Línea de acción 5

Análisis de escenarios de derrames

Procesamiento de datos de CTD, termosalinómetro y ADCPs

Reporte de datos

Experimento de Dispersión en Aguas Profundas

(DWDE-4)

Paula Pérez Brunius (CICESE)

Alejandro Domínguez (CICESE)

Noviembre del 2016

CIGoM
Consorcio de Investigación del Golfo de México

CICESE MR

Contents

1 INTRODUCTION 5
2 Stations 6
3 DESCRIPTION OF DATA 8
3.1 General 8
3.1.1 CTD instrument 8
3.1.2 Thermosalinograph 9
3.1.3 ADCPs 10
4 DATA PROCESSING 13
4.1 CTD 13
4.1.1 Seabird processing 13
4.1.2 Python CTD processing 15
4.2 ADCPs 16
4.3 Thermosalinograph 19
5 CTD casts transects 22
5.1 Section North 24
5.2 Section South 29
6 REFERENCIAS Y AGRADECIMIENTOS 34
7 Appendix 35
7.1 APPENDIX A. Scientific Crew 35
7.2 APPENDIX B. CTD calibration sheets 35
7.3 APPENDIX C: ADCP processing logbooks 49
7.4 APPENDIX D CTD PROFILES 60
7.4.1 In situ Temperature 60
7.4.2 Practical Salinity 62
7.4.3 Oxygen 64
7.4.4 Chlorophyl-a Aquatracka 65
7.4.5 Wetstar CDOM 67
APPENDIX F. ADCP profiles. 77

List of Figures

Figure 1: Stations DWDE-4 6
Figure 2. a) Sea surface circulation pattern for the 25th of April and ship path. The map shows a large cyclone-anticyclone dipole in the west, and several other mesoscale structures. The ADCP velocities are shown along the ship track for comparison. b) SST from AVHRR for 1st of May. 7
Figure 3: Vorticity and Kinetic Energy GoM. Loop current dominates the Kinetic Energy and vorticity signals, but the other mesoscale eddies are visible. 7
Figure 4: Zonal and Longitudinal velocities measured by the 75 kHz ADCP during the DWDE-4 cruise. The gap at the end was caused by bad weather during the cruise. 12
Figure 5: Temperature, Salinity and Chlorophyll-a measured along ship path during DWDE-4 cruise. 21
Figure 6: Absolute Salinity vs Conservative temperature diagram for downcast data DWDE-4 σ_t and π (spiciness) contours are shown every 1.0 g/kg. 24
Figure 7: Conservative Temperature section South DWDE4. 30
Figure 8: Absolute Salinity section South DWDE4 cruise. 30
Figure 9: Oxygen section South DWDE4 cruise. 31
Figure 10: Beam transmission section South DWDE4. 32
Figure 11: Brunt-Vaisala Frequency section South DWDE4. 32
Figure 12: Colored Dissolved Organic Matter section South DWDE4. 33
Figure 13: Chelsea Chlorophyl-a Aqua sensor DWDE4. 33
Figure 14: Conservative Temperature section North DWDE4. 25
Figure 15: Absolute Salinity section North DWDE4 cruise. 25
Figure 16: Oxygen section North DWDE4 cruise. 26
Figure 17: Beam transmission section North DWDE4. 26
Figure 18: Brunt-Vaisala Frequency section North DWDE4. 27
Figure 19: Colored Dissolved Organic Matter section North DWDE4. 28
Figure 20: Chelsea Chlorophyl-a Aqua sensor DWDE4. 29

List of Tables

Table 1: CTD sensor specifications and calibration dates.. 8
Table 2: Thermosalinograph sensor specifications and calibration dates. 10
Table 3: CTD variables DWDE4 campaign. 13
Table 4: CTD cast's information for DWDE4 cruise. 22

1 INTRODUCTION

This study is part of the megaproject “Ocean observation platforms, base line, numerical modeling and scenarios of natural response capability of the Gulf of Mexico, under potential large scale oil spills”, conducted by the Consorcio de Investigación del Golfo de México (CIGoM), and funded by Fondo Sectorial SENER-CONACyT-Hidrocarburos. The overall goals of the megaproject include: improve the predictability of pollutant transport; obtain a baseline of biological, ecological and biogeochemical parameters; and establish possible consequences of large scale oil spill scenarios in the deep waters of the Gulf of Mexico.

The large megaproject is subdivided in several subprojects, and the activities of the cruise reported here are part of the Deep Water Dispersion Experiment (DWDE), which is the observational program of the subproject “Deep and shallow particle dispersion and biological connectivity over the continental slope in the western Gulf of Mexico”, the goals of which are:

- Provide new information on the most important transport mechanisms of pollutants released in the deep waters of the Perdido region.
- Provide a dataset to assess the accuracy of numerical model predictions and improve the parameterizations of submesoscale features in ocean models for deep water regions of the Gulf of Mexico.
- Develop a solid understanding of background levels of hydrocarbon fluorescence as well as carbon sources in the deep water regions of the Gulf of Mexico.
- Integrate biological connectivity estimations with model predictions to increase our understanding of the influence of mesoscale features on pelagic populations.

This report summarizes the data processing of the ship data obtained during DWDE-4.

2 Stations

DWDE-4 campaign consisted of 25 stations where biological, chemical and physical samples were collected, CTD casts were measured and where drifters and ARGO floats were released, Figure 1: Stations DWDEFigure 1.

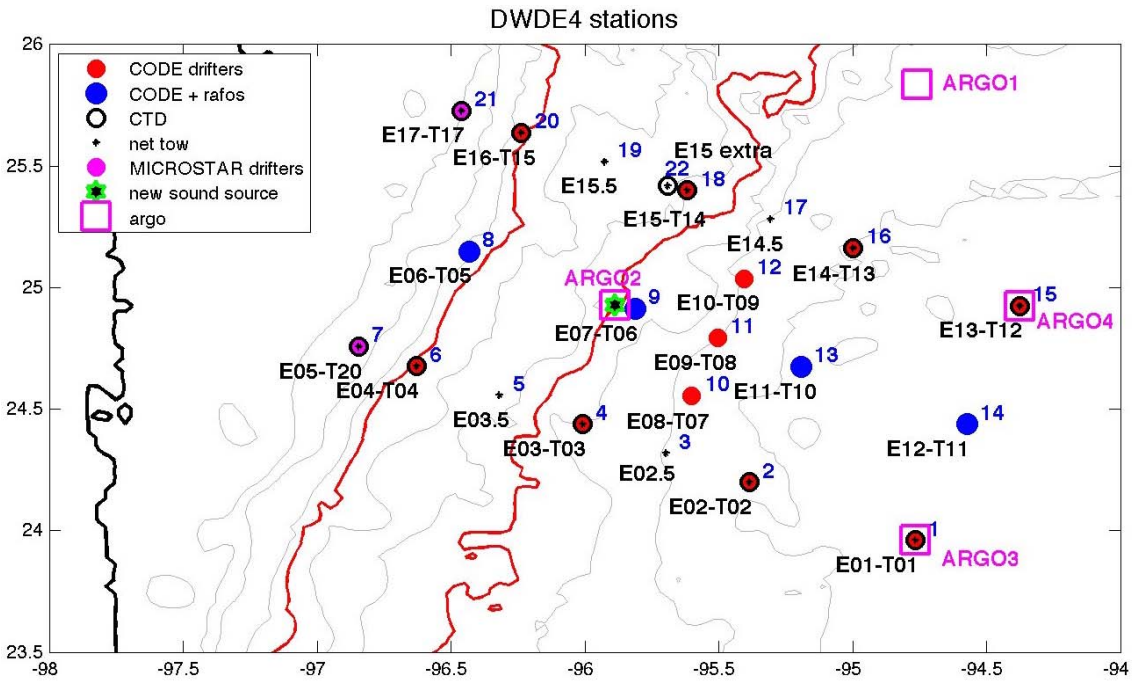


Figure 1: Stations DWDE-4

The surface circulation pattern (April 25th) and ship trajectory are shown in Figure 2. Particularly of interest is the large dipole centered at (-95, 26) and formed by one large cyclone in the north and a large deformed anticyclone at the south. Both eddies were measured by the three ship mounted ADCPs but only the large anticyclone was sampled by the CTD casts.

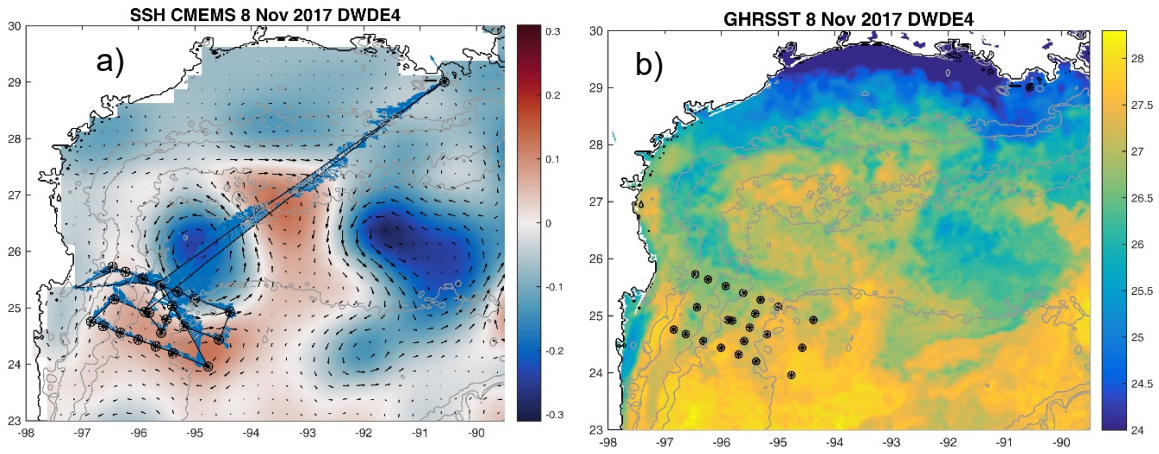


Figure 2. a) Sea surface circulation pattern for the 8th of November and ship path. The map shows a large cyclone-anticyclone structure in the west, and several other mesoscale structures. The ADCP velocities are shown along the ship track for comparison. b) SST from GHRSST for 8th of November 2017.

The Figure 3 shows the vorticity (vort) and Kinetic Energy (KE) field derived from CMEMS altimetry. Some interesting features are the high KE signal associated to all detected eddies, especially at the jets formed at the center of the dipoles, and the high (negative) positive vorticity patches in (anti) cyclones.

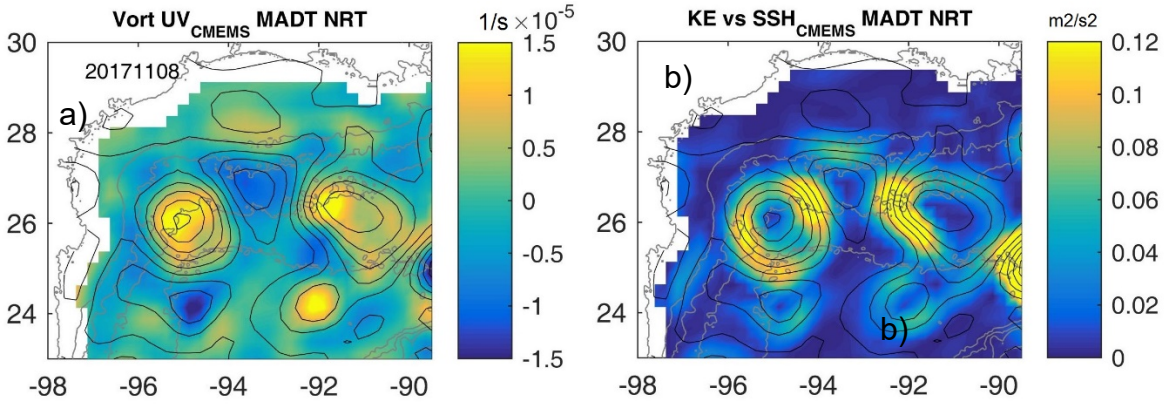


Figure 3: Vorticity (a) and Kinetic Energy (b) at North-West GoM. Several mesoscale eddies are visible both in vorticity and KE.

3 DESCRIPTION OF DATA

3.1 General

This report describes the data acquired during the DWDE-4 cruise in the region of Perdido in the Gulf of Mexico from November 4th to 12th 2017, on board the R/V Pelican. A total of 11 CTD casts were collected in two cross-shelf transects: north (E13-E15) and south (E1-E5 stations) see Figure 1.

3.1.1 CTD instrument

The CTD instrument used during this cruise was an SBE-911 plus, made by Sea-bird Electronics Inc.

Table 1: CTD sensor specifications and calibration dates.

PARAMETERS AND SENSORS	RANGE	ACCURACY	RESOLUTION (at 24 Hz)	CALIB. DATE
Conductivity: SBE04 (x2)	0-70 Sm-1	0.003 Sm-1	0.0004Sm-1	11/09/2016
Pressure: Paroscientifi Digiquartz	0-10350 dbar	0.015% of full scale	0.001% of full scale	11/16/2016
Temperature: SBE03 (x2)	-5.0 - +35 °C	± 0.001 °C	0.0003 °C	05/23/2017, 11/10/2016
Oxygen: SBE43 (x2)	120% of surface saturation	± 2% of saturation	N/A	05/18/2017, 05/02/2016

Colored Dissolved Organic Matter: Fluorometer Wet Labs CDOM	Chl-a: 0.03-75 µg/L, Uranine: 0.03-75 µg/L	N/A	Chl-a: 0.03 µg/L, Uranine: 1 µg/l	5/22/2007
Fluorometer Chelsea Aqua 3	Chl-a: 0.01-100 µg/L, Rhodamine: 0.01-100 µg/L, Fluorescein: 0.01-100 µg/L, Turbidity: 0.01-100 FTU	N/A	Chl-a: 0.01 µg/L, Rhodamine: 0.01 µg/L, Fluorescein: 0.01 µg/L, Turbidity: 0.01 FTU	12/21/2016
Beam Transmission: transmissiometer Wetlabs C-Star	0-100%	N/A	N/A	01/24/2017

The CTD was equipped with the standard sensors: temperature(x2), conductivity (x2) (salinity) and pressure (depth). In addition, two backscatter fluorometers were installed to determine the distribution of chlorophyll and natural chromophoric dissolved organic matter (CDOM). The CDOM sensor, from WetLabs, with an excitation/emission setting of 370nm/460nm, and an Aquatracka 3 Chlorophyll-a sensor also from Chelsea Technologies. The CTD was also equipped with two oxygen sensors. All the sensors were deployed at all hydrographic stations. Specifications for the CTD sensors are given in Table 1.

3.1.2 Thermosalinograph

In addition, surface data was continuously collected along track by the ship's Sea-bird Electronics SBE 21 thermosalinograph, a Wetstar Fluorometer and a WETLabs CStar 25.0-centimeter path length transmissometer.

The data collected were: temperature, salinity, chlorophyll-a, and beam transmission. Specifications of the sensors are given in Table 2.

Table 2: Thermosalinograph sensor specifications and calibration dates DWDE-4.

PARAMETERS AND SENSORS	RANGE	ACCURACY	RESOLUTION (at 24 Hz)	CALIB. DATE
Conductivity	0 - 7 Sm-1	± 0.001 S/m	0.0001 S/m	N/A
Temperature	-5 to +35 °C	± 0.01 °C	0.001 °C	N/A
Temperature, SBE 38 remote	-5 to +35 °C	± 0.001 °C	0.0003 °C	N/A
Chlorophyll-a	0.03-75 µg/L		0.03 µg/L	08/09/16
Beam Transmission: transmissometer Wetlabs C-Star 25 cm path length	0-100%	N/A	N/A	01/09/2017 field calibration: 02-02-2017
Surface PAR: Biospherical Intruments.	0-100%	N/A	N/A	01/25/2017

3.1.3 ADCPs

R/V Pelican has three Acoustic Doppler Current Profilers (1200 kHz, 300 kHz and 75 kHz RDI) but the 300KHz was not active.

The ADCP Workhorse 1200 Khz resolves the surface with high detail. The instrument is configured with a vertical resolution (bin size) of 0.5m and time resolution of two minutes. Depending on the operation conditions the maximum

range achieved is about 12m. The first measured bin is at 5m depth giving us information down to 17 meters.

To measure large depths an Ocean Surveyor 75 Khz was used. This instrument was configured with a bin size of 16m and time resolution of 5 minutes. The maximum achieved range was approximately 770 m, considering a blanking distance of 27 m, in good conditions, the instrument measured up to 790 m.

As stated before, the range that the instruments measure depends on multiple factors: the instrument characteristics, the navigation and the weather conditions. Measurements under low-wind (small-waves) conditions are the best.

The ADCP data shows two regions with gaps in velocities (Figure 4: Zonal and Longitudinal velocities measured by the 75 kHz ADCP during the DWDE-4 cruise. The gap at the end was caused by bad weather during the cruise.Figure 4), first one located around km 1400, was due to a mistake: during the tests to check the sound source all the ADCPs where turned off but not turned on when tests where finished. The second big gap was due to bad weather: a period of high waves between 9th and 10th of November (local time). The gaps are also visible in the WH1200KHz (not shown here).

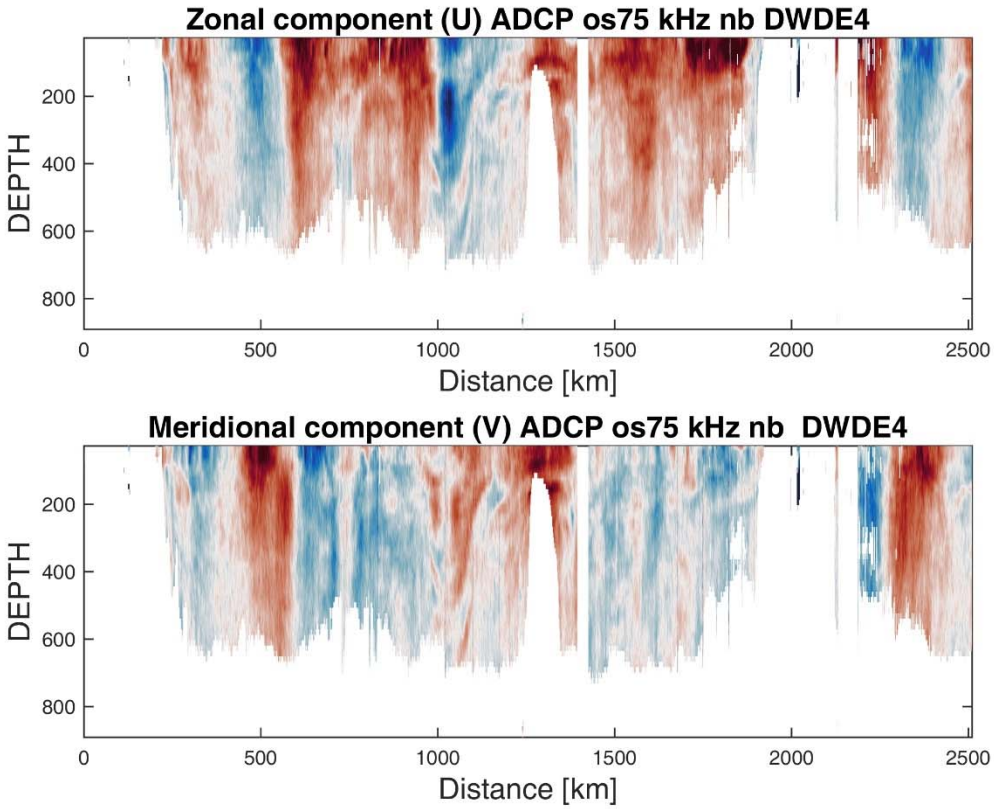


Figure 4: Zonal and Longitudinal velocities measured by the 75 kHz ADCP during the DWDE-4 cruise. The gap at the end was caused by bad weather during the cruise.

4 DATA PROCESSING

4.1 CTD

The CTD data processing consisted of two stages: Seabird: Seasave and Data Processing modules and Python CTD library.

4.1.1 Seabird processing

The first part of the processing of CTD data was done using Seabird software Version 7.26.6.26.

1. First step in this stage was to convert data from its original hexadecimal values (frequency and voltage) to ascii values (from HEX to CNV files), during this stage a hysteresis correction was applied to the Oxygen values. The conversion process was performed using the Seasave program from Seabird.

The extracted variables and their units are presented in Table 3:

Table 3: CTD variables DWDE4 campaign.

VAR. NAME	VARIABLE MEASURED	UNITS
prDM	Pressure, Digiquartz	dBar
Pumps	Pump Status	on(1)/off(0)
t090C	Temperature (ITS-90)	°C
t190C	Temperature, 2 (ITS-90)	°C
timeS	Time, Elapsed	Seconds
Spar	SPAR/Surface Irradiance	microEinsteins/m2/s
sal00	Salinity, Practical	PSU
sal11	Salinity, Practical, 2	PSU
sbeox0ML/L	Oxygen, SBE 43	ml/l
sbeox1ML/L	Oxygen, SBE 43, 2	ml/l
wetCDOM	Fluorescence, WET Labs CDOM	mg/m^3

flC	Fluorescence, Chelsea Aquatracka	ug/l
CStarTr0	Beam Transmission, WET Labs C-Star	%
depSM	Depth (salt water)	m
dz/dtM	Descent Rate	m/s
Scan	Scan Count	Count
altM	Altimeter	M
timeJ	Julian Days	Days
c0S/m	Conductivity	S/m
c1S/m	Conductivity, 2	S/m
sbeox0Mm/Kg	Oxygen, SBE 43	µmol/kg

2. Following the extraction of the variable, the **Wildedit** module was used. This module eliminates bad data: large values and values flagged as "bad" are eliminated from the data series. To discard bad data, the module calculates the mean 100 data points (corresponding to about 5 seconds of sampling) and eliminates those values where data deviates by more than 2 standard deviations. And the process is repeated with the new ensemble, and data deviating more than 20 standard deviations are flagged as bad.

3. The module **Filter** is used to low-pass filter the salinity and pressure with constants A=0.03 and B=0.15 seconds, respectively.

4. Next step in the processing is aligning the oxygen and conductivity data, two seconds and 0.73 seconds are applied respectively to oxygen and conductivity and salinity. This alignment is applied using the **align CTD** module.

5. The last stage of the Seabird processing is to apply **CellTm** module. This step applies cell thermal mass correction for the lag in the response of temperature sensor.

