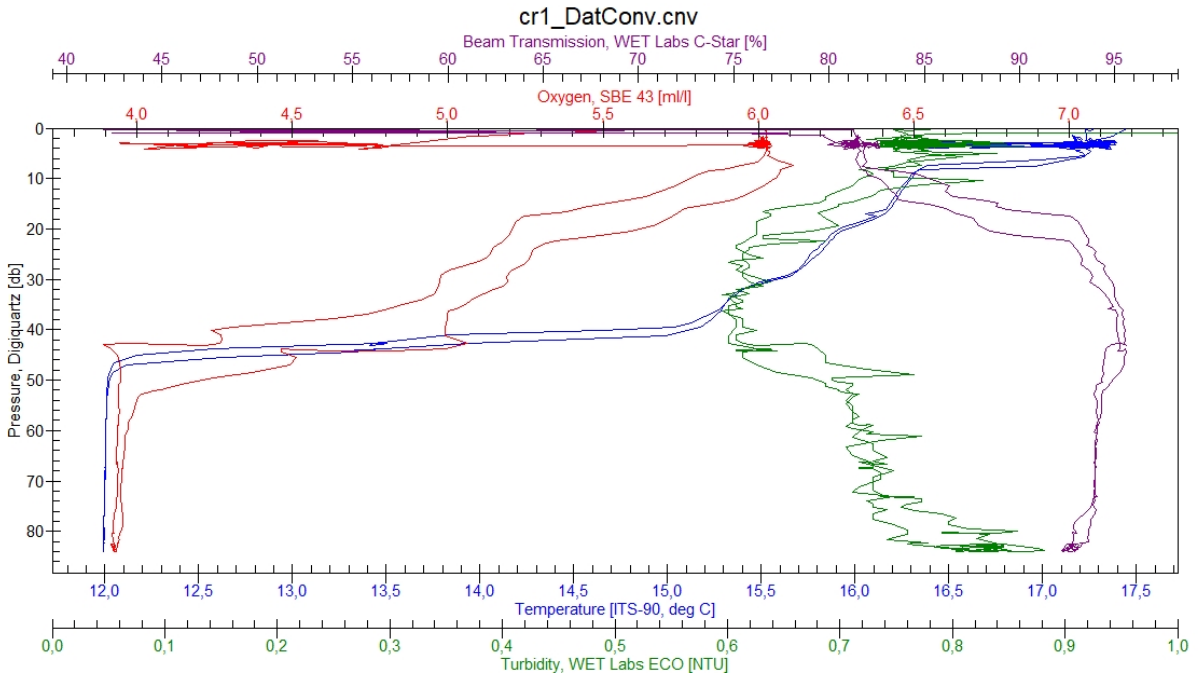
1. With her size, draught and basic equipment, the RV Ellen Khuzwayo is a perfect ship for coastal and shelf oceanography. Scientific berths are a limitation especially when working 24 hours during surveys. Enthusiastic officers and crew are very helpful and capable of assisting in all scientific operations.
2. It is absolutely essential to have a competent electronics technician on the cruise, as is not possible for unfamiliar scientific crews to setup and operate instrumentation alone.
3. Despite not used frequently and lack of factory calibration — the CTD and sensors, and TSG seem to be working well.
4. Surface PAR sensor needs to be installed (See **ACTIONS**).
5. The S-ADCP requires confirmation from Teledyne RD on correct functioning of the transducer (beams) and deck unit (See **ACTIONS**).
6. Simrad EK 60: data quality needs to be confirmed (See **ACTIONS**).
7. A-Frame and scientific winches worked well. However, in preparation for the main survey in March 2019, the CTD winch needs to be tested to 1000 m and the settings of the winches display in the ops room need to be checked (See **ACTIONS**).
8. This report will be followed by a list of detailed notes and queries to prepare for the second SOLSTICE cruise in March 2019.

