CTD Data RV Heincke HE533

Data Processing Report

Contents

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1 Introduction

This report describes the processing of CTD raw data acquired by Seabird SBE 911plus CTD on board RV Heincke during expedition HE533.

2 Workflow

The different steps of processing and validation are visualized in Figure 1. The CTD raw data are delivered from Andreas Wisotzki (AWI). The station book of the RV Heincke cruise is extracted from the DAVIS SHIP data base (https://dship.awi.de). The first CTD station and cast is processed manually in SBE Data Processing to configure the *.psa Seabird routines *Data Conversion*, *Wild Edit*, *Bottle Summary*, *Split*, *Translate*, *Cell Thermal Mass*, *Loop Edit* and *Bin Average*. The Seabird routines are then run in a batch job *CTDjob* in ManageCTD to process the complete CTD data set. The downcast of each CTD station/cast is used for further processing. In *CTDjob* the start record and the lowest altimeter point of the downcast is selected. From the downcast data figures to compare both oxygen sensors are generated. The oxygen sensor choice and the offset between the two oxygen sensors is documented in the processing summary table. With the *Utilities* → *Dship Ebook* function of ManageCTD the DAVIS SHIP station book extraction is used for getting the header information of all CTD stations/casts of the cruise. ManageCTD *Utilities* → *Find Profile* function compares station times of the header with the entries in the station book to find out the correct naming of the stations and casts. In *CTDheader* in ManageCTD the header information of each CTD station/cast is displayed, controlled and corrected if necessary. *CTDdespike* in ManageCTD is used for a visual check of the data and to erase/interpolate spikes in the data if necessary. Additionally, a sensor pair (Temp1/Sal1 or Temp2/Sal2) is chosen for each station/cast of the RV Heincke cruise in *CTDdespike*.

ManageCTD *Utilities* → *CheckDoubleSensors* controls the quality of temperature and conductivity sensors. For this purpose outliers of too high sensor pair differences could be removed. The data is then converted to spreadsheet format with *dsp2odv* for visualization of the data in Ocean Data View (ODV). The second visual inspection of the CTD data allows a comparison with data from other CTD casts from close-by stations to verify the oxygen sensor data. Therefore, potential reference cruise data is downloaded from PANGAEA (http://www.PANGAEA.de). The reference data is converted to *.mat format. In the ManageCTD Final Processing the CTD data is displayed together with the reference data. Bad data points, sensors or casts are interpolated or erased from the data set and filters are applied if necessary. The processed CTD data are written to text files and imported to PANGAEA (http://www.PANGAEA.de) for publication.

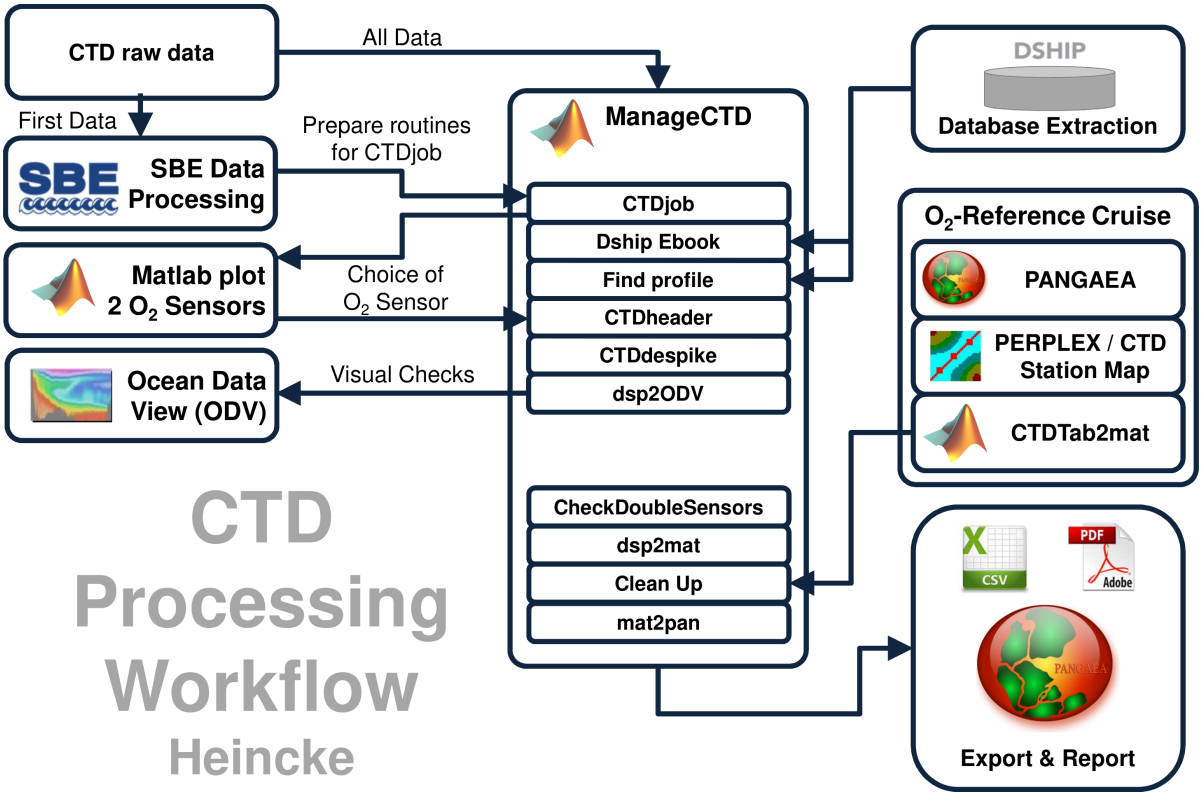

Figure 1: CTD data Processing Workflow

3 Cruise details

Vessel name	RV Heincke
Cruise name	HE533
Cruise start	16.05.2019 Bremerhaven
Cruise end	12.06.2019 Bremerhaven
Cruise duration	27 days
No. of CTD casts	63

4 Sensor Layout

This chapter describes the CTD sensors mounted during this cruise:
SBE 911plus CTD (SN: 1015), SBE Instrument Configuration Version 7.23.0.1.