6. Finally, data is then saved as ascii CNV files.

4.1.2 Python CTD processing

The second part of the processing of the CTD data was performed using the Python CTD library (https://github.com/ocefpaf/python-ctd). A tool to load hydrographic data into Pandas DataFrame. This library includes some methods for data pre-processing and analysis.

In this stage a seven-step process was performed:

1. First a moving average with a time window of 2 seconds is applied to descent velocity and oxygen values. This filter is applied to remove the noise of the high frequency signals. The descent velocity will be used to remove pressure reversals later on.

2. Remaining bad values are eliminated from the wetCDOM, flC, and CStarTr0 variables. In some occasions the lack of synchronization between sensors and the data acquisition system results in wrong recorded values. These values can be detected as jumps in the data that have a fixed value (e.g. 0). These values were not removed by the Wild Edit module. This step is important to avoid the generation of artificial peaks in the processed data.

3. Pressure reversals are eliminated from the dataset using a threshold velocity of 0.25 m/s. The pressure reversals arise from the ship heave. This method is equivalent to **Loop Edit** module of Sea-bird.

4. A despiking process is applied to all series. The despike process is equivalent to Wildedit from Seabird.

5. Splitting on downcast and upcast is performed. This step consist of separating the data from down and up components of the casts. Usually the downcast is the data that is used to analyze due to the fact that instruments are measuring undisturbed parcels of water.

6. Bin average of the data is performed in order to obtain data every 1 dBar.

7. The data were inspected visually for each cast, comparing upcast and downcasts, as well as the primary and secondary sensors, after which final editing of the data were made.

8. Data is saved as CSV files ready to be used.

The final data results from the processed data collected by the primary sensors during the downcast. The positions for each cast were obtained by averaging the ships' GPS data over the duration of the CTD downcast

4.2 ADCPs

The ADCP data were collected and pre-processed by the python UHDAS-CODAS system implemented by the University of Hawaii, which automatically and continuously graphed the data in near-real time.

UHDAS (University of Hawaii Data Acquisition System) is an open source acquisition software, this is responsible for acquiring the three ADCPs and other instrument's data required for the processing. UHDAS is capable to acquire information from several ADCPs using only one computer, this is an advantage compared with the VmDAS system (Teledyne RD Instruments) which needs one computer per ADCP.

The **CODAS processing** (Common Ocean Data Access System) processing system is a Python and C suite of programs specially designed to process and store ADCP data. CODAS processing system uses data from ADCPs, GPS and navigation system to extract velocities of the flow relative to the ship.

In general, four steps are needed to process ADCP data:

1. A reference layer is used to remove the ship's speed from the velocities measured by the ADCPs. By assuming the oceans reference layer is smooth, positions can be nudged to smooth the ship's velocity, which directly results in a smooth reference layer.

2. GPS heading correction of the gyro heading, using a quality-controlled difference in headings. A GPS-derived heading source may provide a more accurate (but less reliable) heading source than the gyro.

3. Estimation of the heading misalignment from either "bottom track " or "water track". Watertrack calibration use sudden accelerations (such as stopping and starting of the ship when doing station-work) to derive an estimate of the heading misalignment.

4. Edition of the database to remove bad data.

CODAS processing is managed by the Python program quick_adcp.py. The actual steps for processing the ADCP data with the CODAS processing software are the following:

1. Setting up a processing directory (**adcptree.py**)

2. Scanning the data files in order to determine whether there are issues with timestamps that need to be addressed. Two operations are performed during this stage:
   - List time ranges and other information about the data files

- Create a file with the time range of the data

3. Load data into CODAS database. This is achieved by calling quick_adcp.py with a control file with parameters for processing. When working with UHDAS the program handles single-ping data and performs the following actions:
    1. Read the ADCP and ancillary serial data
    2. Find the UTC time, position and attitude
    3. Edit out bad single-ping velocities
    4. Average the single ping data
    5. Write to disk

4. Heading correction: obtain a heading correction for the gyro heading, using the GPS-based attitude device and check the health of the accurate heading device.

5. Navigation: find and smooth the reference layer.

6. Calibration: determine preliminary angle and amplitude calibrations from watertrack and/or bottom track data (using corrected headings)

7. Editing: bottom interference, wire interference, bubbles, ringing, identifying problems with heading and underway bias. This includes the use of gautoedit manual processing.

8. Calibration: final calibration using edited data.

9. Documentation: record the different steps during the processing of the data.

10. Extraction: netcdf or matlab files.

4.3 Thermosalinograph

Data from the ship's thermosalinograph were extracted from the MIDAS dataset. Due to the different time resolutions for the navigation and thermosalinograph a process to merge the data was needed.

The MIDAS system collects atmospheric and sea surface data, but only Temperature, Salinity and Fluorescence were extracted.

Figure 5 shows Temperature, Salinity and Fluorescence along the ship track measured by the thermosalinograph and SST from GHRSST. A cyclonic eddy is detected in the CMEMS altimetry data, and is centered approximately at (-95°W, 26°N) but is not clearly detected in T, S and Chl-a. There are low values in temperature and salinity around the core but the Chlorophyll shows no contrast in and out of the eddy. Low temperature and low salinity in that eddy could be related with the presence of riverine water, the Chl-a MODIS image (8/Nov) shows a plume of high chlorophyll content along the North section that seems to be advected from the shelf.

A very interesting feature is the difference between the low values of Chl-a (<15µg/l) at the beginning of the cruise and the high values of Chl-a (>18µg/l) at the end of the cruise. There are two mechanisms that could result on such different values: advection of riverine waters by the cyclone-anticyclone structure and the deepening of the mixed layer by strong winds, the second mechanism seems more plausible due to the fact that the measurements are close to homogeneous in the measurements from Perdido to Cocodrie (~21.5µg/l) and increasing from Cocodrie to Perdido (12 to 17 µg/l). The high values in CHl-a are found after the increase in wind velocity in the zone.

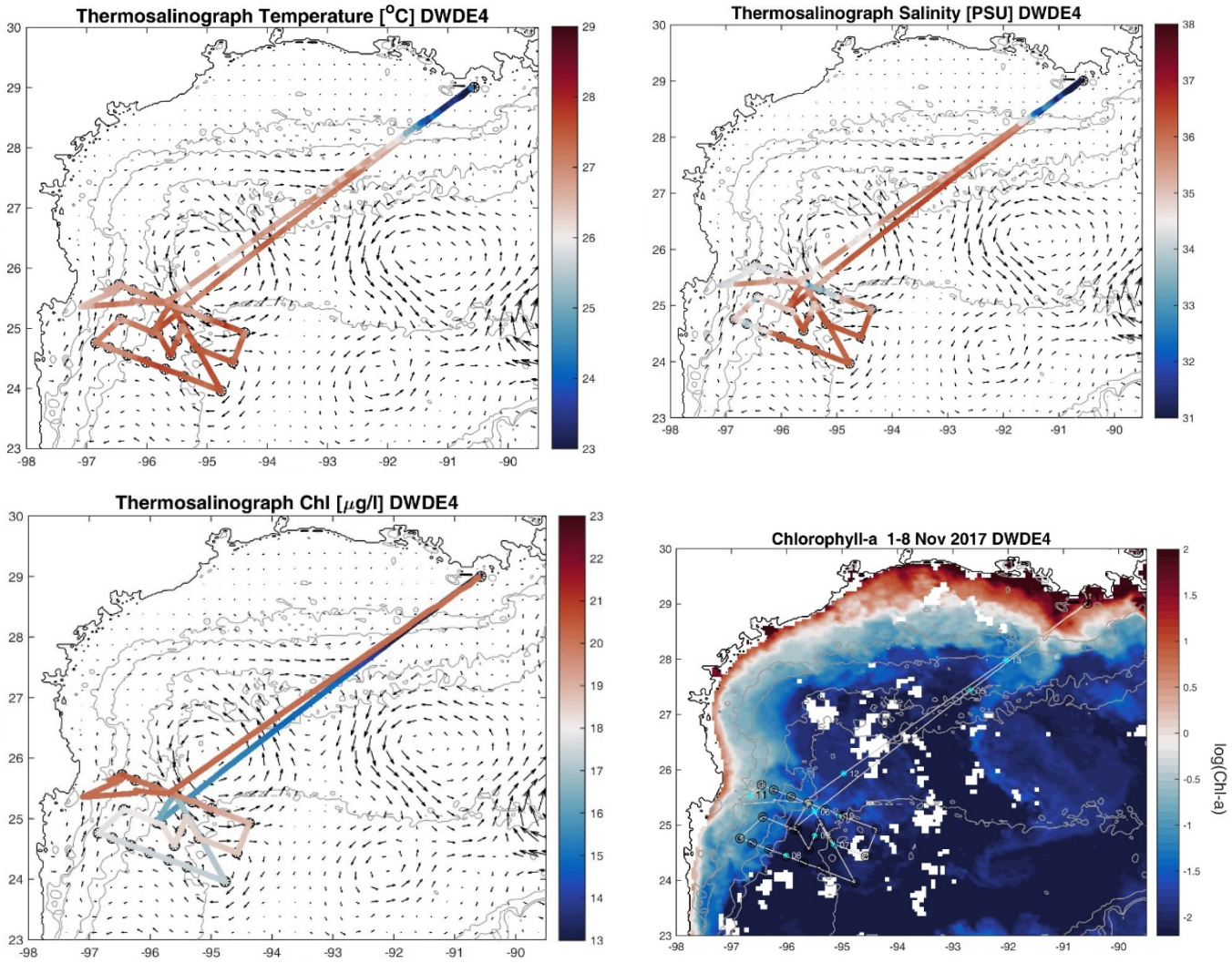


Figure 5: Temperature, Salinity and Chlorophyll-a measured along ship path during DWDE-4 cruise, and Chl-a from GHRSST averaged from 1st to 8th of November 2017.

5 CTD casts transects

The transect casts were collected along 2 cross-shelf sections: South and North. South section consisted of five stations and 5 casts and the North section consisted of five stations and 6 casts.

The information about the CTD casts is given in Table 4. The latitudes and longitudes where calculated as the mean value of the cast positions recorded by the GPS.

Table 4: CTD cast's information for DWDE4 cruise.

DAY	SECTION	STATION	CAST #	DEPTH (m) Cast/Bottom	Lat	Long
04/25/2017	South	E1	1	3402/3600	23° 58.086 N	94° 47.220 W
04/25/2017	South	E2	2	3401/3500	24° 12.697 N	95° 23.768 W
04/25/2017	South	E3	3	2438/2500	24° 26.834 N	96° 00.674 W
04/26/2017	South	E4	4	655/702	24° 40.899 N	96° 37.648 W
04/26/2017	South	E5	5	141/154	24° 45.604 N	96° 50.634 W
04/26/2017	North	E13	6	3547/3700	24° 55.407 N	94° 22.617 W
04/26/2017	North	E14	7	3400/3500	25° 09.196 N	94° 59.407 W
04/27/2017	North	E15	8	1401/1500	25° 23.622 N	95° 37.228W
04/27/2017	North	E16	9	502/550	25° 38.013 N	96° 14.381 W

04/28/2017	North	E17	10	98/102	25° 43.611 N	96° 27.667 W
04/28/2017	North	E15	11	3455	25° 25.050 N	95° 41.407 W

As presented in the DWDE1 report, results will be shown using the new **International Thermodynamic Equation Of Seawater – 2010 (TEOS-10) [1]**. A thermodynamic description of sea water based on Gibbs function, in this formulation of thermodynamic properties are calculated directly and are fully consistent.

First, as an alternative to the T-S diagram, the diagram of Absolute Salinity vs Conservative Temperature is shown in Figure 6. The figure also shows iso-contours of potential density anomaly and spiciness. Dissolved oxygen (in color shows deep waters (d>1000 m) having large concentrations. The plot also shows the presence of warm (T>26^{o}C), low salinity (S<36g/kg) and high oxygen (O>4.5ml/l) waters, probably due to the existence of riverine waters.

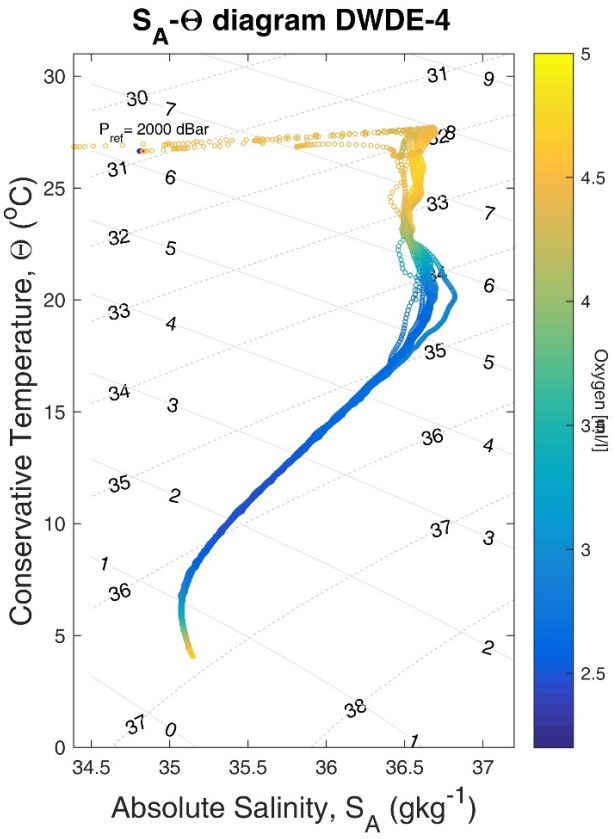


Figure 6: Absolute Salinity vs Conservative temperature diagram for downcast data DWDE-4 σ_t and π (spiciness) contours are shown every 1.0 g/kg.

5.1 Section North

Cross-shelf section plots of Conservative Temperature, Absolute Salinity, Oxygen, Beam Transmissivity, Brunt-Vaisala frequency, CDOM and Chlorophyll-a are shown from Figure 7Figure 14 to Figure 13. Appendix E shows all available plots for Section North.

In TEOS-10, Absolute Salinity (SA) is preferred over Practical Salinity due to the fact that SA is the appropriate salinity variable for the accurate calculation of horizontal density gradients in the ocean, and it is also the appropriate salinity variable for the calculation of freshwater fluxes and for calculations involving the exchange of freshwater with the atmosphere

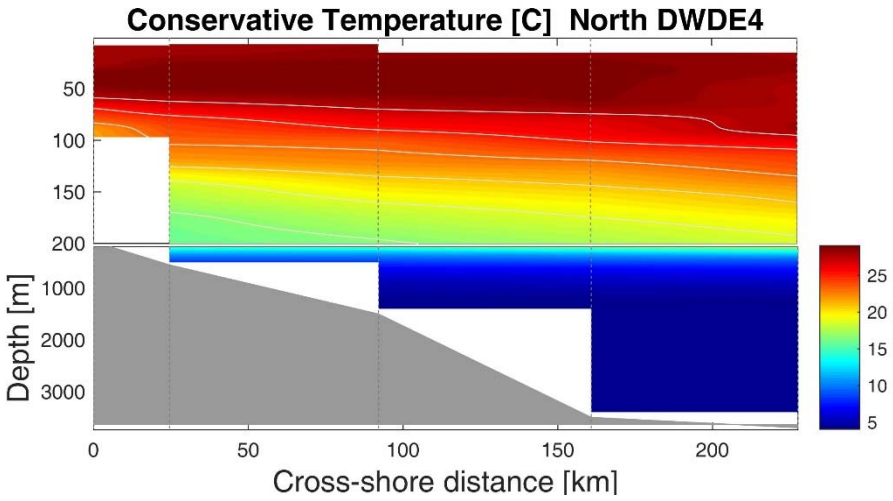


Figure 7: Conservative Temperature section North DWDE4.

Figure 7 shows the Conservative temperature section. Isotherms are shallower as they approach the shelf, hinting the presence of upwelling. This is consistent with the presence of a small core of low-oxygen (Figure 9) at the bottom of the western cast near the shelf. A plume of colder water is present at the surface, the plume has low salinity as show in Figure 8 hinting a riverine origin.

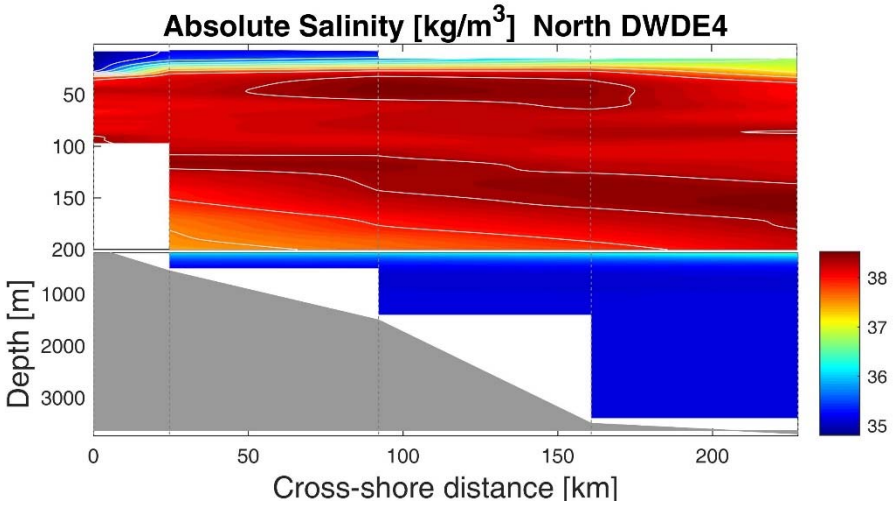


Figure 8: Absolute Salinity section North DWDE4 cruise.

Figure 8 shows two cores of high salinity (S~38.5) are visible: one at the center of the section located about 50 m deep, and the other covering all the section extending from 100 to 180 m.

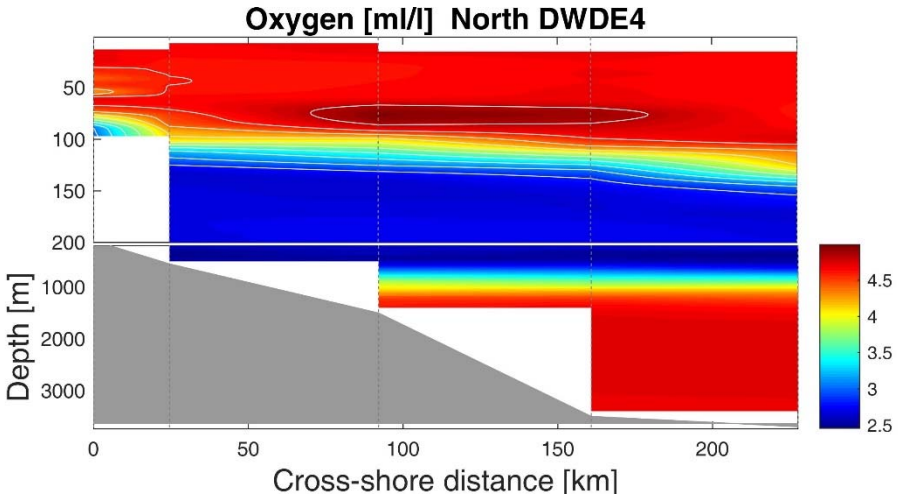


Figure 9: Oxygen section North DWDE4 cruise.

Oxygen concentration (Figure 9) shows a clear oxycline extending from 7m at the west of the section down to 180m at the east. A core of high concentration (>4.7ml/l) is visible at the center of the section about 75m deep just below the core of high salinity shown in Figure 8. The characteristic minimum in oxygen is observed between 130 and 900 m, and oxygen rich (O>4 ml/l) deep waters are also observed.

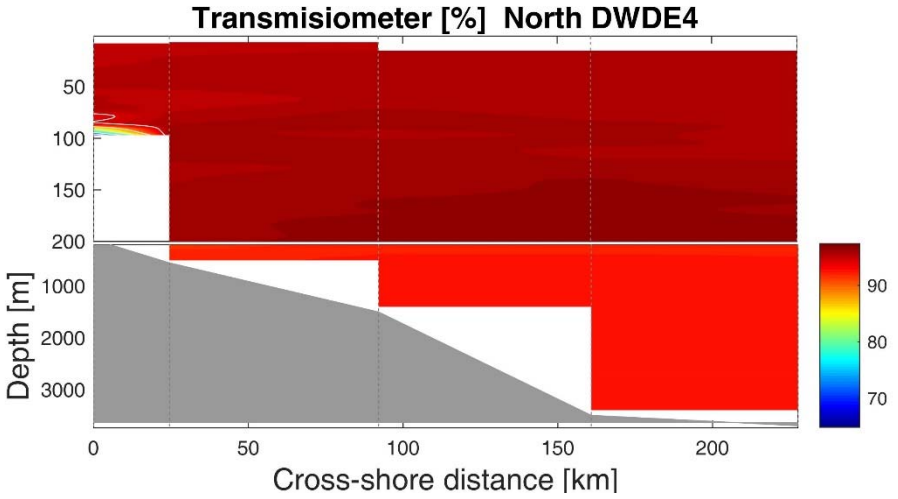


Figure 10: Beam transmission section North DWDE4.

Figure 10 shows beam transmission in the section. A very low transmissivity core is located about 100m deep in the west.

Brunt-Vaisala frequency (BVF) is shown in Figure 11. It is observed that the section is not well mixed, several peaks of the are located in the first 100m. But a core of high BVF ($N>1.5x10^{-3}$ s^{-2}) is located about ~30m deep and a plume showing the interphase with the less saline plume is evident. A core of high N2 at 75m extends almost all the section and coincides with the high Chlorophyll concentration of the Figure 13.

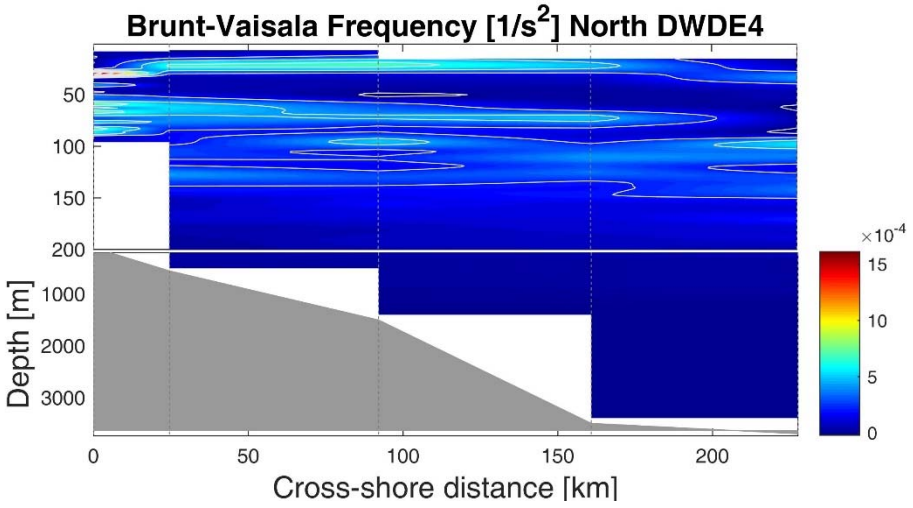


Figure 11: Brunt-Vaisala Frequency section North DWDE4.