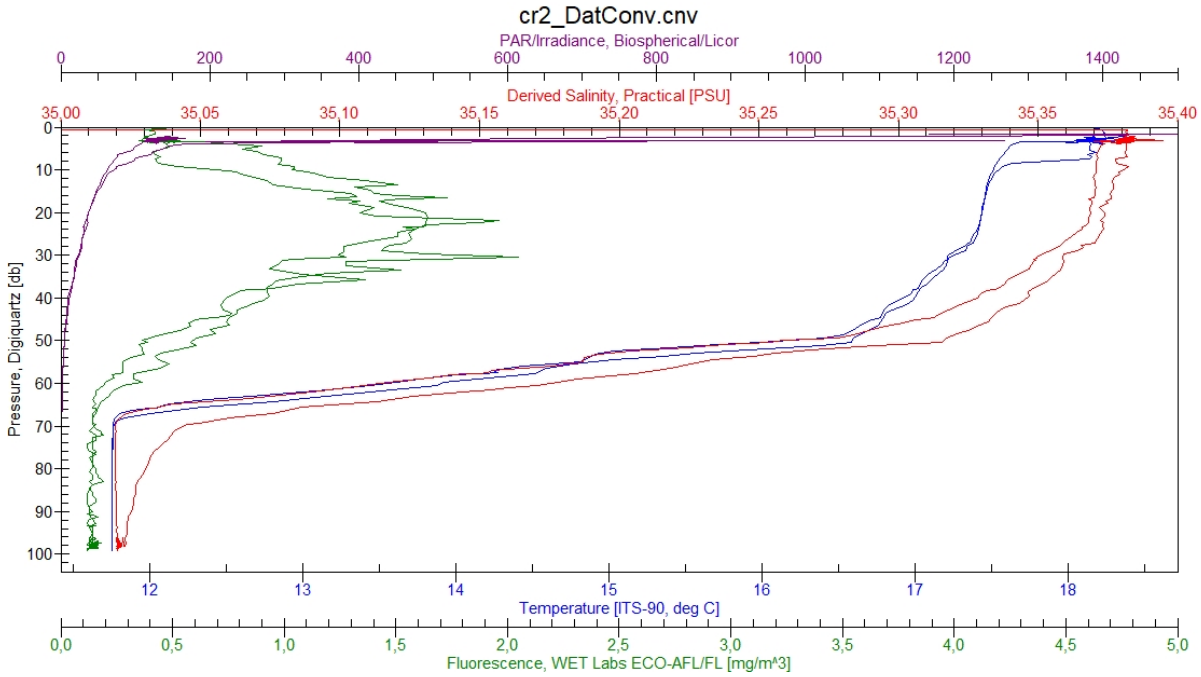
Appendix 1:

Raw data from all the CTD casts without any data processing. Two plots per station are shown to illustrate all the variables measured.

The name of each station (CR1, CR2, CR3, CR4) is at the top of each plot.



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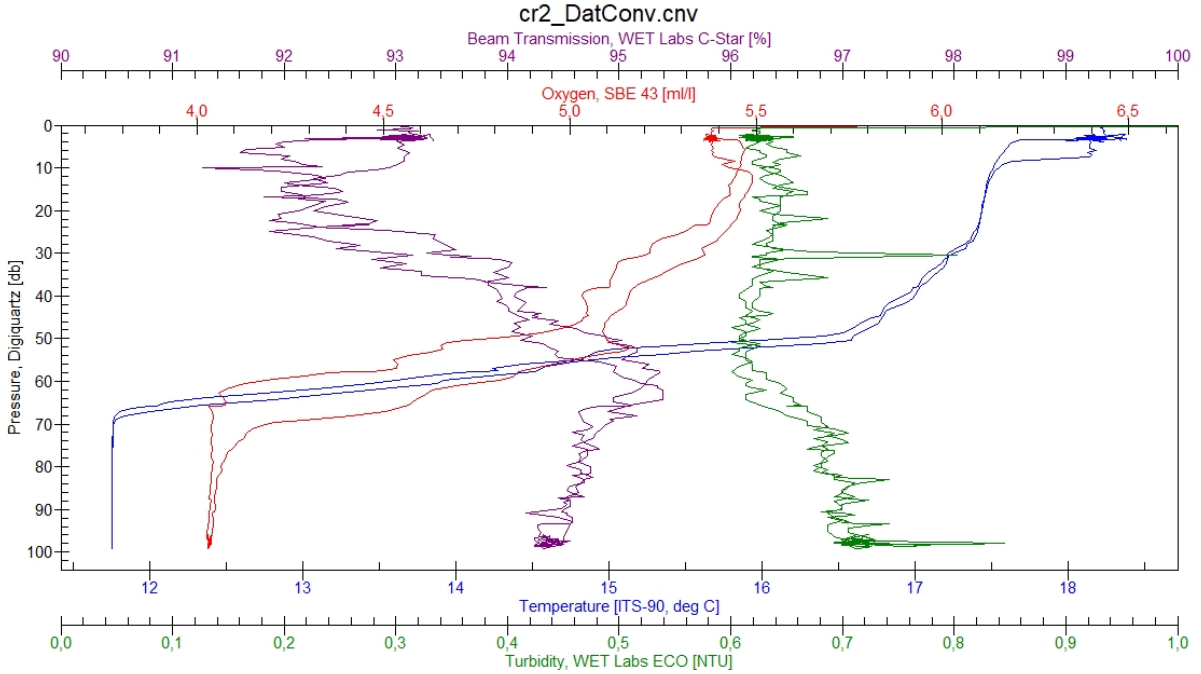
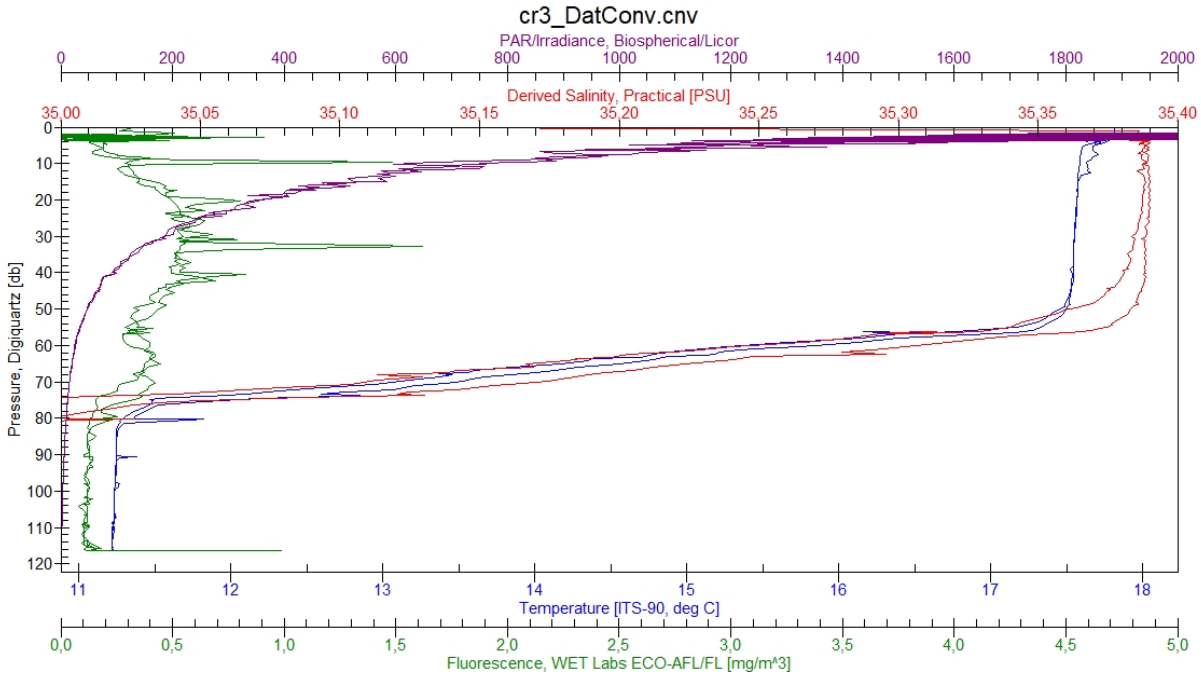
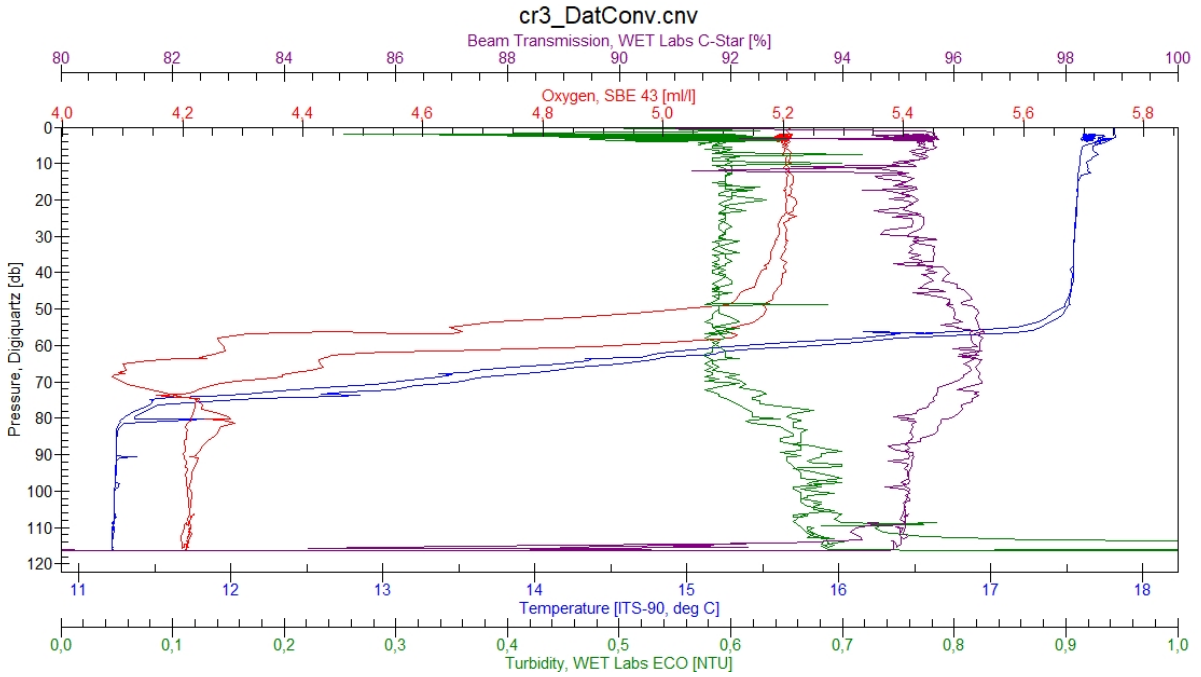