The CDOM section in Figure 12 shows large values (>.7 mg/m^3) at the surface and below 800 m. Large values at the surface might be related with the presence of riverine waters.

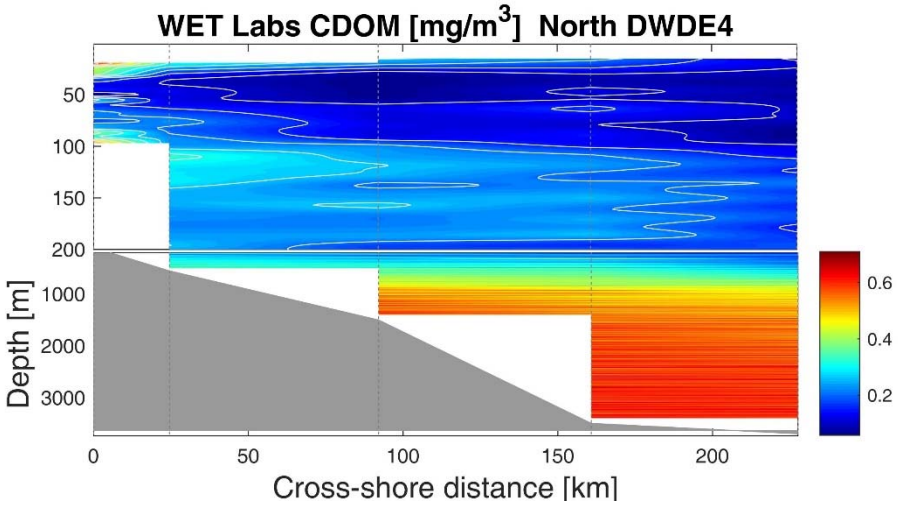


Figure 12: Colored Dissolved Organic Matter section North DWDE4.

Figure 13 shows Chlorophyll-a in the North section. The sensor detects a region of high concentration (Chl-a>0.25) between 60 and 140 m approximately for all the section, but with two cores: one located in the west at about 70m and the other extending from 140 km to the end of the section at ~75m. From

Figure 5 it can be seen that this section measured along a plume of high chlorophyll that was advected by the cyclone from the shelf.

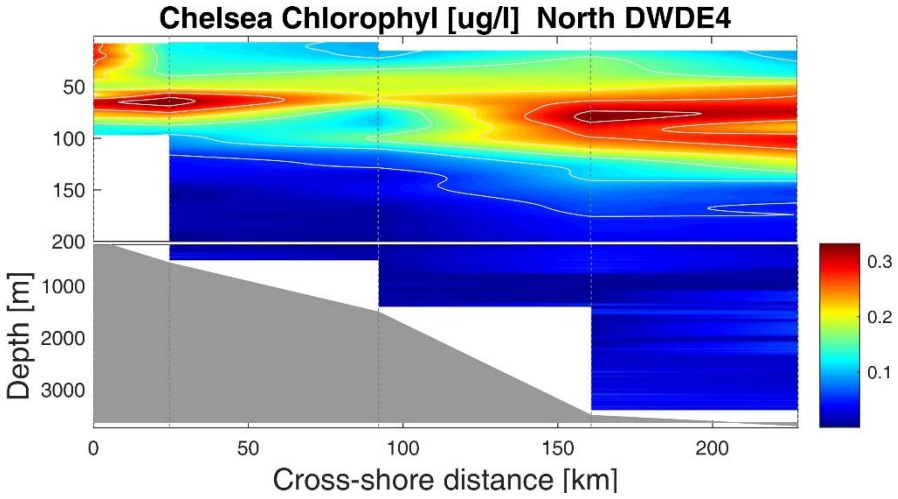


Figure 13: Chelsea Chlorophyl-a Aqua sensor section North DWDE4.

Also of interest there is a core of low chlorophyll at ~90m (~km 90 of the section). It coincides with a core of N2 in Figure 11

5.2 Section South

The same variables, as those in the previous section, are shown here for the South section from Figure 7 to Figure 13.

Figure 14 shows the Conservative temperature section for section South. Figure 2 shows this section measured an anticyclonic structure, with a small eddy core located at (95W,24N). A small deepening of the isotherms is visible in this section (~km 160). Contours about 70 m sugest the existence of a thermocline.

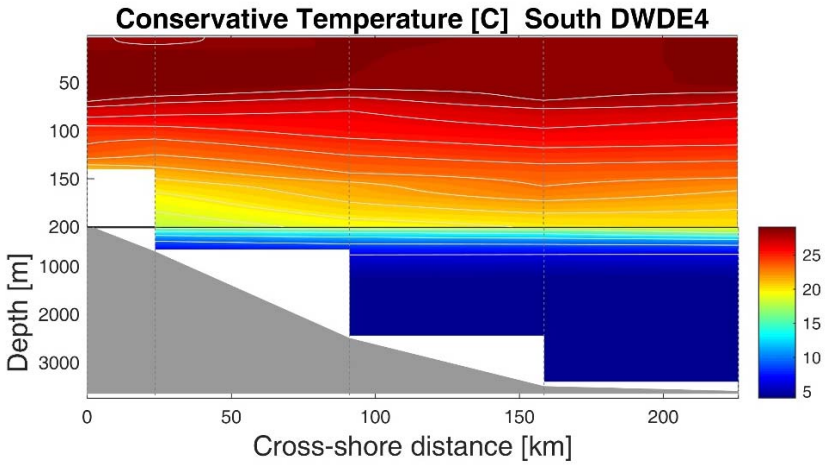


Figure 14: Conservative Temperature section South DWDE4.

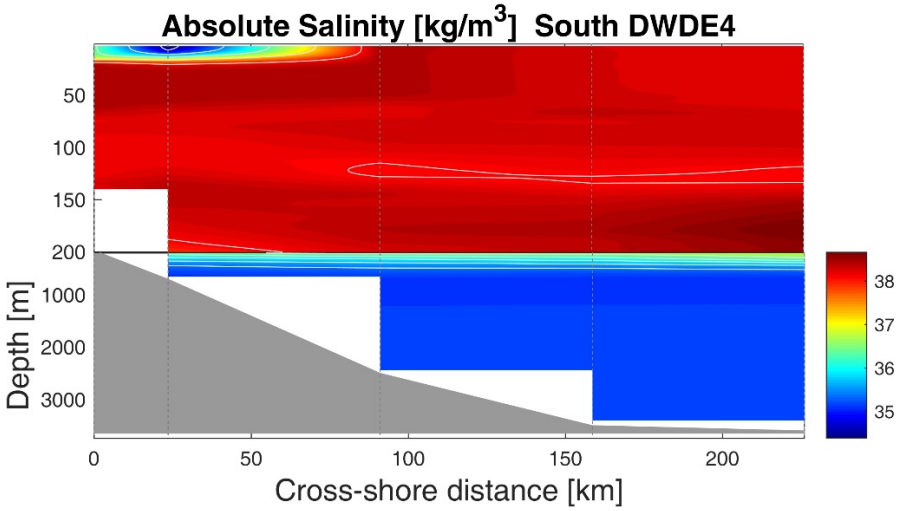


Figure 15: Absolute Salinity section South DWDE4 cruise.

Figure 15 shows a surface core of very low salinity (S~35) at the west. This core is located just above a core of high N2 in the Figure 18 signaling a riverine origin of the waters.

Figure 5.d shows the Chlorophyll-a high concentration waters being advected offshore by the cyclone-anticyclone structure located in Perdido.

Oxygen concentration is shown in Figure 16. In general the plot shows very homogeneous region extending from surface to the position of the maximum (~5ml/l) (located between 50 and 100m). This region of maximum concentration occurred in the same position as a high N2 in Figure 18. The region of minimum oxygen between 150 and 1000m is also observed.

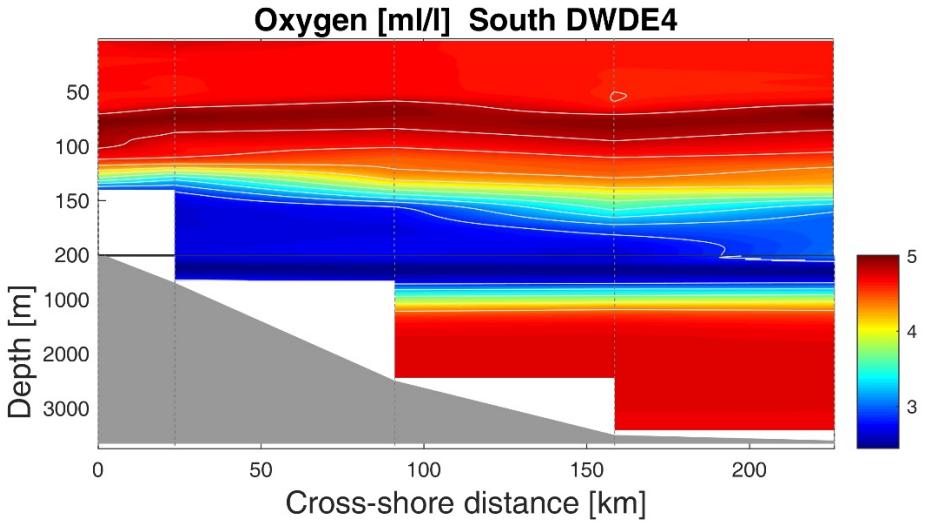


Figure 16: Oxygen section South DWDE4 cruise.

Figure 17 show transmissivity for South section. Two low beam transmission cores are found in the upper 200m. The first one at the west ~140m and the second one centered ~km 90, and ~160m deep.

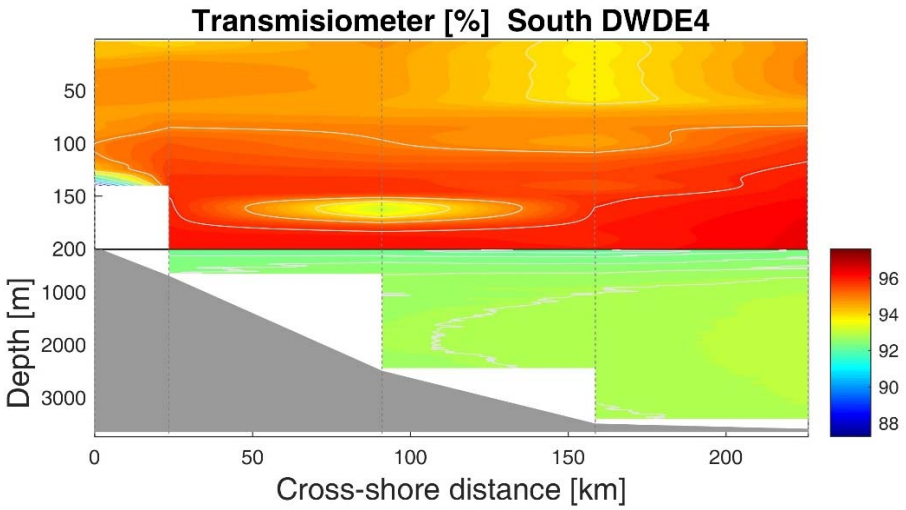


Figure 17: Beam transmission section South DWDE4.

Close to the shelf, several peaks of large Brunt-Vaisala frequency are located between 50m and 150m deep (Figure 18), the larger of the peaks ($N>10x10^{-4}s^{-2}$) is located near the surface, and is related with the plume of riverine water. A large N2 region ($N>5x10^{-4}s^{-2}$) crosses all the section between 60 and 80 m deep, signaling the position of the base of the mixed layer.

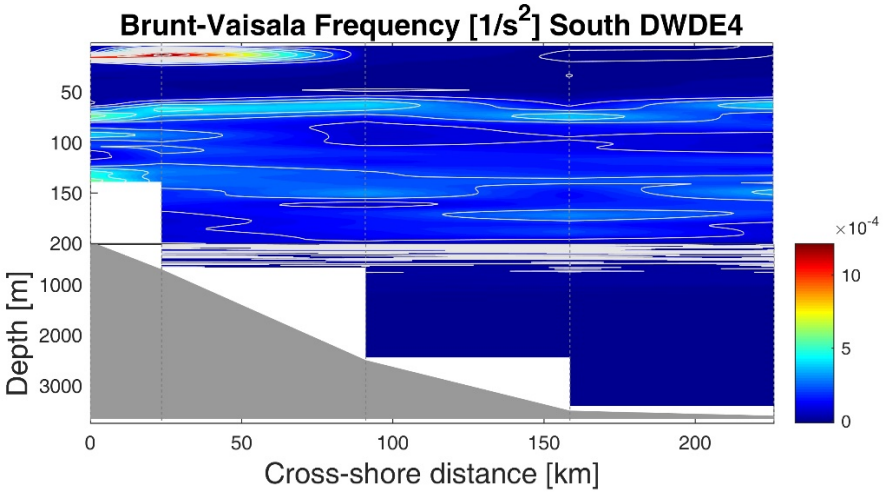


Figure 18: Brunt-Vaisala Frequency section South DWDE4.

The CDOM section in Figure 19 shows a surface core of high values (>.4 mg/m^3) and large values (>.6 mg/m^3) below 1000 m.

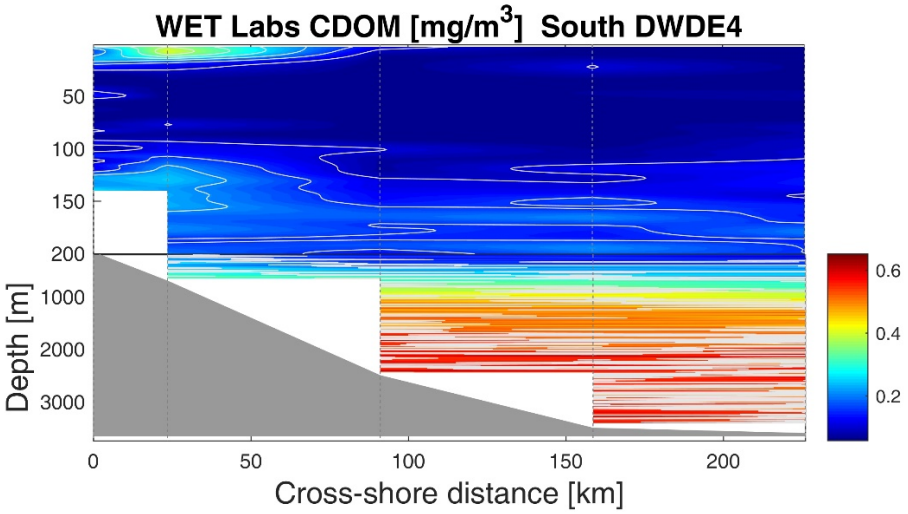


Figure 19: Colored Dissolved Organic Matter section South DWDE4.

Figure 20: Chelsea Chlorophyl-a Aqua sensor DWDE4.Figure 20 shows Chlorophyll-a in the section. The sensor detects a region of high concentration ~100m approximately for all the section. Deep values cannot be trusted as the sensor experienced some troubles ad large depths, probably due to data cable been damaged.

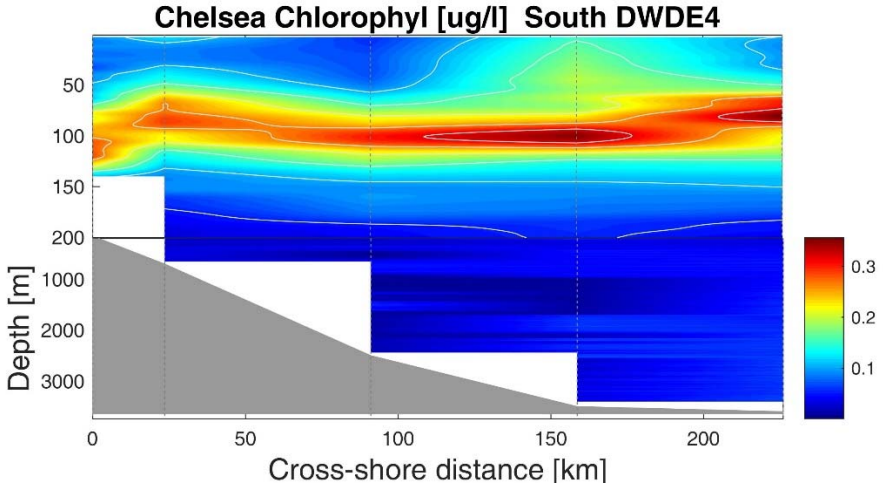


Figure 20: Chelsea Chlorophyl-a Aqua sensor DWDE4.

6 REFERENCIAS Y AGRADECIMIENTOS

[1] IOC, SCOR and IAPSO, 2010: *The international thermodynamic equation of seawater – 2010: Calculation and use of thermodynamic properties*. Intergovernmental Oceanographic Commission, Manuals and Guides No. 56, UNESCO (English), 196 pp.

[2]**UHDAS+CODAS** 2015.05.01-python documentation, http://currents.soest.hawaii.edu/docs/doc/index.html, accessed 20-Nov-2016

[3] **Python CTD ver. 0.2.1**: *Tools to load hydrographic data as DataFrames,* https://github.com/ocefpaf/python-ctd, *accessed 15-Nov-2016*

[4] **Seasoft V2: SBE Data Processing CTD Data Processing & Plotting Software for Windows** manual. Ver. 7.25.0

Agradecimientos

"Esta investigación ha sido financiada por el Fondo Sectorial CONACYT-SENER-Hidrocarburos, proyecto 201441. Esta es una contribución del Consorcio de Investigación del Golfo de México (CIGoM). Reconocemos a PEMEX por promover ante el Fondo la demanda específica sobre los derrames de hidrocarburos y el medio ambiente."

"This research has been funded by the Mexican National Council for Science and Technology - Mexican Ministry of Energy - Hydrocarbon Fund, project 201441. This is a contribution of the Gulf of Mexico Research Consortium (CIGoM). We acknowledge PEMEX's specific request to the Hydrocarbon Fund to address the environmental effects of oil spills in the Gulf of Mexico."

7 Appendix

7.1 APPENDIX A. Scientific Crew

Scientific crew DWDE4

Name	Institution
Dra. Paula Pérez Brunius*	CICESE
Sharon Herzka	CICESE
Heather Furey	WHOI
Sergei Molodstov	TAMUG
Paula García Carrillo	CICESE
Argelia Ronquillo	CICESE
Alejandro Domínguez	CICESE
Renata Goulart	CICESE
Javier Rodríguez	CICESE
Jesús Cano	CICESE
Oscar Hernández	CICESE
Domitilo Najera	CICESE
Doris Piñero	CICESE
Simao Paixao	CICESE
*** Chief Scientist**	

7.2 APPENDIX B. CTD calibration sheets

PSA file: F:\ADominguez\DATA\DWDE4\DATA\PE18_15_Perez_CTD\RAW\Seabird\PE18_15_Perez.psa

Date: 02/21/2018

Instrument configuration file: F:\ADominguez\DATA\DWDE4\DATA\PE18_15_Perez_CTD\RAW\Seabird\PE18_15_Perez.xmlcon

Configuration report for SBE 911plus/917plus CTD

Frequency channels suppressed : 0

Voltage words suppressed : 0

Computer interface : RS-232C

Deck unit : SBE11plus Firmware Version >= 5.0

Scans to average : 1

NMEA position data added : No

NMEA depth data added : No

NMEA time added : No

Surface PAR voltage added : Yes

Scan time added : No

1) Frequency 0, Temperature

Serial number : 1119

Calibrated on : 23 May 2017

G : 4.83442465e-003

H : 6.58142787e-004

I : 2.11421176e-005

J : 1.42268134e-006

F0 : 1000.000

Slope : 1.00000000

Offset : 0.0000

2) Frequency 1, Conductivity

Serial number : 0626

Calibrated on : 09-Nov-2016

G : -4.11417820e+000

H : 4.28976260e-001

I : 3.32014485e-004

J : 2.94094591e-006

CTcor : 3.2500e-006

CPcor : -9.57000000e-008

Slope : 1.00000000

Offset : 0.00000

3) Frequency 2, Pressure, Digiquartz with TC

Serial number : 0461

Calibrated on : 16-Nov-2016

C1 : -4.244351e+004

C2 : 4.166578e-002

C3 : 1.316300e-002

D1 : 3.513100e-004

D2 : 0.000000e+000

T1 : 3.028370e+001

T2 : -2.660010e-004

T3 : 4.083110e-006

T4 : 2.653090e-009

T5 : 0.000000e+000

Slope : 1.00002000

Offset : -0.32860

AD590M : 1.281640e-002

AD590B : -9.225620e+000

4) Frequency 3, Temperature, 2

Serial number : 4511

Calibrated on : 10-Nov-2016

G : 4.41122298e-003

H : 6.44996377e-004

I : 2.20745880e-005

J : 1.82808343e-006

F0 : 1000.000

Slope : 1.00000000

Offset : 0.0000

5) Frequency 4, Conductivity, 2

Serial number : 3079

Calibrated on : 09-Nov-2016

G : -9.82298129e+000

H : 1.38376330e+000

I : -7.80068077e-006

J : 7.86342183e-005

CTcor : 3.2500e-006

CPcor : -9.57000000e-008

Slope : 1.00000000

Offset : 0.00000

6) A/D voltage 0, Oxygen, SBE 43

Serial number : 1419

Calibrated on : 05-18-17

Equation : Sea-Bird

Soc : 5.20700e-001

Offset : -5.10000e-001

A : -3.94580e-003

B : 1.87980e-004

C : -3.31620e-006

E : 3.60000e-002

Tau20 : 1.24000e+000

D1 : 1.92634e-004

D2 : -4.64803e-002

H1 : -3.30000e-002

H2 : 5.00000e+003

H3 : 1.45000e+003

7) A/D voltage 1, Oxygen, SBE 43, 2

Serial number : 0803

Calibrated on : 05-02-17

Equation : Sea-Bird

Soc : 4.30600e-001

Offset : -5.17700e-001

A : -3.37200e-003

B : 2.15230e-004

C : -3.35280e-006

E : 3.60000e-002

Tau20 : 1.04000e+000

D1 : 1.92634e-004

D2 : -4.64803e-002

H1 : -3.30000e-002

H2 : 5.00000e+003

H3 : 1.45000e+003

8) A/D voltage 2, Altimeter

Serial number : 0937

Calibrated on :

Scale factor : 14.190

Offset : 0.000

9) A/D voltage 3, Transmissometer, WET Labs C-Star

Serial number : 868DR

Calibrated on : 1-24-2017

M : 20.4462

B : -1.2268

Path length : 0.250

10) A/D voltage 4, Fluorometer, Chelsea Aqua 3

Serial number : 088-139

Calibrated on : 12/21/2016

VB : 0.350800

V1 : 1.845800

Vacetone : 0.439800

Scale factor : 1.000000

Slope : 1.000000

Offset : 0.000000

11) A/D voltage 5, Fluorometer, Seapoint

Serial number : 3077

Calibrated on : 08-02-2017

Gain setting : 30 x, 0-5 µg/l

Offset : 0.000

12) A/D voltage 6, Fluorometer, WET Labs ECO CDOM

Serial number : FLCDRTD-742

Calibrated on : 5-22-07

Dark output : 0.066

Scale factor : 50.000

13) A/D voltage 7, Free

14) SPAR voltage, Unavailable

15) SPAR voltage, SPAR/Surface Irradiance

Serial number : 6409

Calibrated on : 11/07/16

Conversion factor : 1625.46729000

Ratio multiplier : 1.00000000

Scan length : 33

Pump Control

This setting is only applicable to a custom build of the SBE 9plus.