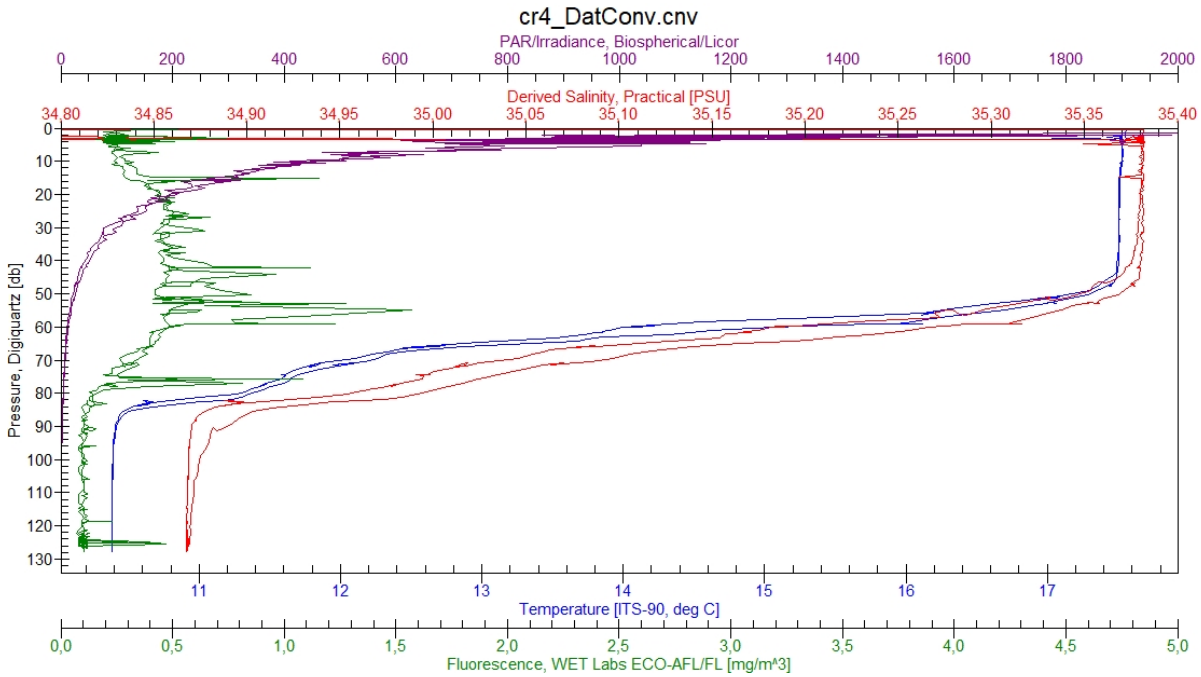
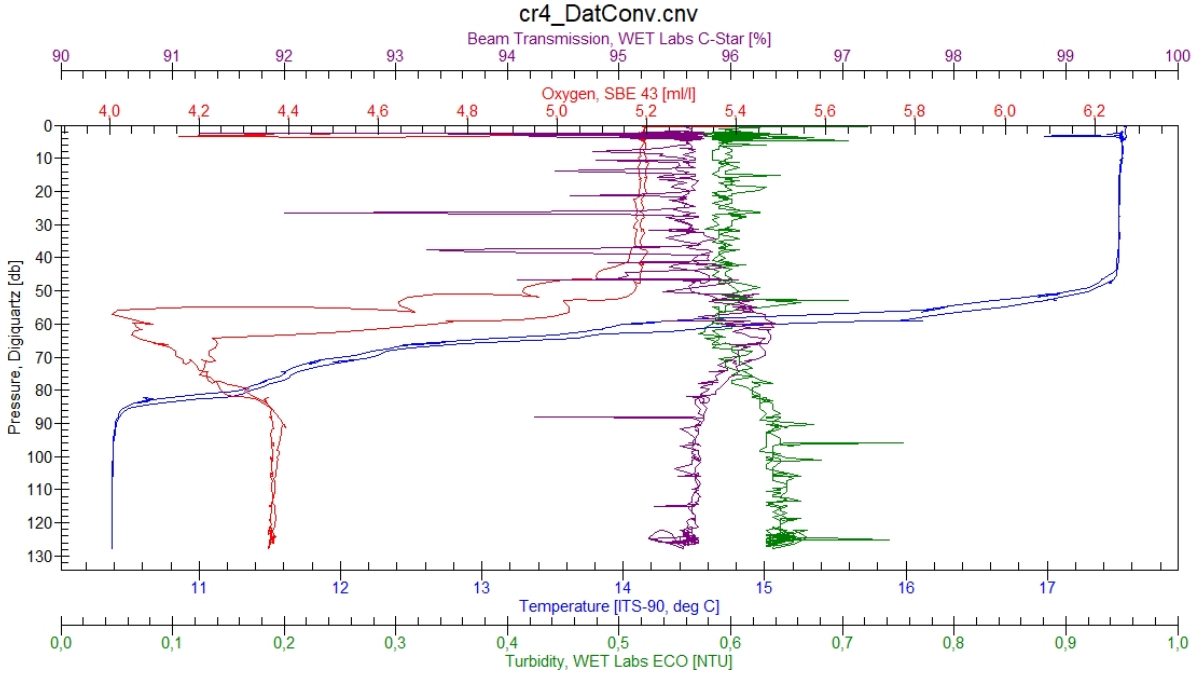
17
18
Temperature [ITS-90, deg C]
0,0
0,5
1,0
1,5
2,0
2,5
3,0
3,5
4,0
4,5
5,0
Fluorescence, WET Labs ECO-AFL/FL [mg/m^3]