Enable pump on / pump off commands: NO

Data Acquisition:

Archive data: YES

Delay archiving: NO

Data archive: D:\CTD Data\2018\PE18_15_Perez\Deck_Test_Nov_2_2017.hex

Timeout (seconds) at startup: 60

Timeout (seconds) between scans: 20

Instrument port configuration:

Port = COM8

Baud rate = 19200

Parity = N

Data bits = 8

Stop bits = 1

Water Sampler Data:

Water Sampler Type: SBE Carousel

Number of bottles: 12

Port: COM7

Enable remote firing: NO

Firing sequence: Sequential

Tone for bottle fire confirmation uses PC sound card.

Header information:

Header Choice = Include Default Header Information in File

prompt 0 = Event Number (yyyymmddhhhh)

prompt 1 = Local Time (hhhh)

prompt 2 = Activity

prompt 3 = Latitude (dd mm.mmm N)

prompt 4 = Longitude (dd mm.mmm W)

prompt 5 = Bottom Depth (m)

prompt 6 = Station #

TCP/IP - port numbers:

Data acquisition:

Data port: 49163

Status port: 49165

Command port: 49164

Remote bottle firing:

Command port: 49167

Status port: 49168

Remote data publishing:

Converted data port: 49161

Raw data port: 49160

Miscellaneous data for calculations

Depth, Average Sound Velocity, and TEOS-10

Latitude when NMEA is not available: 0.00000000

Longitude when NMEA is not available: 0.00000000

Average Sound Velocity

Minimum pressure [db]: 20.00000000

Minimum salinity [psu]: 20.00000000

Pressure window size [db]: 20.00000000

Time window size [s]: 60.00000000

Descent and Acceleration

Window size [s]: 2.00000000

Plume Anomaly

Theta-B: 0.00000000

Salinity-B 0.00000000

Theta-Z / Salinity-Z 0.00000000

Reference pressure [db] 0.00000000

Oxygen

Window size [s]: 2.00000000

Apply hysteresis correction: 1

Apply Tau correction: 1

Potential Temperature Anomaly

A0: 0.00000000

A1: 0.00000000

A1 Multiplier: Salinity

Serial Data Output:

Output data to serial port: NO

Mark Variables:

Variables:

Digits Variable Name [units]

------ --------------------

0 Scan Count

4 Depth [salt water, m]

7 Conductivity [S/m]

5 Salinity, Practical [PSU]

6 Oxygen, SBE 43 [mg/l]

5 Temperature [ITS-90, deg C]

Shared File Output:

Output data to shared file: NO

TCP/IP Output:

Raw data:

Output raw data to socket: NO

XML wrapper and settings: NO

Seconds between raw data updates: 0.00000000

Converted data:

Output converted data to socket: NO

XML format: NO

SBE 11plus Deck Unit Alarms

Enable minimum pressure alarm: NO

Enable maximum pressure alarm: NO

Enable altimeter alarm: NO

SBE 14 Remote Display

Enable SBE 14 Remote Display: NO

PC Alarms

Enable minimum pressure alarm: NO

Enable maximum pressure alarm: NO

Enable altimeter alarm: NO

Enable bottom contact alarm: NO

Alarm uses PC sound card.

Options:

Prompt to save program setup changes: YES

Automatically save program setup changes on exit: NO

Confirm instrument configuration change: YES

Confirm display setup changes: YES

Confirm output file overwrite: YES

Check scan length: YES

Compare serial numbers: YES

Maximized plot may cover Seasave: NO

7.3 APPENDIX C: ADCP processing logbooks

WH1200KHz Logbook

File: F:\ADominguez\DATA\DWDE4\DATA\PE18_15_Perez_ADCP\proc\wh1200\quick_run.log

2017-11-13 13:14:15,415 INFO quick_adcp importing numpy version 1.11.0

2017-11-13 13:14:15,424 INFO quick_adcp importing matplotlib version 1.5.1

2017-11-13 13:14:15,588 INFO quick_adcp ==========

2017-11-13 13:14:15,588 INFO quick_adcp ==========

2017-11-13 13:14:15,588 INFO quick_adcp command line was: /usr/local/currents/bin/run_quick.py -d wh1200

2017-11-13 13:14:15,588 INFO quick_adcp cwd is /home/data/PE18_15_Perez_ADCP/proc/wh1200

about to run these steps:

- write_clearflags
- scandata
- avg_and_load
- codaseditsetup
- setflags
- getnav
- lst_hdg

- plot_headcorr

- navsteps

- find_pflags

- apply_edit

- navsteps

- lst_temp

- plot_temp

- lst_npings

- calib

- matfiles

- adcpsect

- refabs

- smoothnav

- putnav

- refplots

- find_pflags

- codaseditsetup

2017-11-13 13:14:15,590 INFO quick_adcp ----------

2017-11-13 13:14:15,590 INFO quick_adcp step 1: set up files in "edit" directory

2017-11-13 13:14:15,590 INFO quick_adcp ----------

2017-11-13 13:14:15,590 INFO quick_adcp step 2: scan files for time range

2017-11-13 13:14:15,650 INFO quick_adcp looking for database with adcpdb/a_pe*.blk

2017-11-13 13:14:15,650 INFO quick_adcp database found: listing blocks

2017-11-13 13:14:15,658 INFO quick_adcp ----------

2017-11-13 13:14:15,658 INFO quick_adcp step 3: generate averaged data...

2017-11-13 13:14:15,674 INFO quick_adcp ----------

2017-11-13 13:14:15,674 INFO quick_adcp step 4: load averaged data (to database)

2017-11-13 13:14:15,698 INFO quick_adcp database time range:

2017-11-13 13:14:15,699 INFO quick_adcp 2017/11/04 01:09:19 to 2017/11/13 13:12:52

2017-11-13 13:14:15,699 INFO quick_adcp (307.048137 to 316.550602)

2017-11-13 13:14:15,710 INFO quick_adcp ----------

2017-11-13 13:14:15,710 INFO quick_adcp step 5: set up files for codas editing (gautoedit.py)

2017-11-13 13:14:15,710 INFO quick_adcp ----------

2017-11-13 13:14:15,710 INFO quick_adcp step 6: run setflags?

2017-11-13 13:14:15,731 INFO quick_adcp ----------

2017-11-13 13:14:15,731 INFO quick_adcp step 7: get navigation

2017-11-13 13:14:16,058 INFO quick_adcp ----------

2017-11-13 13:14:16,058 INFO quick_adcp step 8: list heading

2017-11-13 13:14:16,078 INFO quick_adcp ----------

2017-11-13 13:14:16,078 INFO quick_adcp step 9: plot heading correction

2017-11-13 13:14:16,588 INFO quick_adcp

2017-11-13 13:14:16,588 INFO quick_adcp ---- running navsteps ---

2017-11-13 13:14:16,588 INFO quick_adcp ----------

2017-11-13 13:14:16,588 INFO quick_adcp step 10: nav steps: run adcpsect

2017-11-13 13:14:16,588 INFO quick_adcp navstep 1

2017-11-13 13:14:16,624 INFO quick_adcp ----------

2017-11-13 13:14:16,624 INFO quick_adcp step 11: nav steps: run refabs

2017-11-13 13:14:16,624 INFO quick_adcp navstep 2

2017-11-13 13:14:16,656 INFO quick_adcp ----------

2017-11-13 13:14:16,656 INFO quick_adcp step 12: nav steps: run smoothr for plots

2017-11-13 13:14:16,656 INFO quick_adcp navstep 3

2017-11-13 13:14:16,819 INFO quick_adcp ----------

2017-11-13 13:14:16,819 INFO quick_adcp step 13: nav steps: smooth navigation for velocities

2017-11-13 13:14:16,819 INFO quick_adcp navstep 4

2017-11-13 13:14:16,973 INFO quick_adcp ----------

2017-11-13 13:14:16,974 INFO quick_adcp step 14: nav steps: put positions and uvship from refsm into codasdb

2017-11-13 13:14:16,974 INFO quick_adcp navstep 5

2017-11-13 13:14:17,251 INFO quick_adcp ----------

2017-11-13 13:14:17,251 INFO quick_adcp step 15: nav steps: make reflayer plots

2017-11-13 13:14:17,251 INFO quick_adcp navstep 6

2017-11-13 13:14:17,817 INFO quick_adcp ----------

2017-11-13 13:14:17,817 INFO quick_adcp step 10: find profile flags

2017-11-13 13:14:17,934 INFO quick_adcp ----------

2017-11-13 13:14:17,934 INFO quick_adcp step 11: apply editing

2017-11-13 13:14:17,972 INFO quick_adcp ----------

2017-11-13 13:14:17,973 INFO quick_adcp step 12: run calibration steps

2017-11-13 13:14:18,687 INFO quick_adcp ----------

2017-11-13 13:14:18,687 INFO quick_adcp step 13: extract and plot temperature

2017-11-13 13:14:18,895 INFO quick_adcp ----------

2017-11-13 13:14:18,895 INFO quick_adcp step 14: extract and plot number of pings per ensemble

2017-11-13 13:14:19,041 INFO quick_adcp ----------

2017-11-13 13:14:19,041 INFO quick_adcp step 15: extract matlab "allbins"

2017-11-13 13:14:19,271 INFO quick_adcp ----------

2017-11-13 13:14:19,271 INFO quick_adcp writing "cruise_info.txt"

OS75KHz Logbook

File: F:\ADominguez\DATA\DWDE4\DATA\PE18_15_Perez_ADCP\proc\os75bb\quick_run.log

2017-11-13 13:15:37,210 INFO quick_adcp importing numpy version 1.11.0

2017-11-13 13:15:37,218 INFO quick_adcp importing matplotlib version 1.5.1

2017-11-13 13:15:37,382 INFO quick_adcp ==========

2017-11-13 13:15:37,382 INFO quick_adcp ==========

2017-11-13 13:15:37,382 INFO quick_adcp command line was: /usr/local/currents/bin/run_quick.py -d os75bb

2017-11-13 13:15:37,382 INFO quick_adcp cwd is /home/data/PE18_15_Perez_ADCP/proc/os75bb

about to run these steps:

- write_clearflags

- scandata

- avg_and_load

- codaseditsetup

- setflags

- getnav

- lst_hdg

- plot_headcorr

- navsteps

- find_pflags

- apply_edit

- navsteps

- lst_temp

- plot_temp

- lst_npings

- calib

- matfiles

- adcpsect

- refabs

- smoothnav

- putnav

- refplots

- find_pflags

- codaseditsetup

2017-11-13 13:15:37,388 INFO quick_adcp ----------

2017-11-13 13:15:37,388 INFO quick_adcp step 1: set up files in "edit" directory

2017-11-13 13:15:37,388 INFO quick_adcp ----------

2017-11-13 13:15:37,388 INFO quick_adcp step 2: scan files for time range

2017-11-13 13:15:37,452 INFO quick_adcp looking for database with adcpdb/a_pe*.blk

2017-11-13 13:15:37,452 INFO quick_adcp database found: listing blocks

2017-11-13 13:15:37,460 INFO quick_adcp ----------

2017-11-13 13:15:37,460 INFO quick_adcp step 3: generate averaged data...

2017-11-13 13:15:37,474 INFO quick_adcp ----------

2017-11-13 13:15:37,474 INFO quick_adcp step 4: load averaged data (to database)

2017-11-13 13:15:37,492 INFO quick_adcp database time range:

2017-11-13 13:15:37,492 INFO quick_adcp 2017/11/04 01:12:19 to 2017/11/13 13:11:54

2017-11-13 13:15:37,492 INFO quick_adcp (307.050220 to 316.549931)

2017-11-13 13:15:37,499 INFO quick_adcp ----------

2017-11-13 13:15:37,500 INFO quick_adcp step 5: set up files for codas editing (gautoedit.py)

2017-11-13 13:15:37,500 INFO quick_adcp ----------

2017-11-13 13:15:37,500 INFO quick_adcp step 6: run setflags?

2017-11-13 13:15:37,512 INFO quick_adcp ----------

2017-11-13 13:15:37,513 INFO quick_adcp step 7: get navigation

2017-11-13 13:15:37,777 INFO quick_adcp ----------

2017-11-13 13:15:37,778 INFO quick_adcp step 8: list heading

2017-11-13 13:15:37,788 INFO quick_adcp ----------

2017-11-13 13:15:37,789 INFO quick_adcp step 9: plot heading correction

2017-11-13 13:15:38,291 INFO quick_adcp

2017-11-13 13:15:38,291 INFO quick_adcp ---- running navsteps ---

2017-11-13 13:15:38,291 INFO quick_adcp ----------

2017-11-13 13:15:38,291 INFO quick_adcp step 10: nav steps: run adcpsect

2017-11-13 13:15:38,291 INFO quick_adcp navstep 1

2017-11-13 13:15:38,309 INFO quick_adcp ----------

2017-11-13 13:15:38,309 INFO quick_adcp step 11: nav steps: run refabs

2017-11-13 13:15:38,309 INFO quick_adcp navstep 2

2017-11-13 13:15:38,325 INFO quick_adcp ----------

2017-11-13 13:15:38,325 INFO quick_adcp step 12: nav steps: run smoothr for plots

2017-11-13 13:15:38,325 INFO quick_adcp navstep 3

2017-11-13 13:15:38,387 INFO quick_adcp ----------

2017-11-13 13:15:38,387 INFO quick_adcp step 13: nav steps: smooth navigation for velocities

2017-11-13 13:15:38,387 INFO quick_adcp navstep 4

2017-11-13 13:15:38,464 INFO quick_adcp ----------

2017-11-13 13:15:38,464 INFO quick_adcp step 14: nav steps: put positions and uvship from refsm into codasdb

2017-11-13 13:15:38,464 INFO quick_adcp navstep 5

2017-11-13 13:15:38,690 INFO quick_adcp ----------

2017-11-13 13:15:38,690 INFO quick_adcp step 15: nav steps: make reflayer plots

2017-11-13 13:15:38,690 INFO quick_adcp navstep 6

2017-11-13 13:15:39,179 INFO quick_adcp ----------

2017-11-13 13:15:39,179 INFO quick_adcp step 10: find profile flags

2017-11-13 13:15:39,241 INFO quick_adcp ----------

2017-11-13 13:15:39,241 INFO quick_adcp step 11: apply editing

2017-11-13 13:15:39,264 INFO quick_adcp ----------

2017-11-13 13:15:39,265 INFO quick_adcp step 12: run calibration steps

2017-11-13 13:15:39,855 INFO quick_adcp ----------

2017-11-13 13:15:39,855 INFO quick_adcp step 13: extract and plot temperature

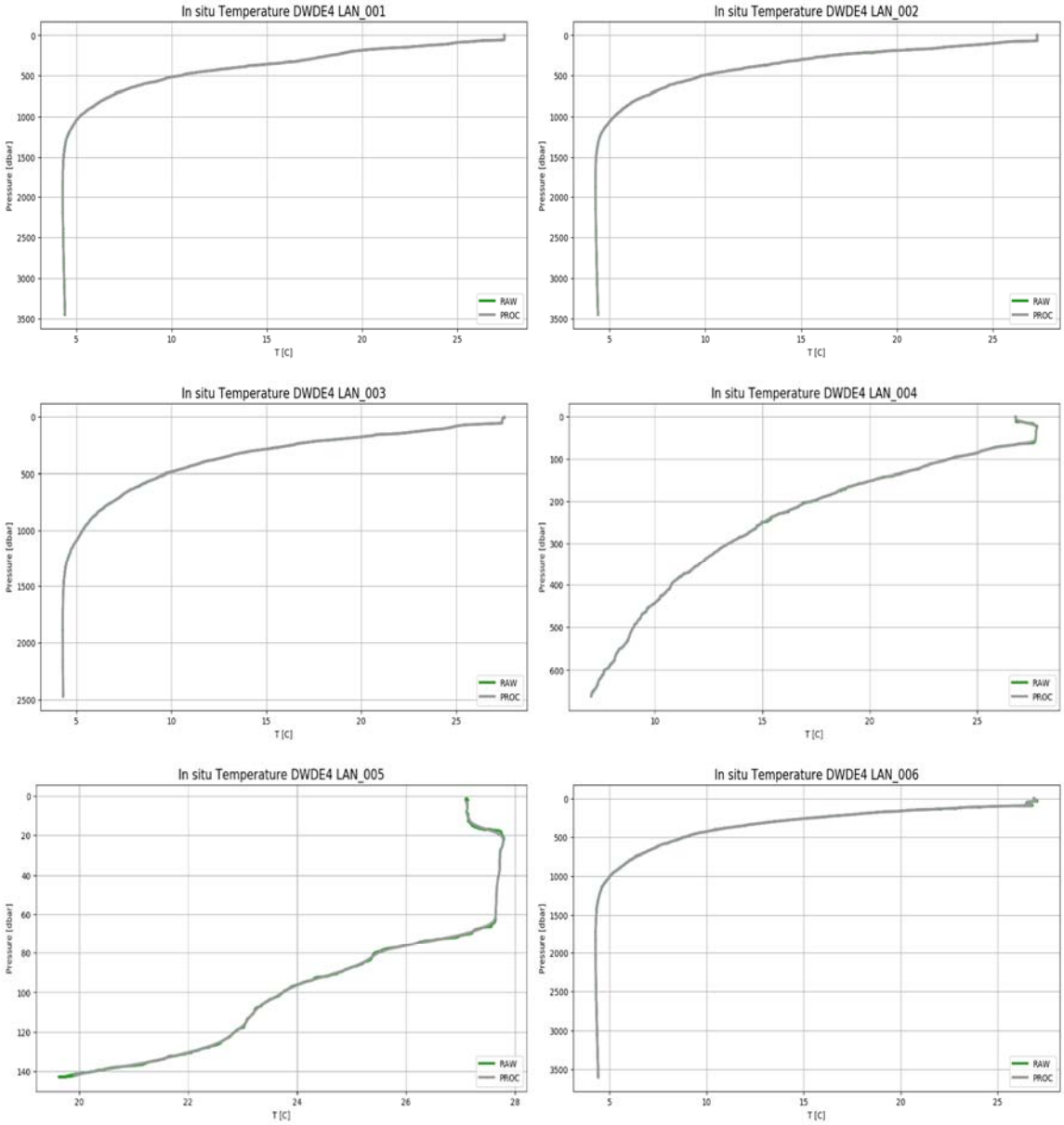
2017-11-13 13:15:40,014 INFO quick_adcp ----------

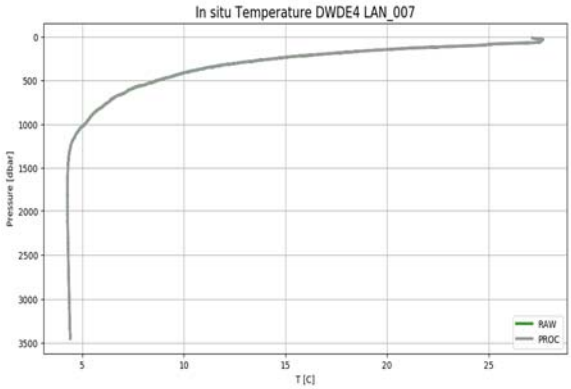
2017-11-13 13:15:40,014 INFO quick_adcp step 14: extract and plot number of pings per ensemble

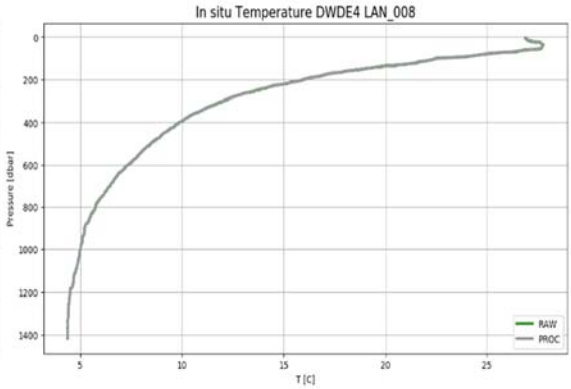
```
2017-11-13 13:15:40,124 INFO     quick_adcp   ------------------------------------------
2017-11-13 13:15:40,124 INFO     quick_adcp   step 15: extract matlab "allbins"

2017-11-13 13:15:40,271 INFO     quick_adcp   ------------------------------------------
2017-11-13 13:15:40,271 INFO     quick_adcp   writing "cruise_info.txt"
```

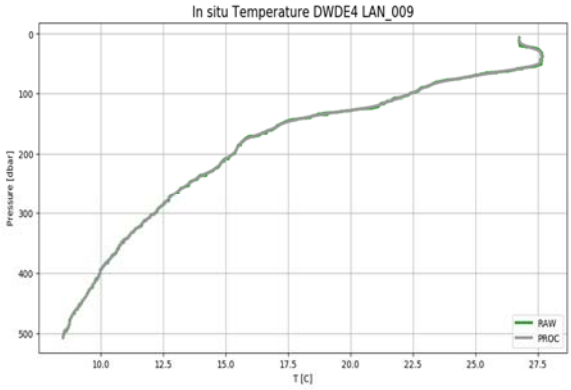
7.4 APPENDIX D CTD PROFILES

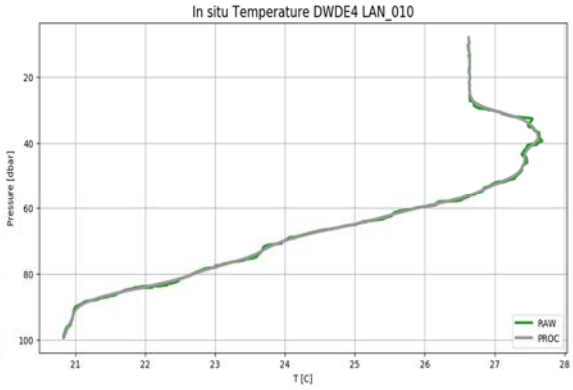
7.4.1 In situ Temperature



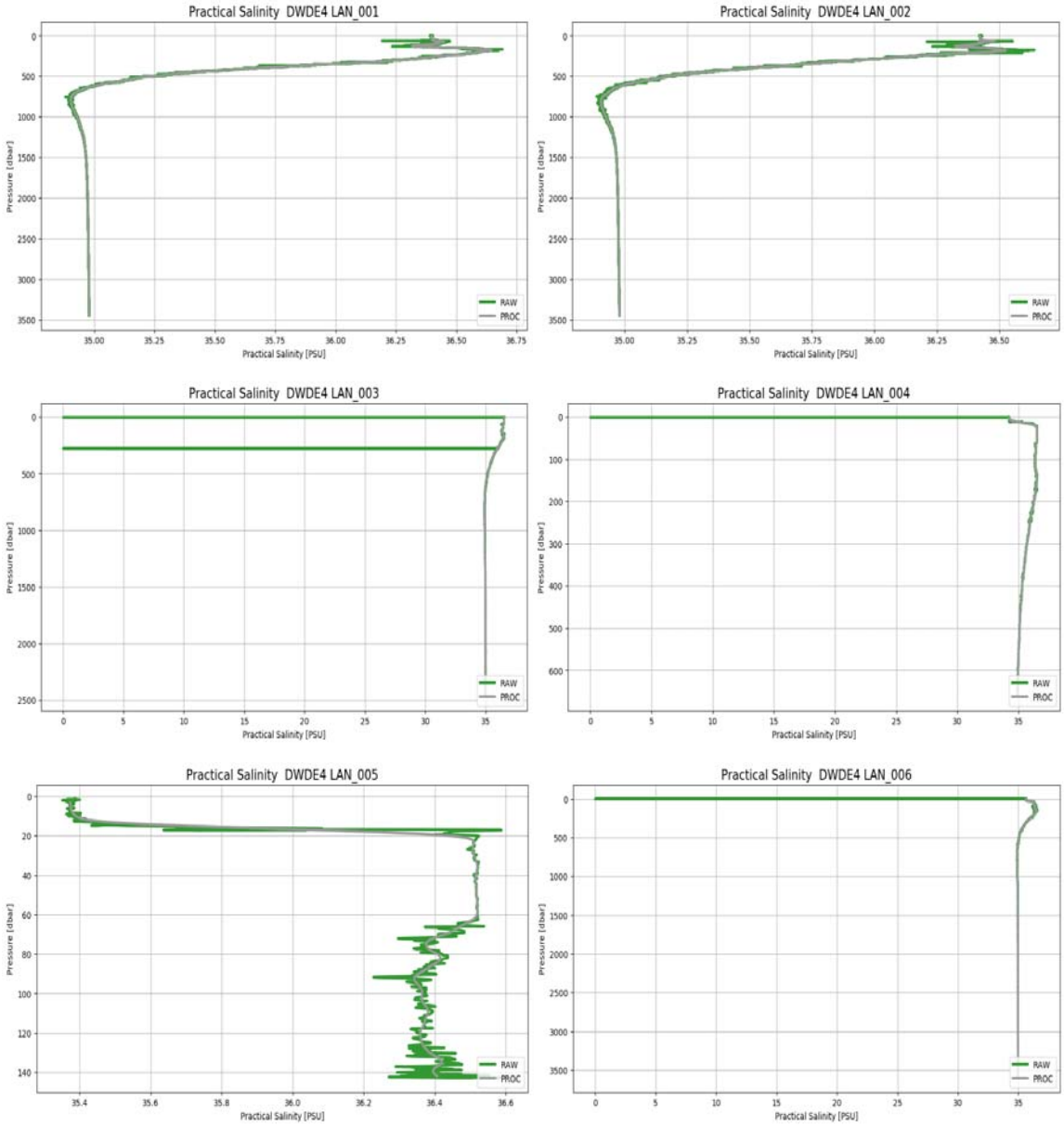

In situ Temperature DWDE4 LAN_007
Pressure [dbar]
T [C]
RAW
PROC

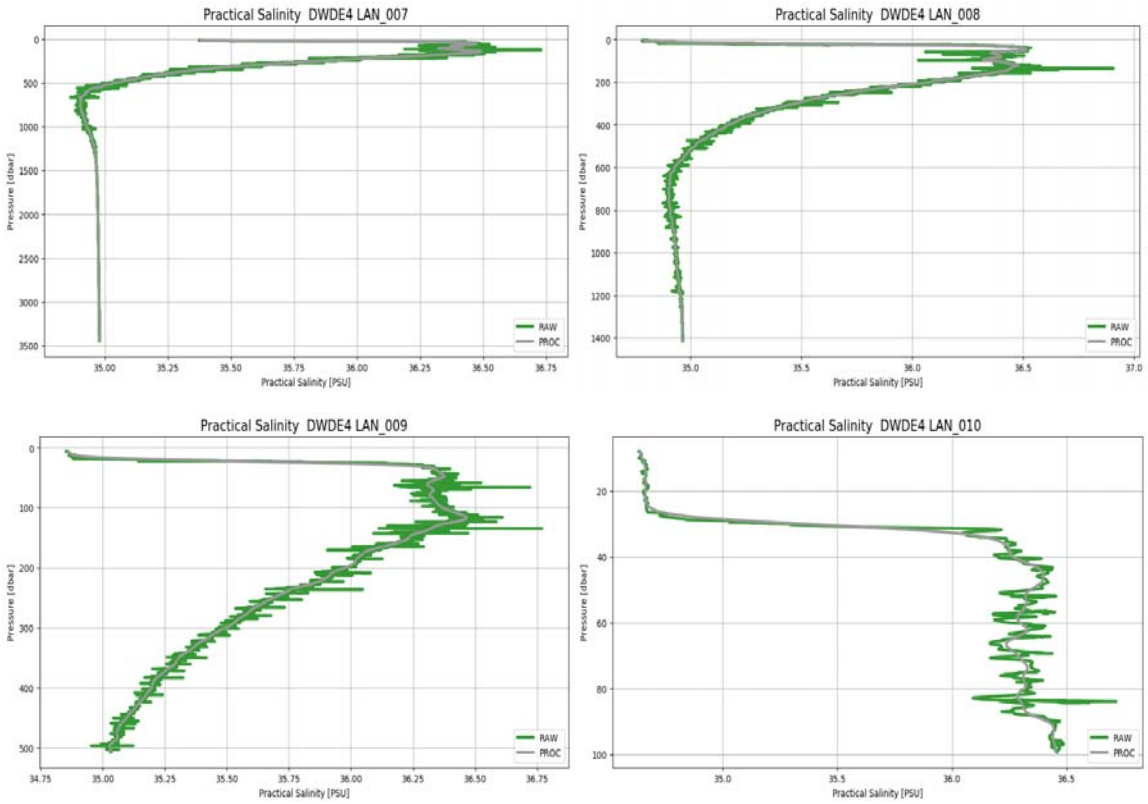

In situ Temperature DWDE4 LAN_008
Pressure [dbar]
T [C]
RAW
PROC


In situ Temperature DWDE4 LAN_009
Pressure [dbar]
T [C]
RAW
PROC

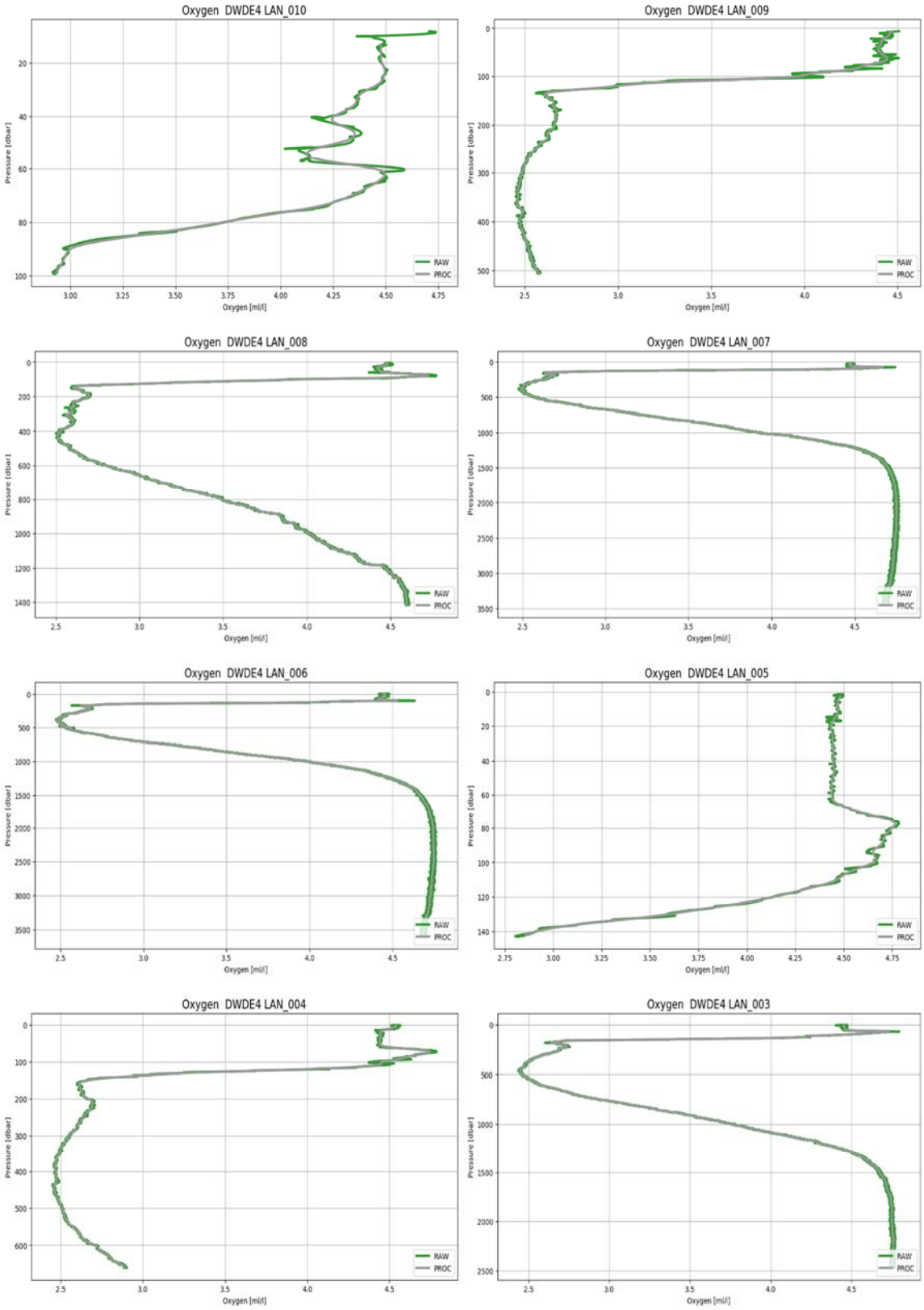

In situ Temperature DWDE4 LAN_010
Pressure [dbar]
T [C]
RAW
PROC

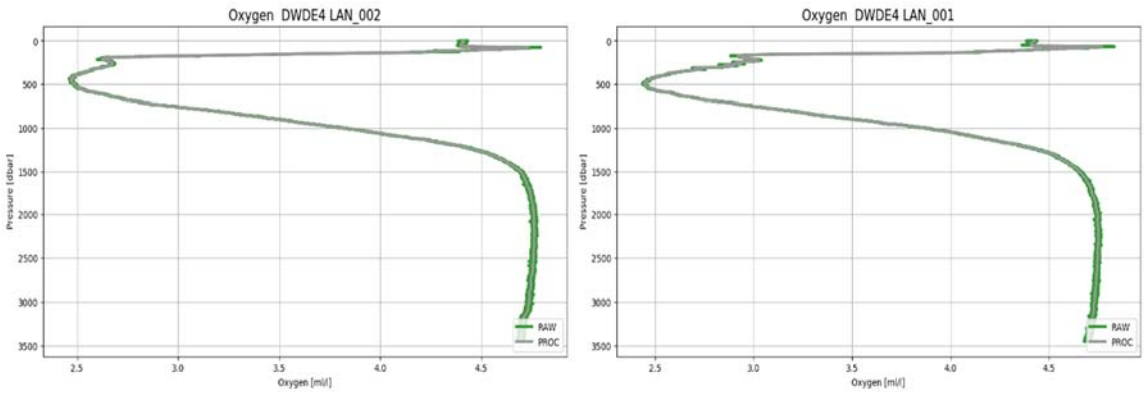
7.4.2 Practical Salinity



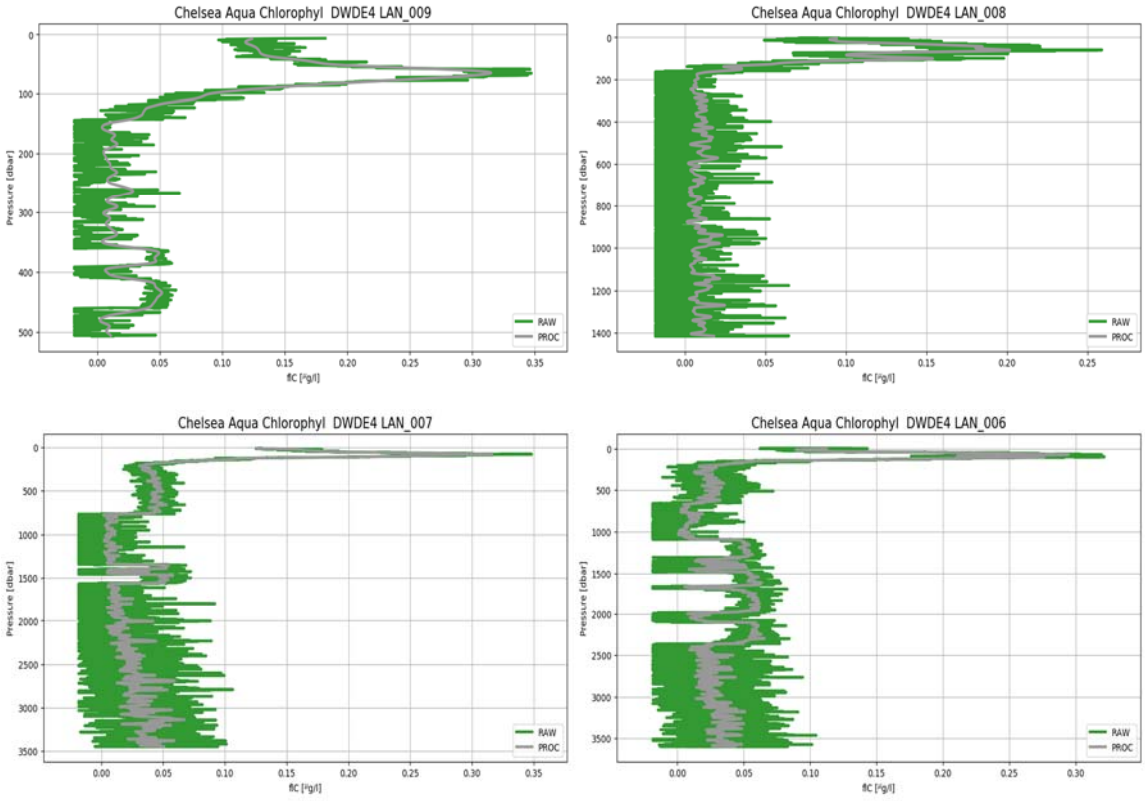

Practical Salinity DWDE4 LAN_007
Pressure [dbar]
Practical Salinity [PSU]
RAW
PROC
Practical Salinity DWDE4 LAN_008
Pressure [dbar]
Practical Salinity [PSU]
RAW
PROC
Practical Salinity DWDE4 LAN_009
Pressure [dbar]
Practical Salinity [PSU]
RAW
PROC
Practical Salinity DWDE4 LAN_010
Pressure [dbar]
Practical Salinity [PSU]
RAW
PROC

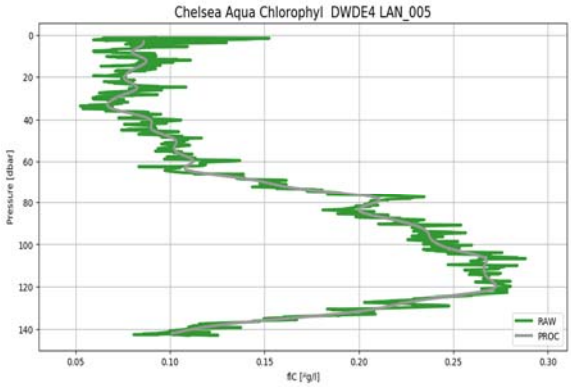
7.4.3 Oxygen

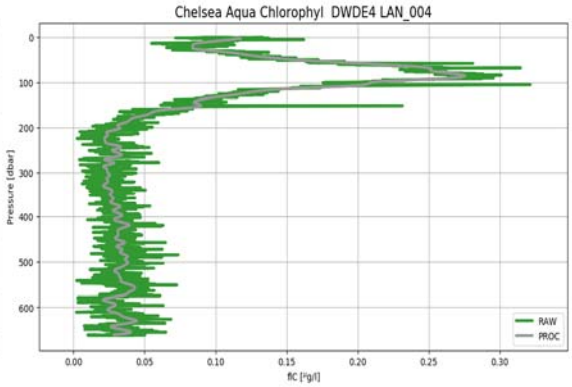

Oxygen DWDE4 LAN_010
Oxygen DWDE4 LAN_009
Oxygen DWDE4 LAN_008
Oxygen DWDE4 LAN_007
Oxygen DWDE4 LAN_006
Oxygen DWDE4 LAN_005
Oxygen DWDE4 LAN_004
Oxygen DWDE4 LAN_003
Pressure [dbar]
Oxygen [ml/l]
RAW
PROC