cr2_DatConv.cnv
Beam Transmission, WET Labs C-Star [%]
90
91
92
93
94
95
96
97
98
99
100
Oxygen, SBE 43 [ml/l]
4,0
4,5
5,0
5,5
6,0
6,5
Pressure, Digiquartz [db]
0
10
20
30
40
50
60
70
80
90
100
12
13
14
15
16
17
18
Temperature [ITS-90, deg C]
0,0
0,1
0,2
0,3
0,4
0,5
0,6
0,7
0,8
0,9
1,0
Turbidity, WET Labs ECO [NTU]


cr3_DatConv.cnv
PAR/Irradiance, Biospherical/Licor
0 200 400 600 800 1000 1200 1400 1600 1800 2000
Derived Salinity, Practical [PSU]
35,00 35,05 35,10 35,15 35,20 35,25 35,30 35,35 35,40
Pressure, Digiquartz [db]
0 10 20 30 40 50 60 70 80 90 100 110 120
11 12 13 14 15 16 17 18
Temperature [ITS-90, deg C]
0,0 0,5 1,0 1,5 2,0 2,5 3,0 3,5 4,0 4,5 5,0
Fluorescence, WET Labs ECO-AFL/FL [mg/m^3]


cr3_DatConv.cnv
Beam Transmission, WET Labs C-Star [%]
80 82 84 86 88 90 92 94 96 98 100
Oxygen, SBE 43 [ml/l]
4,0 4,2 4,4 4,6 4,8 5,0 5,2 5,4 5,6 5,8
Pressure, Digiquartz [db]
0 10 20 30 40 50 60 70 80 90 100 110 120
11 12 13 14 15 16 17 18
Temperature [ITS-90, deg C]
0,0 0,1 0,2 0,3 0,4 0,5 0,6 0,7 0,8 0,9 1,0
Turbidity, WET Labs ECO [NTU]


cr4_DatConv.cnv
PAR/Irradiance, Biospherical/Licor
0 200 400 600 800 1000 1200 1400 1600 1800 2000
Derived Salinity, Practical [PSU]
34,80 34,85 34,90 34,95 35,00 35,05 35,10 35,15 35,20 35,25 35,30 35,35 35,40
Pressure, Digiquartz [db]
0 10 20 30 40 50 60 70 80 90 100 110 120 130
11 12 13 14 15 16 17
Temperature [ITS-90, deg C]
0,0 0,5 1,0 1,5 2,0 2,5 3,0 3,5 4,0 4,5 5,0
Fluorescence, WET Labs ECO-AFL/FL [mg/m^3]


cr4_DatConv.cnv
Beam Transmission, WET Labs C-Star [%]
90 91 92 93 94 95 96 97 98 99 100
Oxygen, SBE 43 [ml/l]
4,0 4,2 4,4 4,6 4,8 5,0 5,2 5,4 5,6 5,8 6,0 6,2
Pressure, Digiquartz [db]
0 10 20 30 40 50 60 70 80 90 100 110 120 130
11 12 13 14 15 16 17
Temperature [ITS-90, deg C]
0,0 0,1 0,2 0,3 0,4 0,5 0,6 0,7 0,8 0,9 1,0
Turbidity, WET Labs ECO [NTU]

Appendix 2:

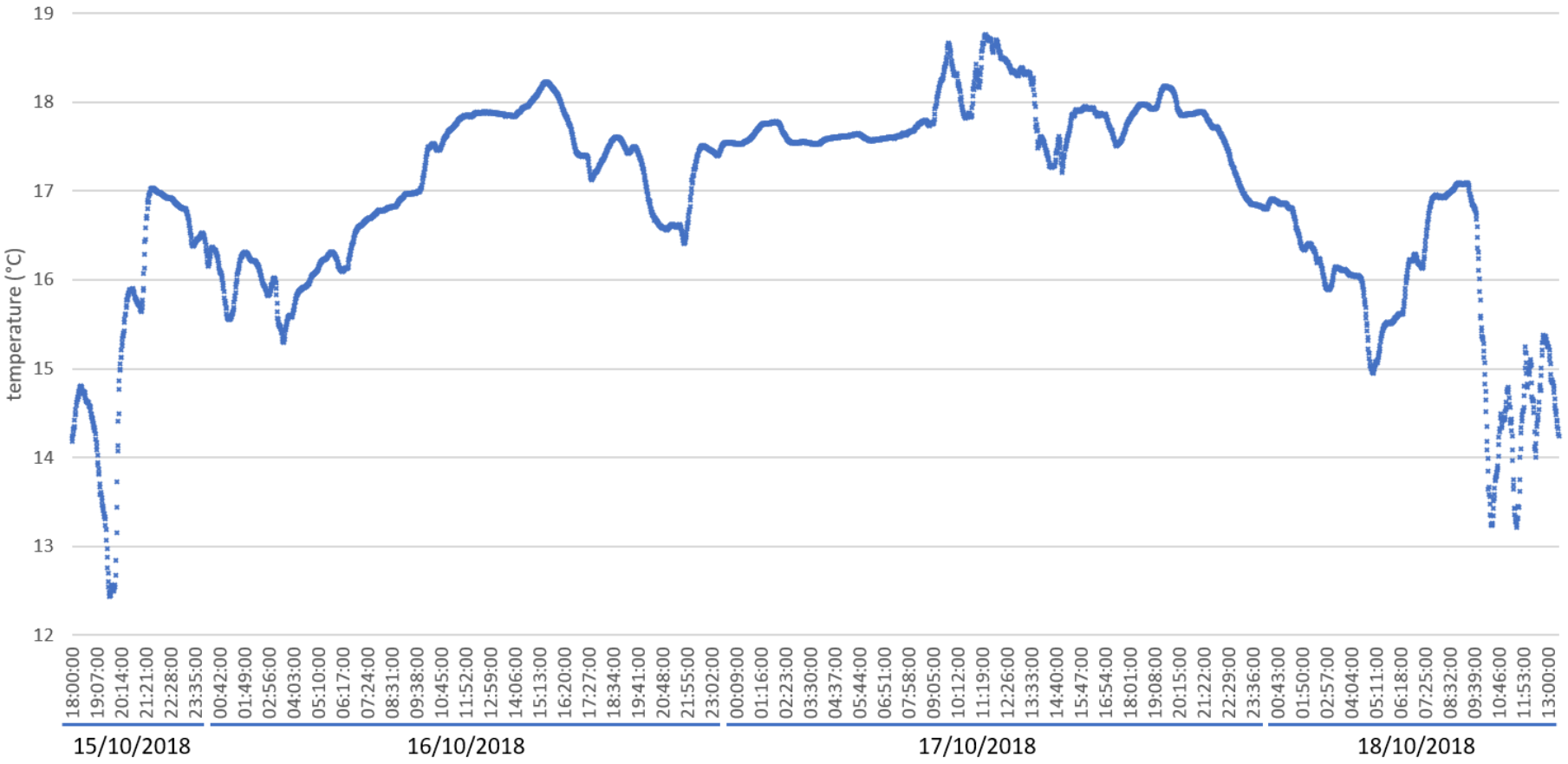


Fig1 (appendix 2): Sea surface temperature measured with the thermosalinograph, per minute, for the whole cruise for quality control