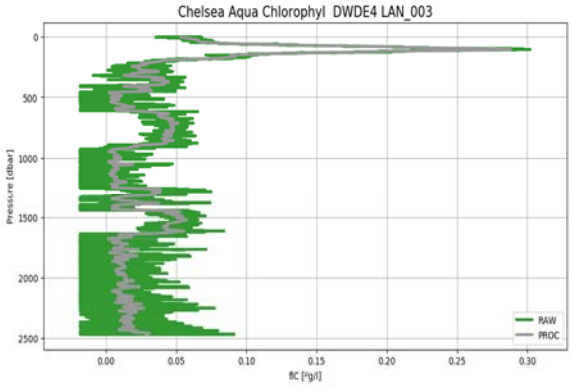


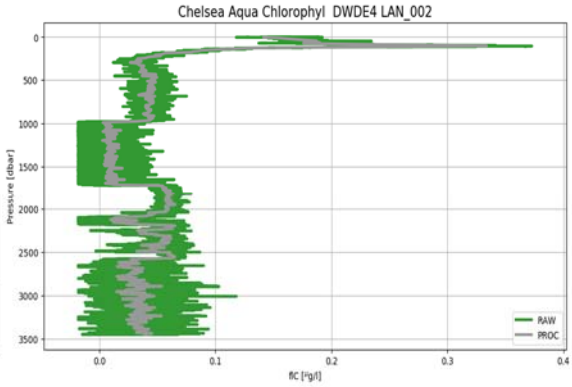
7.4.4 Chlorophyl-a Aquatracka

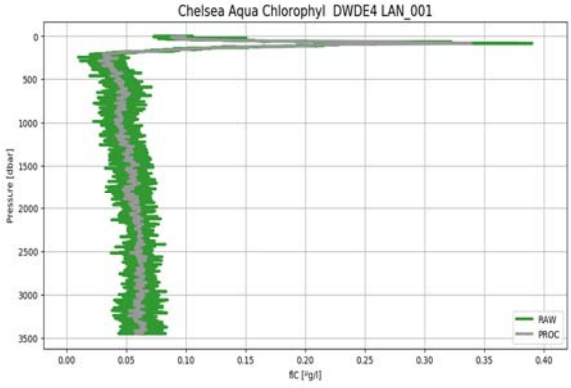


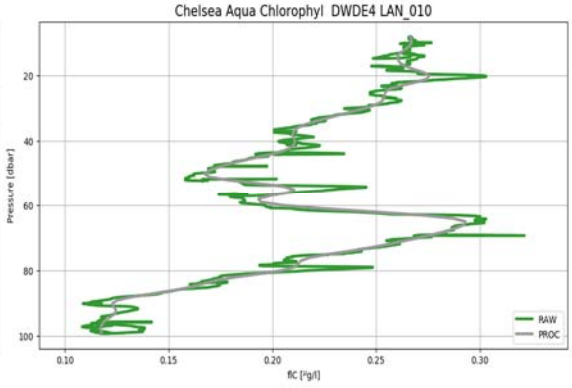

Chelsea Aqua Chlorophyl DWDE4 LAN_005
Pressure [dbar]
fIC [¹g/l]
RAW
PROC


Chelsea Aqua Chlorophyl DWDE4 LAN_004
Pressure [dbar]
fIC [¹g/l]
RAW
PROC

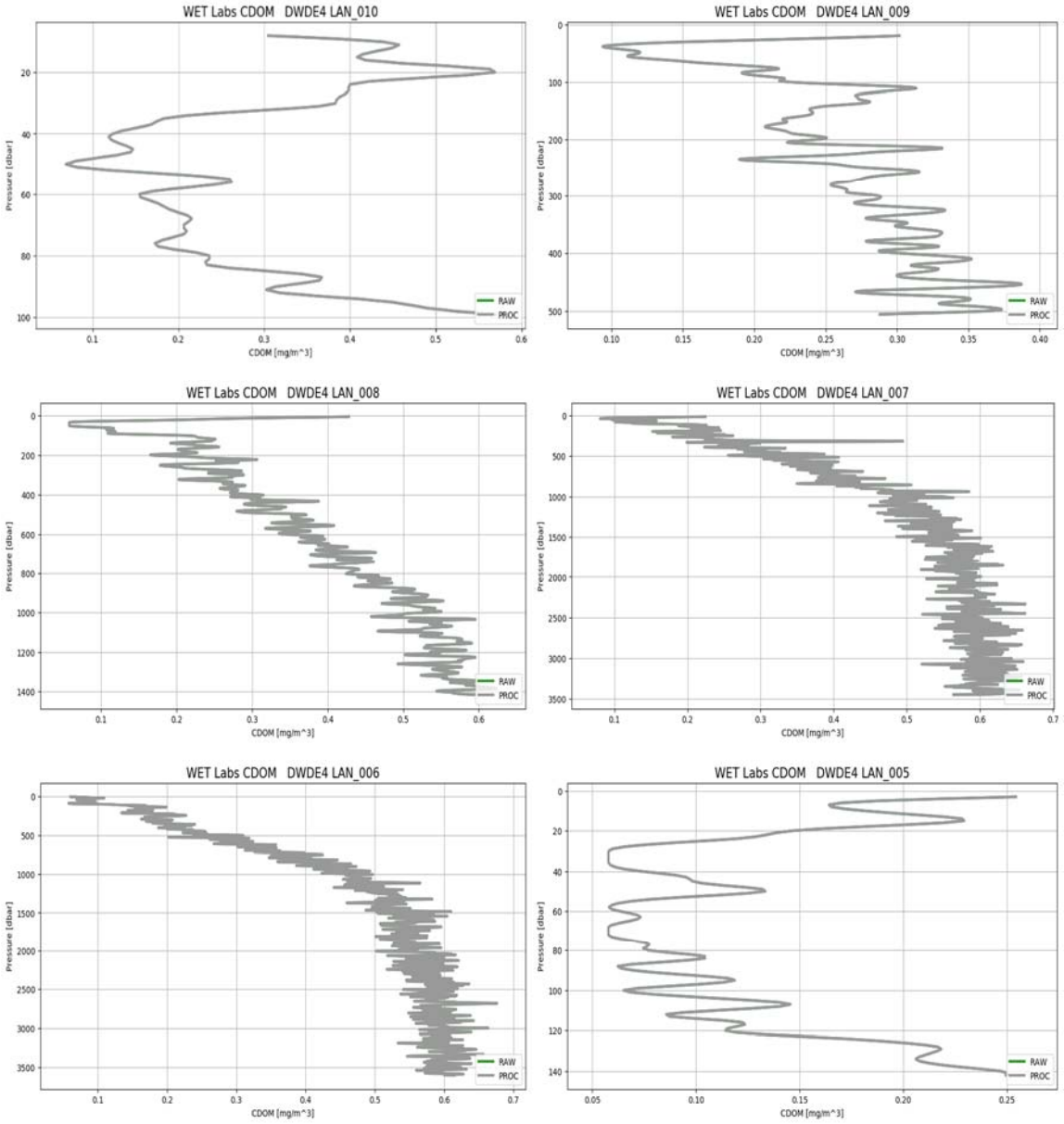

Chelsea Aqua Chlorophyl DWDE4 LAN_003
Pressure [dbar]
fIC [¹g/l]
RAW
PROC

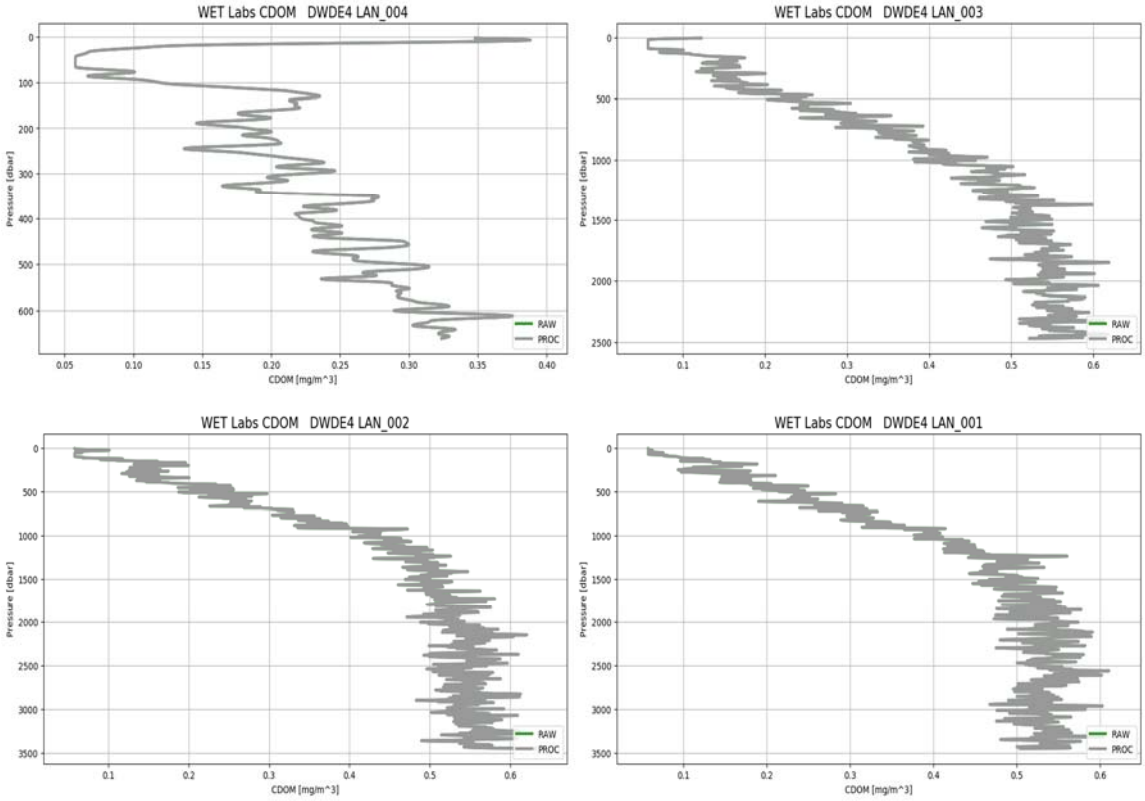

Chelsea Aqua Chlorophyl DWDE4 LAN_002
Pressure [dbar]
fIC [¹g/l]
RAW
PROC


Chelsea Aqua Chlorophyl DWDE4 LAN_001
Pressure [dbar]
fIC [¹g/l]
RAW
PROC

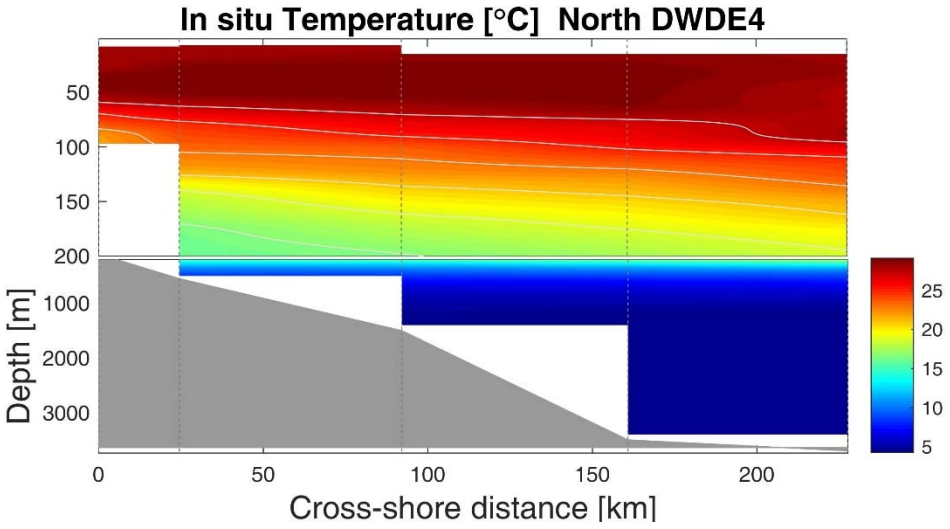

Chelsea Aqua Chlorophyl DWDE4 LAN_010
Pressure [dbar]
fIC [¹g/l]
RAW
PROC

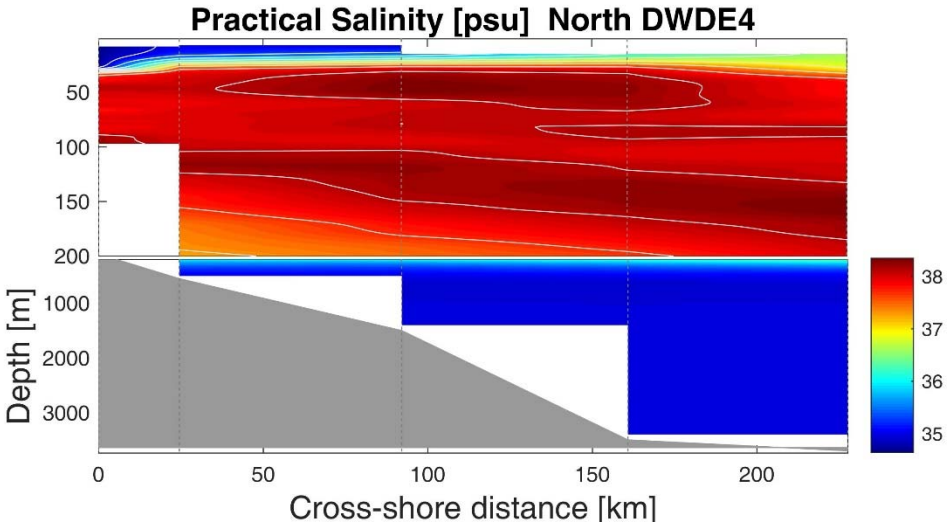
7.4.5 Wetstar CDOM

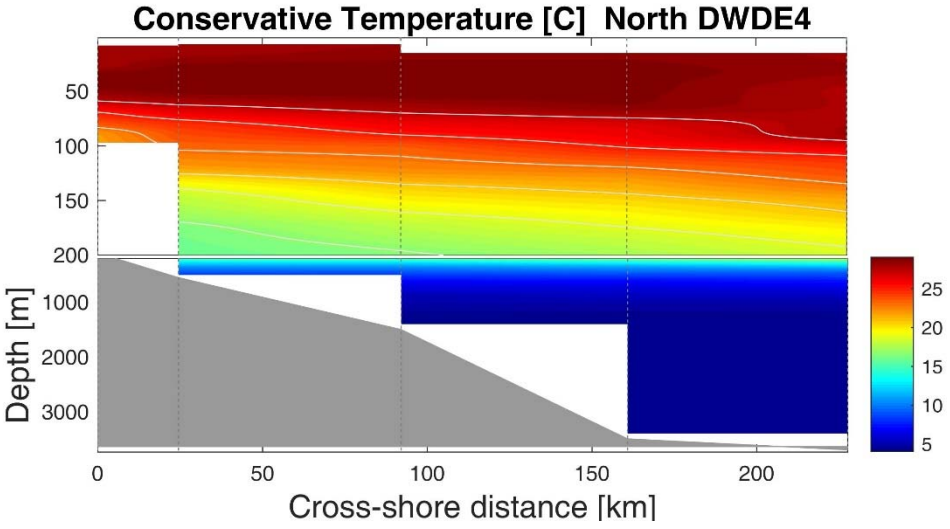


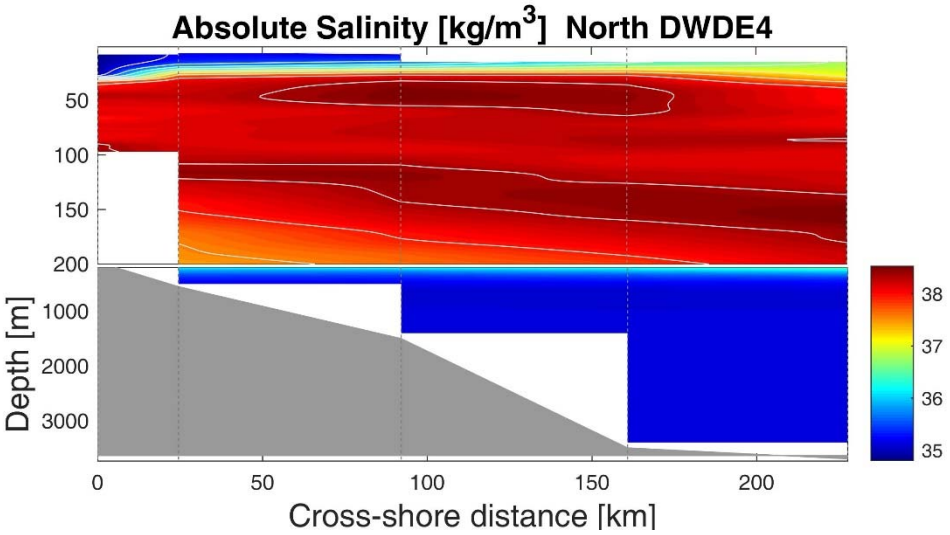

WET Labs CDOM DWDE4 LAN_004
WET Labs CDOM DWDE4 LAN_003
WET Labs CDOM DWDE4 LAN_002
WET Labs CDOM DWDE4 LAN_001
Pressure [dbar]
CDOM [mg/m^3]
RAW
PROC

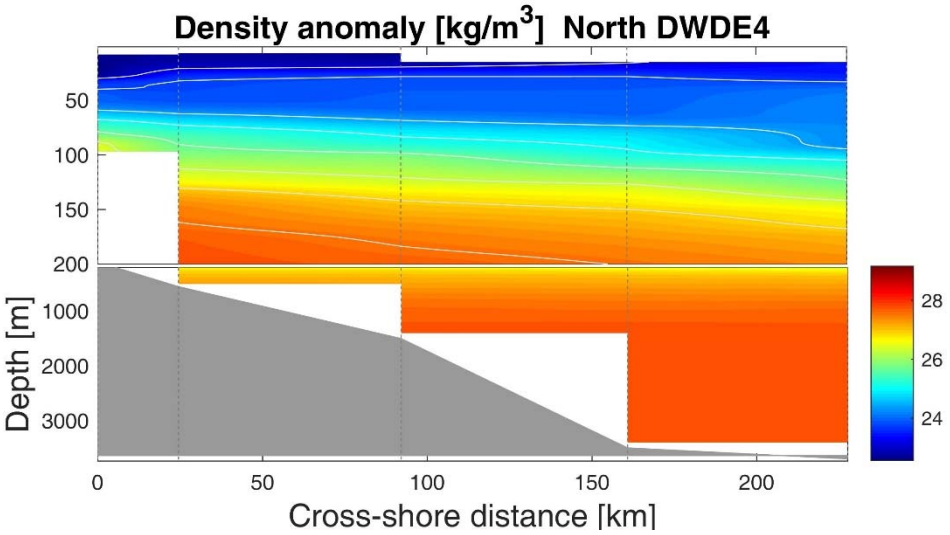
APPENDIX E: CTD CROSS SECTIONS

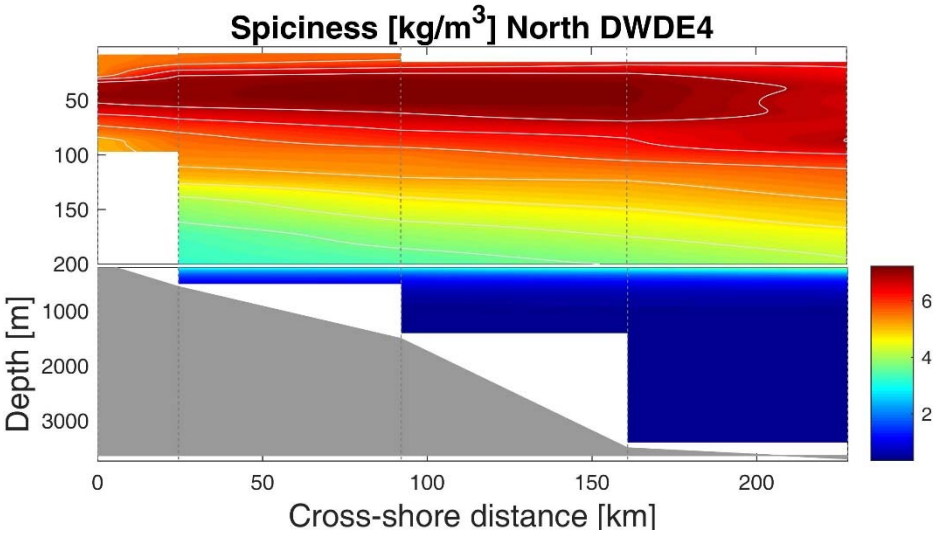


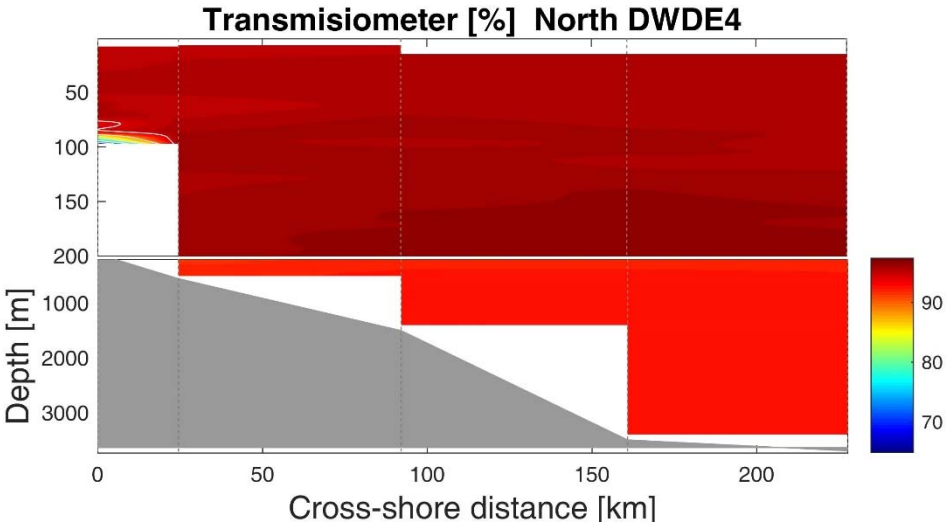


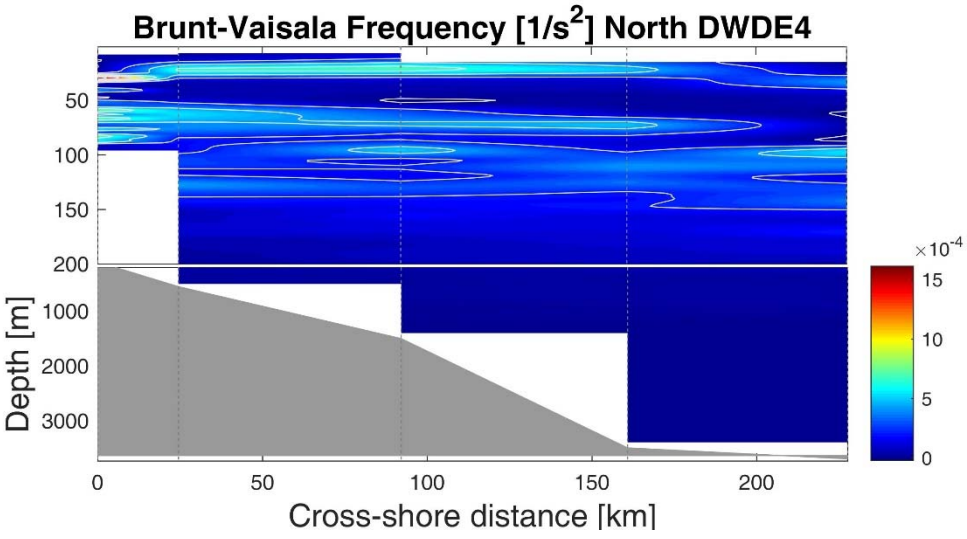

Conservative Temperature [C] North DWDE4
Depth [m]
50
100
150
200
1000
2000
3000
0
50
100
150
200
Cross-shore distance [km]
25
20
15
10
5

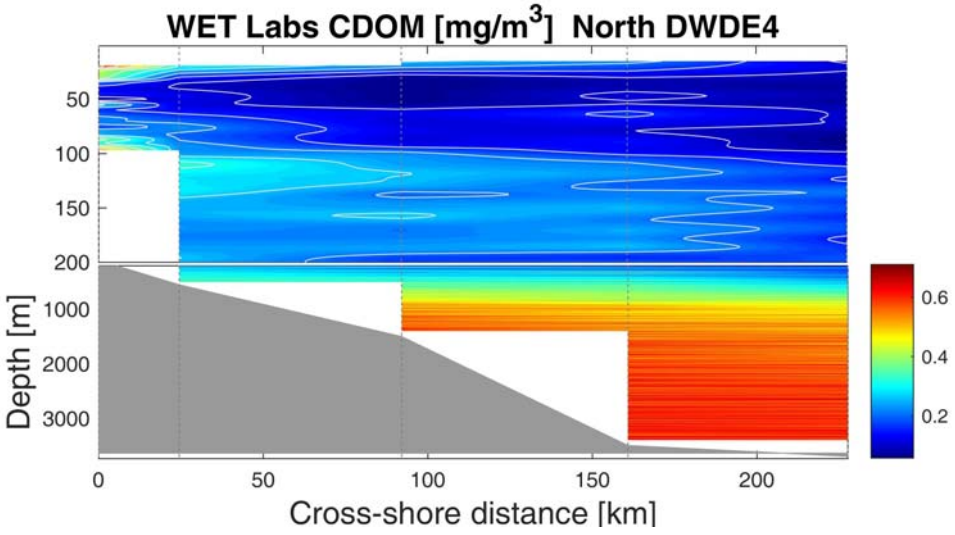

Absolute Salinity [kg/m3] North DWDE4
Depth [m]
50
100
150
200
1000
2000
3000
0
50
100
150
200
Cross-shore distance [km]
38
37
36
35

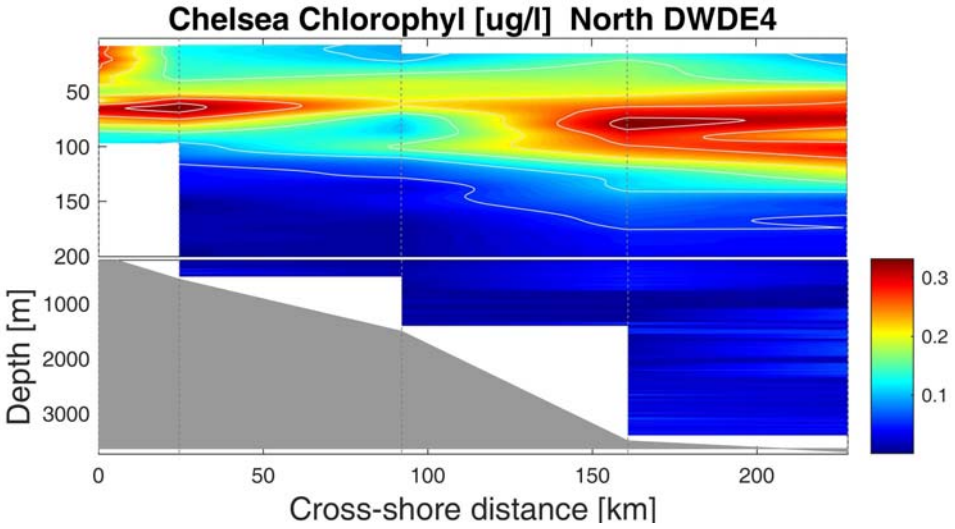

Density anomaly [kg/m3] North DWDE4
Depth [m]
50
100
150
200
1000
2000
3000
0
50
100
150
200
Cross-shore distance [km]
28
26
24

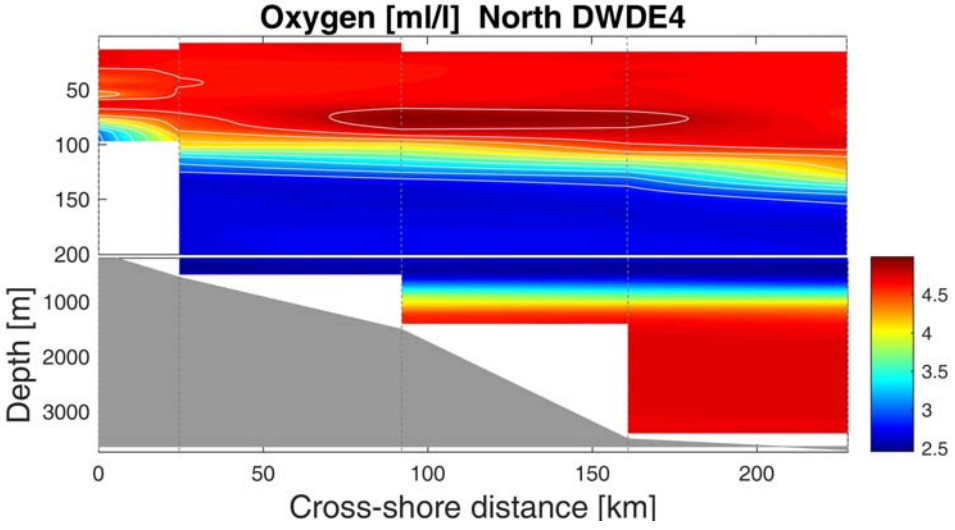

Spiciness [kg/m3] North DWDE4
Depth [m]
50
100
150
200
1000
2000
3000
0
50
100
150
200
Cross-shore distance [km]
6
4
2

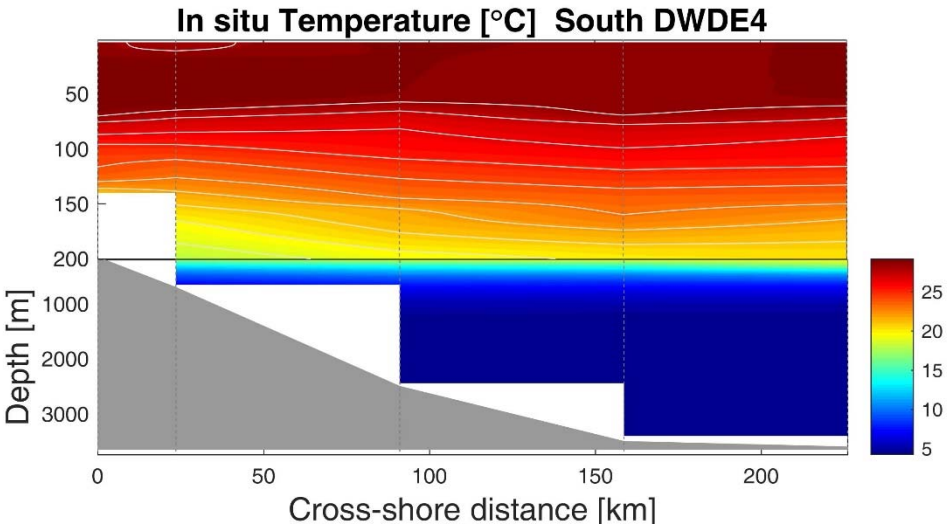

Transmisiometer [%] North DWDE4
Depth [m]
50
100
150
200
1000
2000
3000
0
50
100
150
200
Cross-shore distance [km]
90
80
70

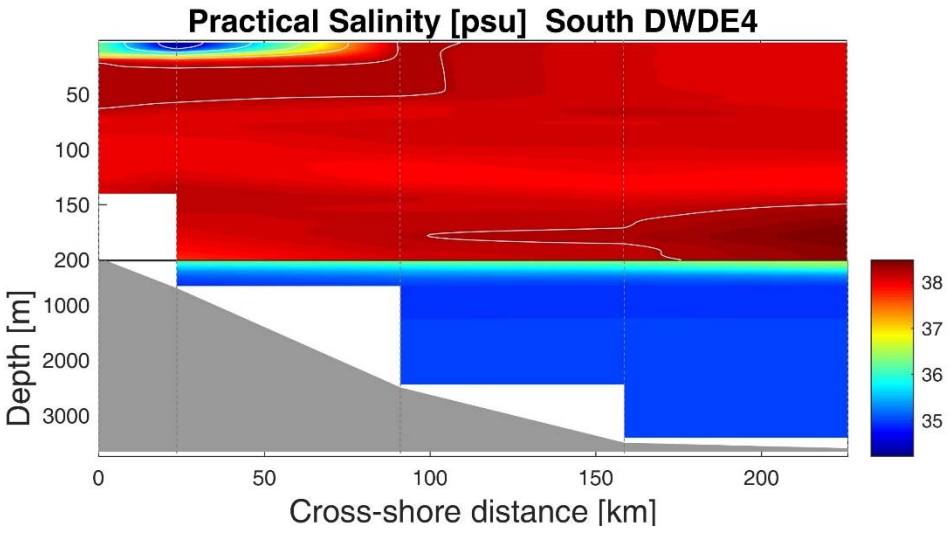

Brunt-Vaisala Frequency [1/s2] North DWDE4
Depth [m]
50
100
150
200
1000
2000
3000
0
50
100
150
200
Cross-shore distance [km]
×10-4
15
10
5
0

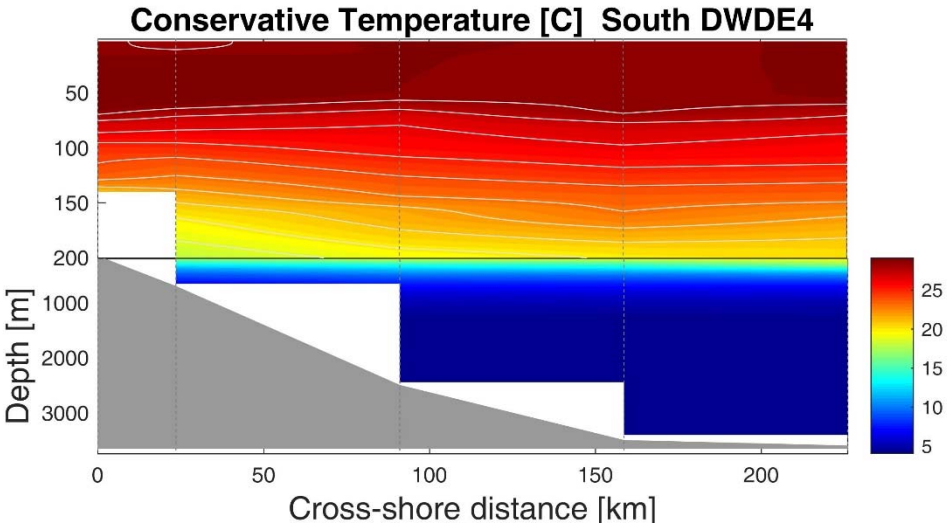

WET Labs CDOM [mg/m3] North DWDE4
Depth [m]
50
100
150
200
1000
2000
3000
0
50
100
150
200
Cross-shore distance [km]
0.6
0.4
0.2

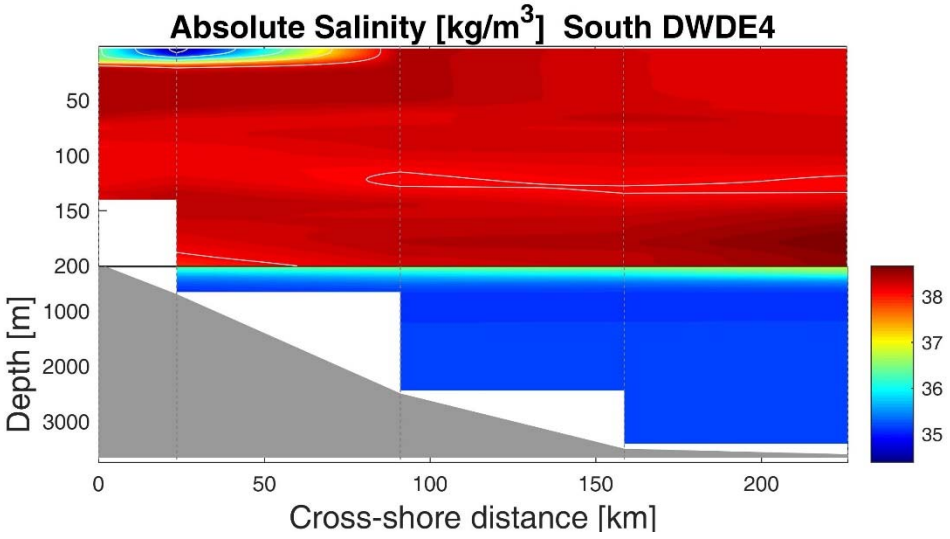

Chelsea Chlorophyl [ug/l] North DWDE4
Depth [m]
50
100
150
200
1000
2000
3000
0
50
100
150
200
Cross-shore distance [km]
0.3
0.2
0.1

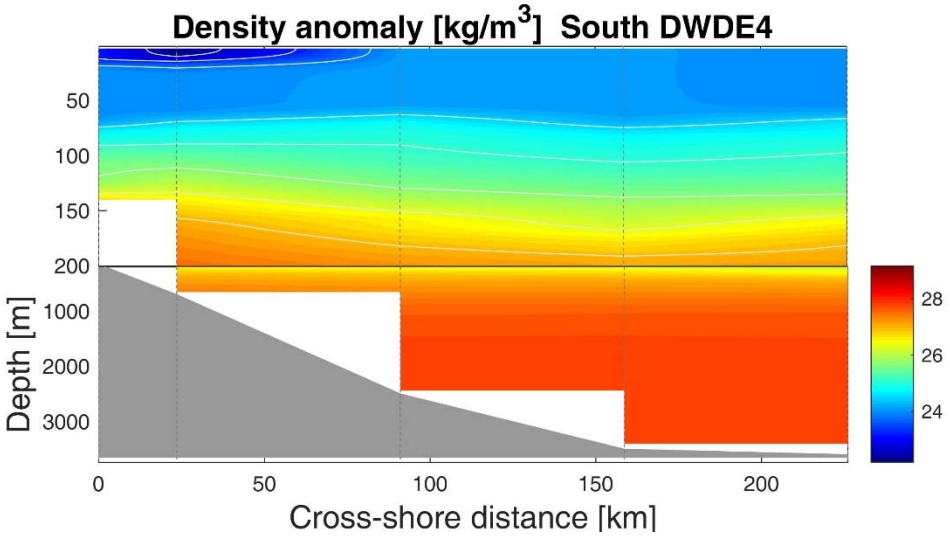

Oxygen [ml/l] North DWDE4
Depth [m]
50
100
150
200
1000
2000
3000
0
50
100
150
200
Cross-shore distance [km]
4.5
4
3.5
3
2.5

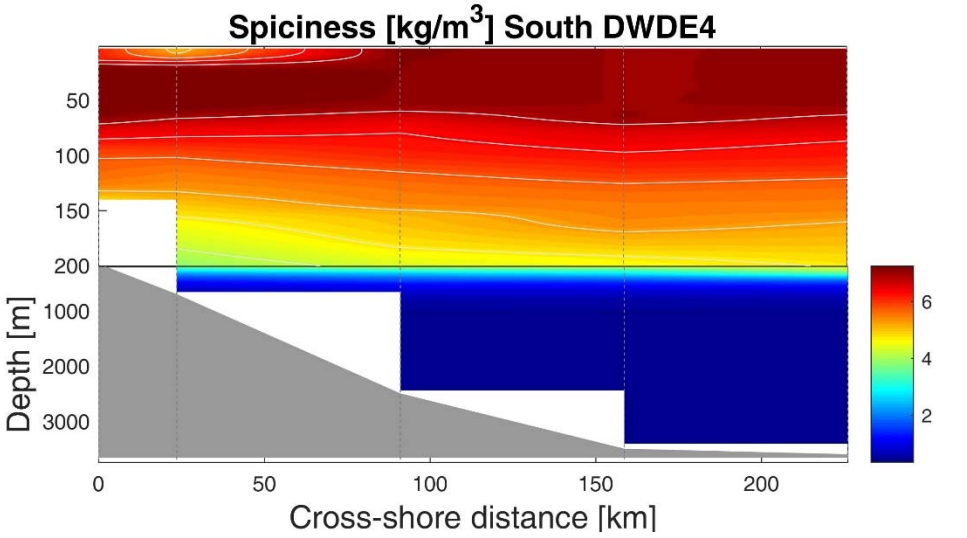

In situ Temperature [°C] South DWDE4
Depth [m]
50
100
150
200
1000
2000
3000
0
50
100
150
200
Cross-shore distance [km]
25
20
15
10
5

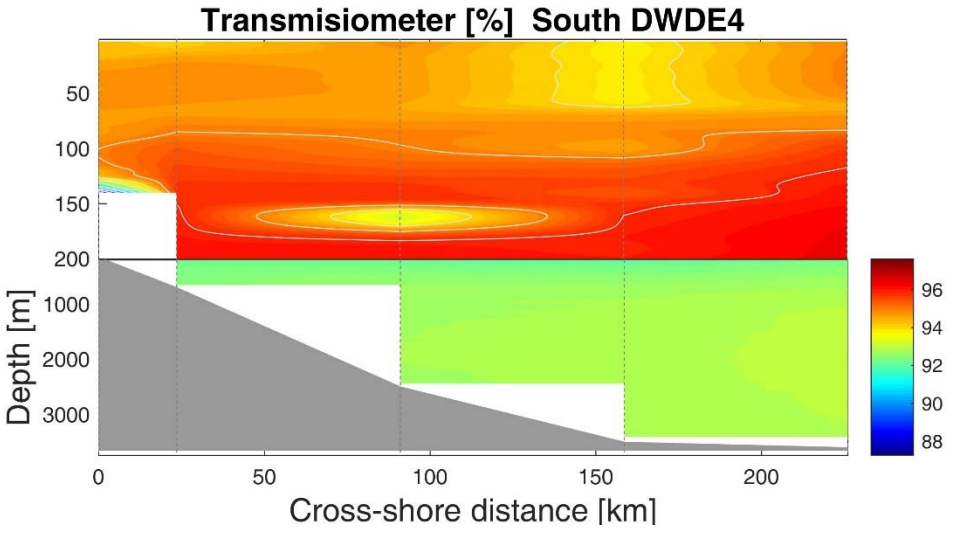

Practical Salinity [psu] South DWDE4
Depth [m]
50
100
150
200
1000
2000
3000
0
50
100
150
200
Cross-shore distance [km]
38
37
36
35

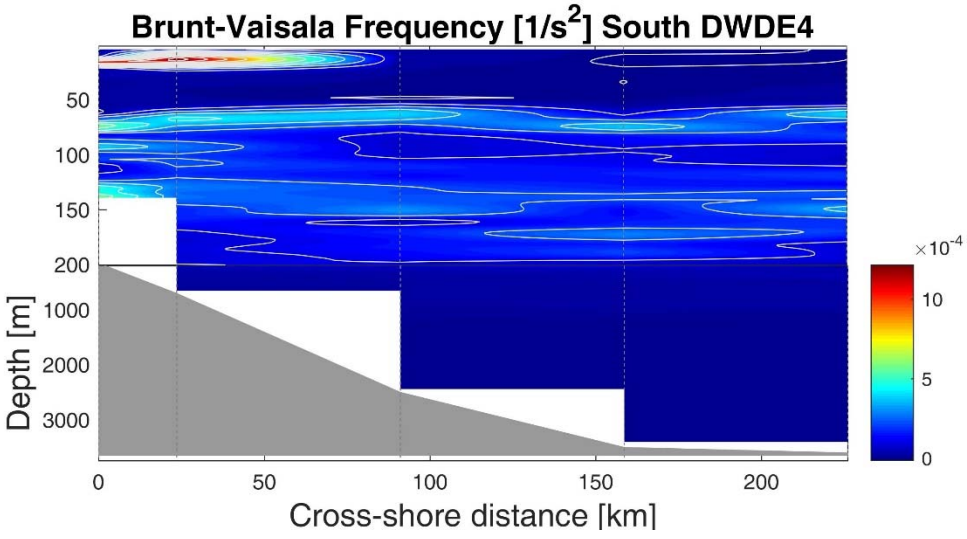

Conservative Temperature [C] South DWDE4
Depth [m]
50
100
150
200
1000
2000
3000
0
50
100
150
200
Cross-shore distance [km]
25
20
15
10
5

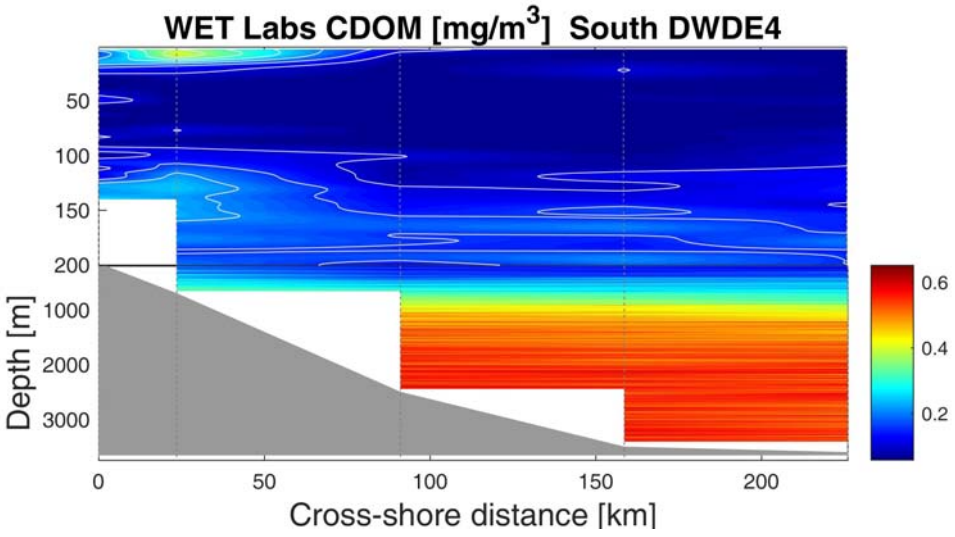

Absolute Salinity [kg/m3] South DWDE4
Depth [m]
50
100
150
200
1000
2000
3000
0
50
100
150
200
Cross-shore distance [km]
38
37
36
35

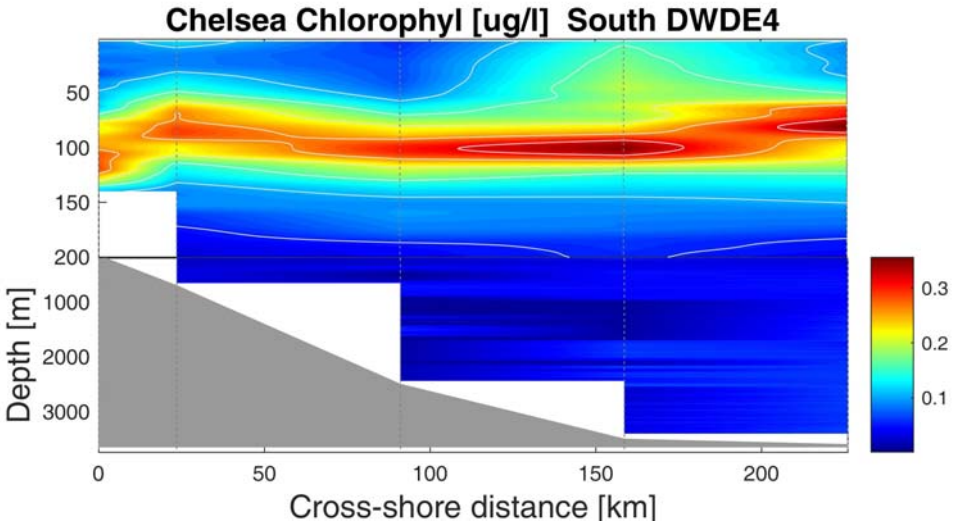

Density anomaly [kg/m3] South DWDE4
Depth [m]
50
100
150
200
1000
2000
3000
0
50
100
150
200
Cross-shore distance [km]
28
26
24

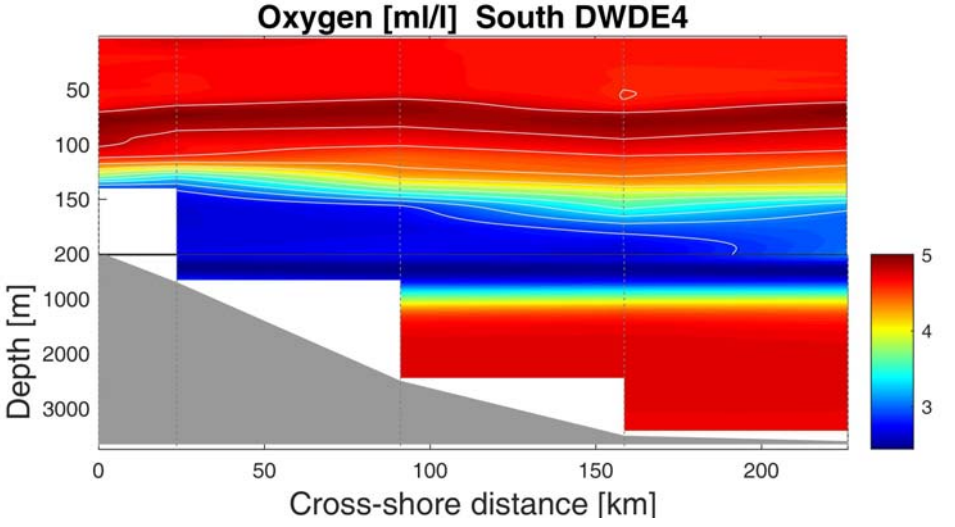

Spiciness [kg/m^3] South DWDE4
Depth [m]
50
100
150
200
1000
2000
3000
0
50
100
150
200
Cross-shore distance [km]
6
4
2