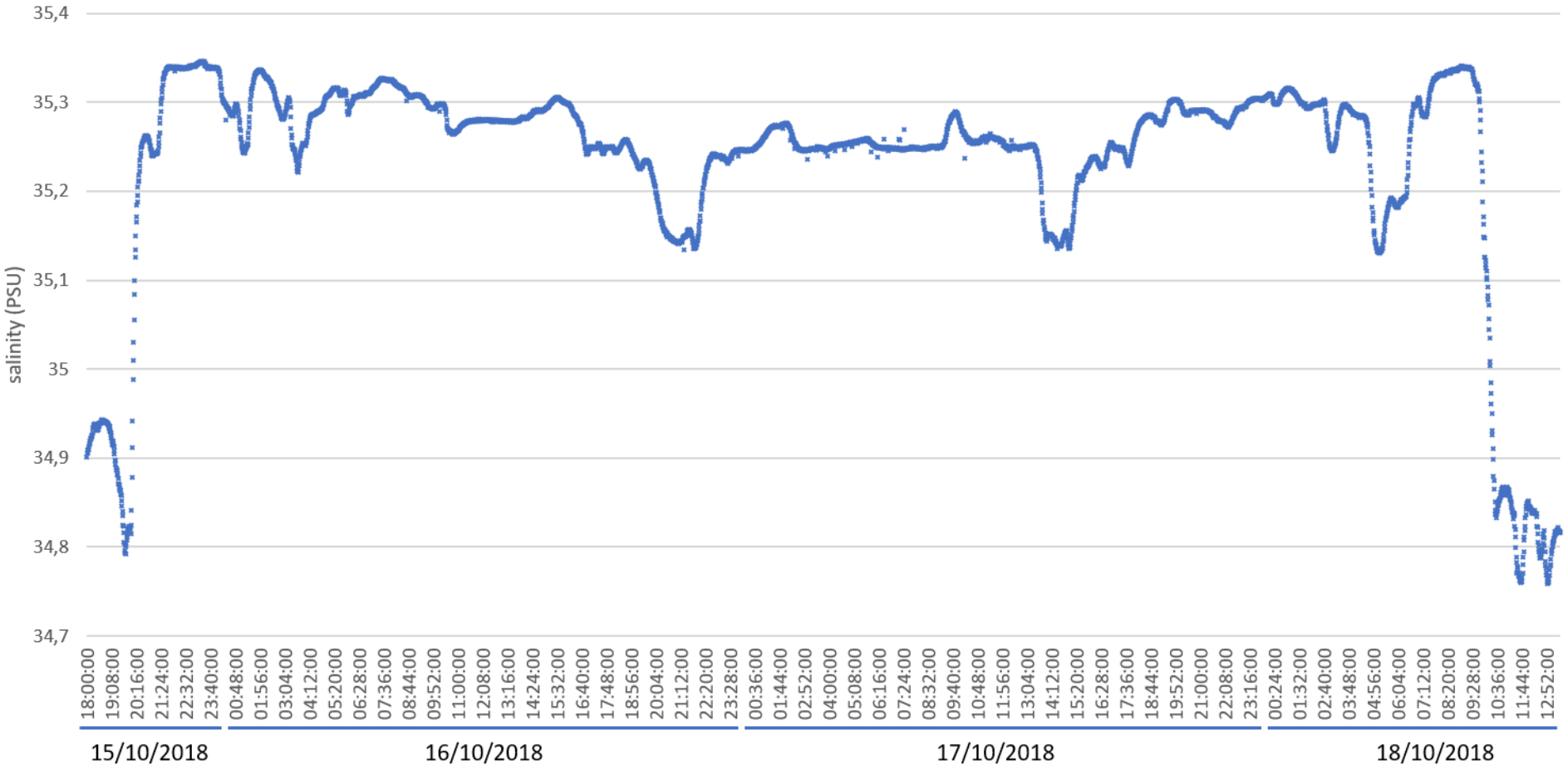


Fig2 (appendix 2): Surface salinity measured with the thermosalinograph, per minute, for the whole cruise for quality control

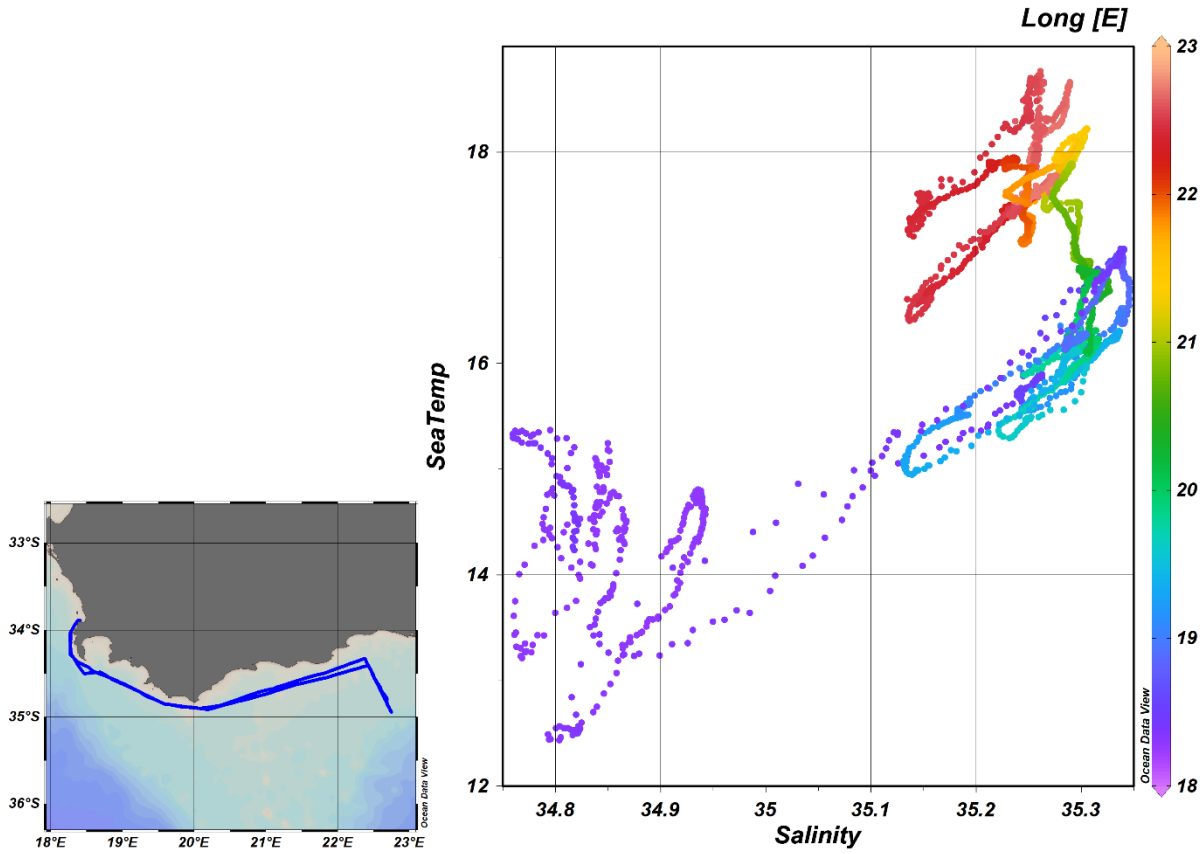


Fig 3 (appendix 2): Sea surface temperature against sea surface salinity, measured with the thermosalinograph for the whole cruise. The colour bar gives an idea of the position of the data points.