Transmisiometer [%] South DWDE4
Depth [m]
50
100
150
200
1000
2000
3000
0
50
100
150
200
Cross-shore distance [km]
96
94
92
90
88

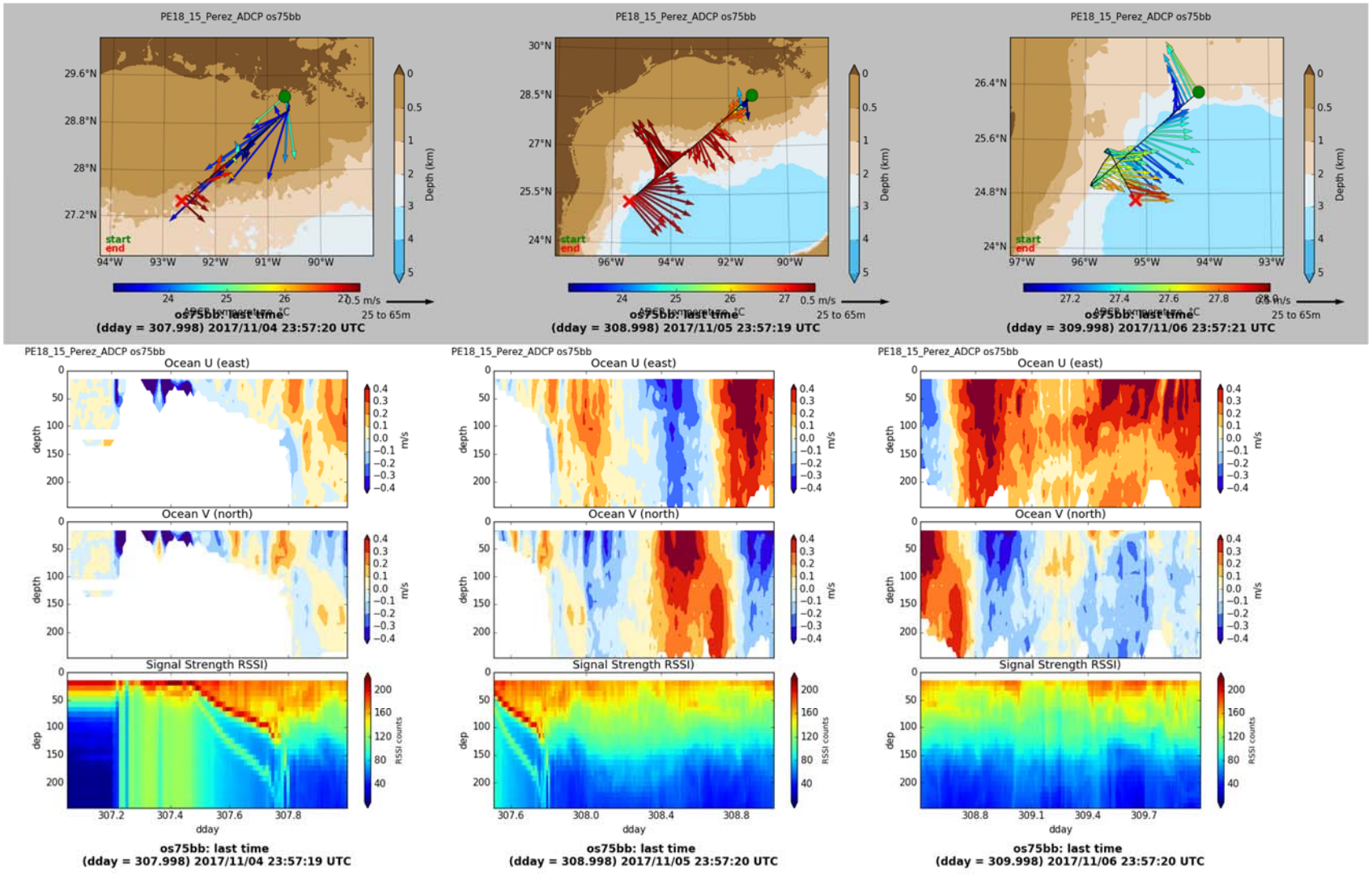

Brunt-Vaisala Frequency [1/s^2] South DWDE4
Depth [m]
50
100
150
200
1000
2000
3000
0
50
100
150
200
Cross-shore distance [km]
×10^{-4}
10
5
0

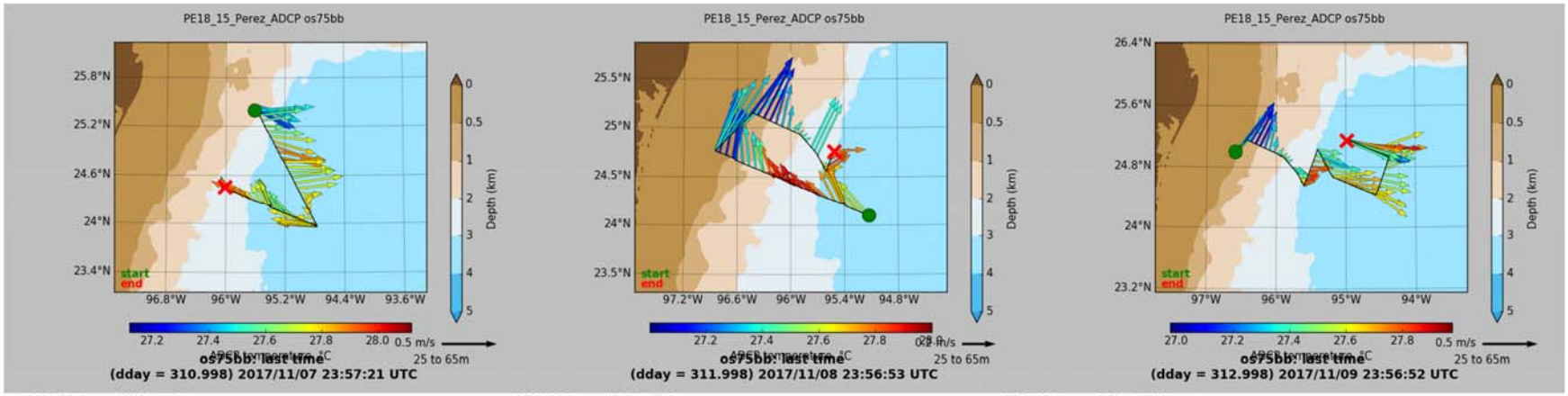

WET Labs CDOM [mg/m3] South DWDE4
Depth [m]
50
100
150
200
1000
2000
3000
0
50
100
150
200
Cross-shore distance [km]
0.6
0.4
0.2

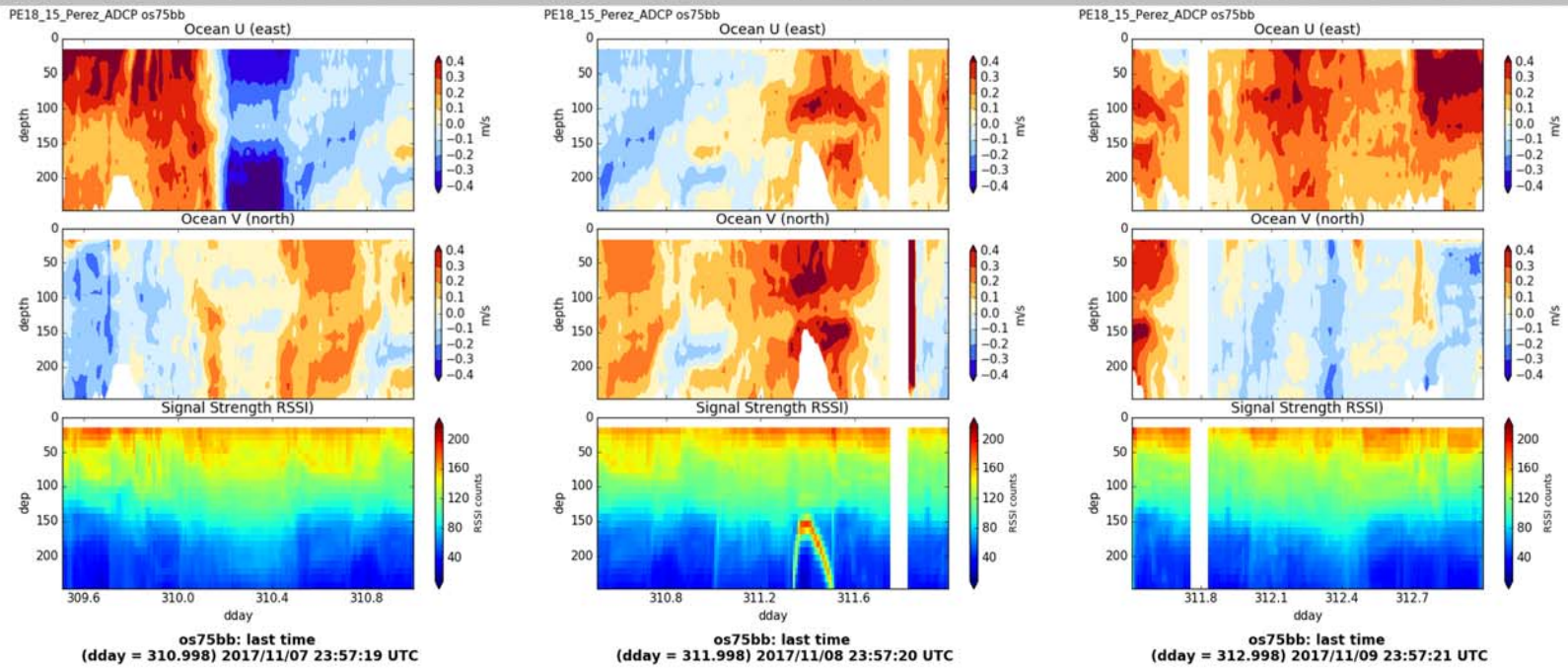

Chelsea Chlorophyl [ug/l] South DWDE4
Depth [m]
50
100
150
200
1000
2000
3000
0
50
100
150
200
Cross-shore distance [km]
0.3
0.2
0.1

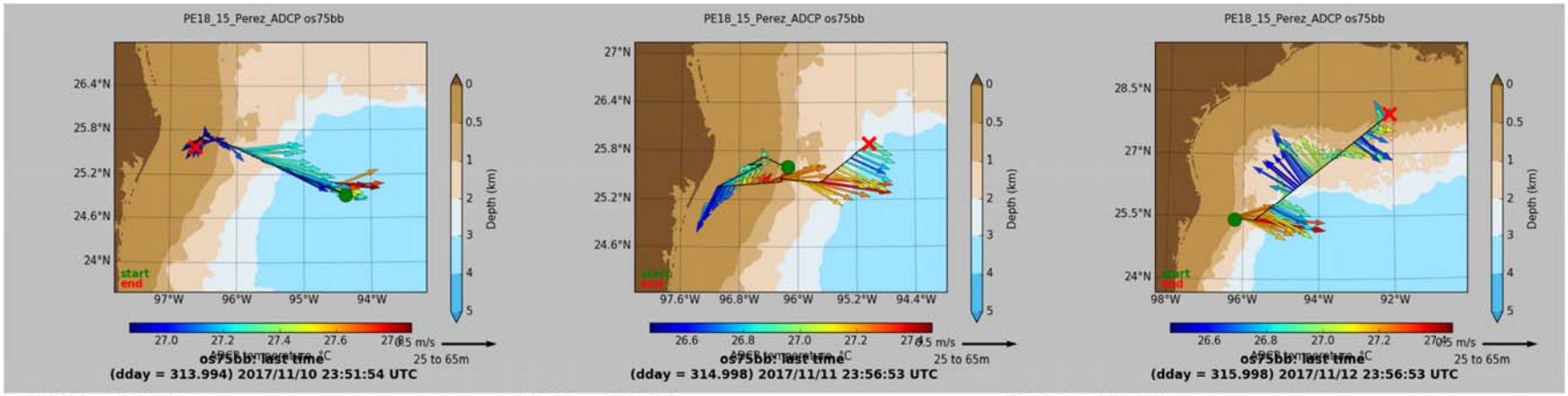

Oxygen [ml/l] South DWDE4
Depth [m]
50
100
150
200
1000
2000
3000
0
50
100
150
200
Cross-shore distance [km]
5
4
3

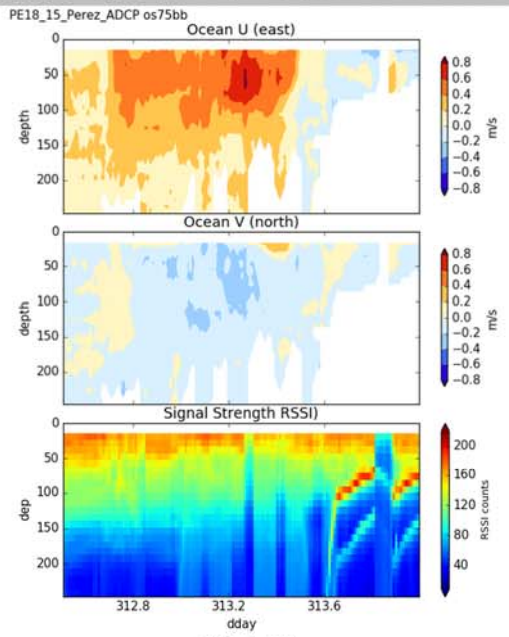
APPENDIX F. ADCP profiles.

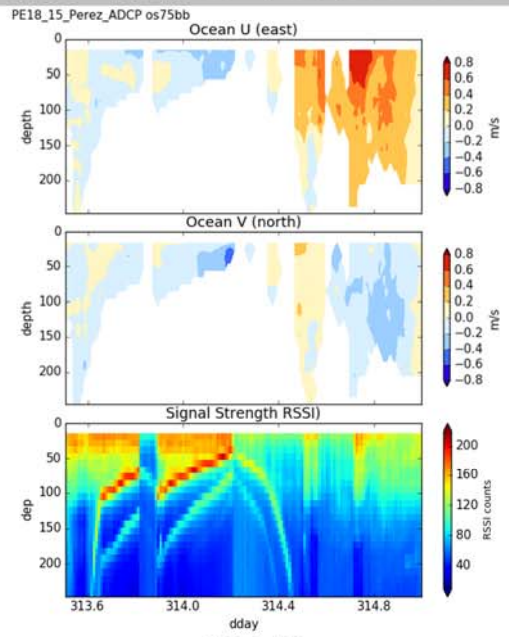


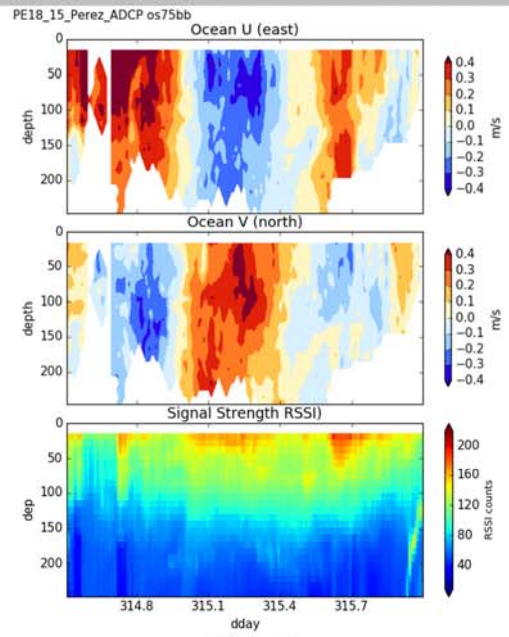

PE18_15_Perez_ADCP os75bb
start
end
Depth (km)
0.5 m/s
25 to 65m
os75bb: last time
(dday = 310.998) 2017/11/07 23:57:21 UTC
PE18_15_Perez_ADCP os75bb
start
end
Depth (km)
0.5 m/s
25 to 65m
os75bb: last time
(dday = 311.998) 2017/11/08 23:56:53 UTC
PE18_15_Perez_ADCP os75bb
start
end
Depth (km)
0.5 m/s
25 to 65m
os75bb: last time
(dday = 312.998) 2017/11/09 23:56:52 UTC

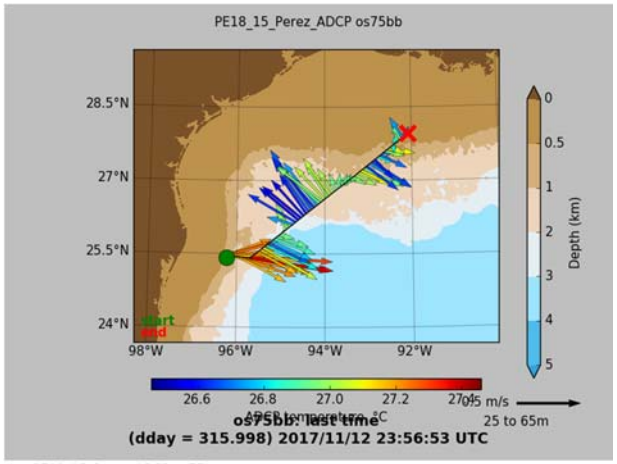

PE18_15_Perez_ADCP os75bb
Ocean U (east)
Ocean V (north)
Signal Strength RSSI)
depth
dep
m/s
RSSI counts
dday
os75bb: last time
(dday = 310.998) 2017/11/07 23:57:19 UTC
PE18_15_Perez_ADCP os75bb
Ocean U (east)
Ocean V (north)
Signal Strength RSSI)
depth
dep
m/s
RSSI counts
dday
os75bb: last time
(dday = 311.998) 2017/11/08 23:57:20 UTC
PE18_15_Perez_ADCP os75bb
Ocean U (east)
Ocean V (north)
Signal Strength RSSI)
depth
dep
m/s
RSSI counts
dday
os75bb: last time
(dday = 312.998) 2017/11/09 23:57:21 UTC

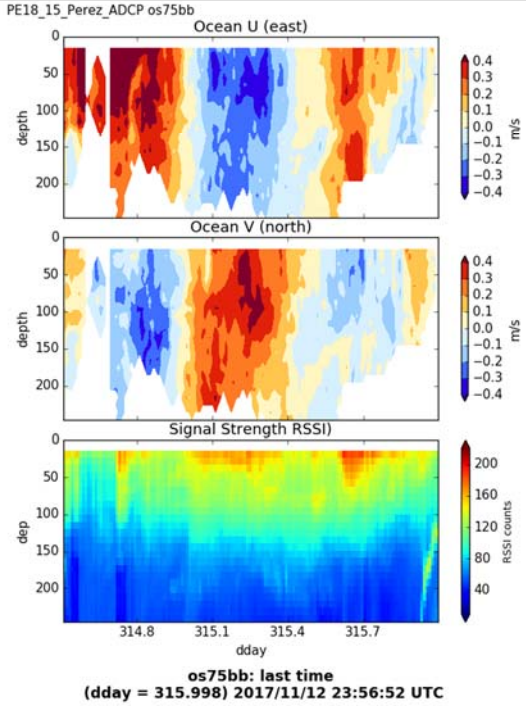

PE18_15_Perez_ADCP os75bb
Depth (km)
start
end
0.5 m/s
25 to 65m
os75bb: last time
(dday = 313.994) 2017/11/10 23:51:54 UTC
PE18_15_Perez_ADCP os75bb
Depth (km)
start
end
0.5 m/s
25 to 65m
os75bb: last time
(dday = 314.998) 2017/11/11 23:56:53 UTC
PE18_15_Perez_ADCP os75bb
Depth (km)
start
end
0.5 m/s
25 to 65m
os75bb: last time
(dday = 315.998) 2017/11/12 23:56:53 UTC


PE18_15_Perez_ADCP os75bb
Ocean U (east)
Ocean V (north)
Signal Strength RSSI)
depth
dep
m/s
RSSI counts
dday
os75bb: last time
(dday = 313.998) 2017/11/10 23:56:52 UTC


PE18_15_Perez_ADCP os75bb
Ocean U (east)
Ocean V (north)
Signal Strength RSSI)
depth
dep
m/s
RSSI counts
dday
os75bb: last time
(dday = 314.998) 2017/11/11 23:56:52 UTC


PE18_15_Perez_ADCP os75bb
Ocean U (east)
Ocean V (north)
Signal Strength RSSI)
depth
dep
m/s
RSSI counts
dday
os75bb: last time
(dday = 315.998) 2017/11/12 23:56:52 UTC


PE18_15_Perez_ADCP os75bb
28.5°N
27°N
25.5°N
24°N
start
end
98°W
96°W
94°W
92°W
0
0.5
1
2
3
4
5
Depth (km)
26.6
26.8
27.0
27.2
27.4
ADCP temperature, °C
0.5 m/s
25 to 65m
os75bb: last time
(dday = 315.998) 2017/11/12 23:56:53 UTC


PE18_15_Perez_ADCP os75bb
Ocean U (east)
depth
0
50
100
150
200
0.4
0.3
0.2
0.1
0.0
−0.1
−0.2
−0.3
−0.4
m/s
Ocean V (north)
depth
m/s
Signal Strength RSSI)
dep
200
160
120
80
40
RSSI counts
314.8
315.1
315.4
315.7
dday
os75bb: last time
(dday = 315.998) 2017/11/12 23:56:52 UTC

CIGoM

Consorcio de Investigación del Golfo de México

Este estudio es parte del proyecto 201441
"Implementación de redes de observación oceanográficas (físicas, geo-químicas, ecológicas) para la generación de escenarios ante posibles contingencias relacionadas a la exploración y producción de hidrocarburos en aguas profundas del Golfo de México"
financiado por el Fondo Sectorial
CONACYT-SENER-Hidrocarburos

Esta es una contribución del
Consorcio de Investigación del Golfo de México

SENER
SECRETARÍA DE ENERGÍA

CONACYT