Appendix 3: Configuration report for SBE 911plus/917plus CTD

Frequency channels suppressed : 2
Voltage words suppressed : 0
Computer interface : RS-232C
Deck unit : SBE11plus Firmware Version >= 5.0
Scans to average : 24
NMEA position data added : Yes
NMEA depth data added : No
NMEA time added : No
NMEA device connected to : PC
Surface PAR voltage added : No
Scan time added : No

1) Frequency 0, Temperature
Serial number : 5913
Calibrated on : 13-Jun-14
G : 4.30663214e-003
H : 6.25593104e-004
I : 1.92487810e-005
J : 1.42977558e-006
F0 : 1000.000
Slope : 1.00000000
Offset : 0.0000

2) Frequency 1, Conductivity
Serial number : 4341
Calibrated on : 19-Jun-14
G : -9.93703569e+000
H : 1.28075772e+000
I : -2.41792292e-003
J : 2.28828744e-004
CTcor : 3.2500e-006
CPcor : -9.57000000e-008
Slope : 1.00000000
Offset : 0.00000

3) Frequency 2, Pressure, Digiquartz with TC
Serial number : 1195
Calibrated on : 25-Jun-14
C1 : -4.042932e+004
C2 : -1.162854e+000
C3 : 1.224700e-002
D1 : 3.406200e-002
D2 : 0.000000e+000
T1 : 3.030403e+001
T2 : -6.701740e-004
T3 : 4.024410e-006

T4 : 3.016400e-009
T5 : 0.000000e+000
Slope : 1.00000000
Offset : 0.00000
AD590M : 1.280500e-002
AD590B : -9.406860e+000

4) A/D voltage 0, Oxygen, SBE 43
Serial number : 2914
Calibrated on : 21-Jun-14
Equation : Sea-Bird
Soc : 5.00430e-001
Offset : -4.88000e-001
A : -3.27850e-003
B : 1.36310e-004
C : -2.88030e-006
E : 3.60000e-002
Tau20 : 1.62000e+000
D1 : 1.92634e-004
D2 : -4.64803e-002
H1 : -3.30000e-002
H2 : 5.00000e+003
H3 : 1.45000e+003

5) A/D voltage 1, OBS, WET Labs, ECO-BB
Serial number : BBRTD-1203
Calibrated on : 27-May-14
ScaleFactor : 0.003038
Dark output : 0.057100

6) A/D voltage 2, Transmissometer, WET Labs C-Star
Serial number : CST-1664DR
Calibrated on : 20-Mar-14
M : 21.3650
B : -0.0850
Path length : 0.250

7) A/D voltage 3, Transmissometer, WET Labs C-Star, 2
Serial number : CST-1671DB
Calibrated on : 20-Jun-14
M : 21.0840
B : -0.0420
Path length : 0.250

8) A/D voltage 4, Fluorometer, WET Labs ECO-AFL/FL
Serial number : FLNTURTD-3203
Calibrated on : 10-Jul-14
Dark output : 0.0700

Scale factor : 1.00000000e+001

9) A/D voltage 5, Turbidity Meter, WET Labs, ECO-NTU
Serial number : FLNTURTD-3203
Calibrated on : 10-Jul-14
ScaleFactor : 5.000000
Dark output : 0.058000

10) A/D voltage 6, PAR/Irradiance, Biospherical/Licor
Serial number : 70566
Calibrated on : 11--Jun-14
M : 1.00000000
B : 0.00000000
Calibration constant : 11299000000.00000000
Multiplier : 1.00000000
Offset : -0.09102135

11) A/D voltage 7, Altimeter
Serial number : 51863
Calibrated on :
Scale factor : 15.000
Offset : 0.000

Scan length : 31

Appendix 4: Data Processing Steps:

datcnv_date = Jan 13 2020 13:48:21, 7.26.7.129 [datcnv_vars = 25]
datcnv_in =
datcnv_skipover = 0
datcnv_ox_hysteresis_correction = yes
datcnv_ox_tau_correction = yes
filter_date = Jan 13 2020 13:50:11, 7.26.7.129
filter_in =
filter_low_pass_tc_A = 0.030
filter_low_pass_tc_B = 0.150
filter_low_pass_A_vars = sal00
filter_low_pass_B_vars = prDM
alignctd_date = Jan 13 2020 13:50:53, 7.26.7.129
alignctd_in =
alignctd_adv = sbeox0V 3.000, sbeox0ML/L 3.000
celltm_date = Jan 13 2020 13:51:35, 7.26.7.129
celltm_in =
celltm_alpha = 0.0300, 0.0000
celltm_tau = 7.0000, 0.0000
celltm_temp_sensor_use_for_cond = primary,
loopedit_date = Jan 13 2020 14:00:04, 7.26.7.129
loopedit_in =
loopedit_minVelocity = 0.000
loopedit_surfaceSoak: do not remove
loopedit_excl_bad_scans = yes
binavg_date = Jan 13 2020 14:01:56, 7.26.7.129
binavg_in =
binavg_bintype = meters
binavg_binsize = 1
binavg_excl_bad_scans = yes
binavg_skipover = 0
binavg_omit = 0
binavg_min_scans_bin = 1
binavg_max_scans_bin = 2147483647
binavg_surface_bin = no, min = 0.000, max = 2.000, value = 0.000
file_type = ascii
END