ID	Sensor Name	Serial No.	Calibration Date
55	TemperatureSensor	5354	30-Nov-18
3	ConductivitySensor	2470	04-Dec-18
45	PressureSensor	1015	26-Jan-17
55	TemperatureSensor	5375	30-Nov-18
3	ConductivitySensor	3573	04-Dec-18
0	AltimeterSensor	46466	23-Mar-09
71	WET_LabsCStar	1348DR	28-Jan-2016
20	FluoroWetlabECO_AFL_FL_Sensor	1365	15-Jan-2016
38	OxygenSensor	2292	28-Dec-18
38	OxygenSensor	3654	28-Dec-18

5 Processing

Details of processing procedures and processing parameters are described in *CTD Processing Logbook of RV Heincke* (hdl: 10013/epic.47427).

Density Inversions and Manual Validation

Obvious outliers were removed manually. For the visual check density inversions > 0.005 kg/m^3 and > 0.01 kg/m^3 were flagged differently for display but not removed automatically. Decisions whether the flagged values were manually removed or not are based on the description in *CTD Processing Logbook of RV Heincke* (hdl: 10013/epic.47427).

Sensor Differences

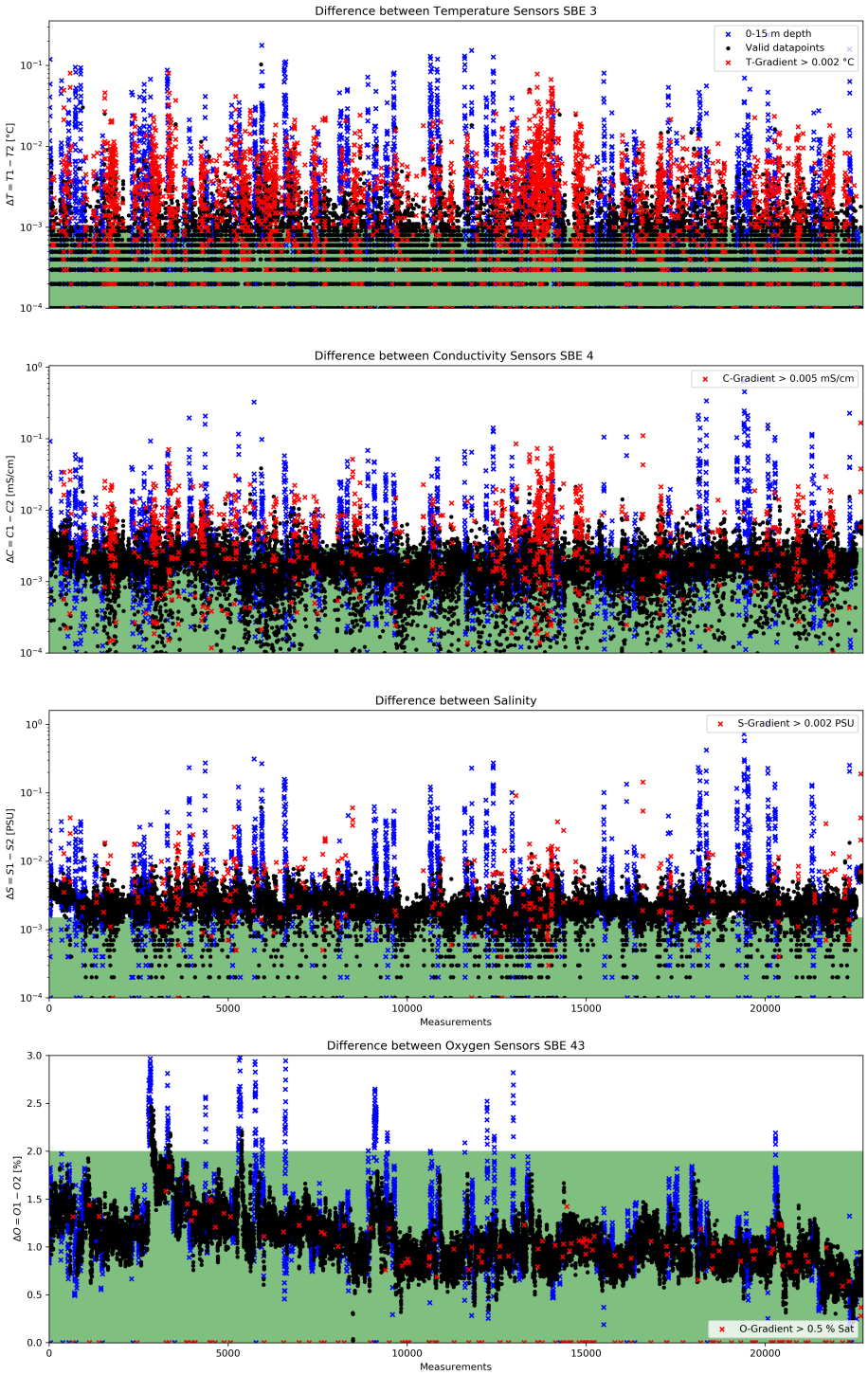

Figure 2: Data accuracy of sensor pairs HE533

6 Results

A complete processing overview for each sensor at each station is summarized in the table in the Appendix (Figure 3).

Double Sensor Check

In Figure 2, the absolute residuals between the sensorpairs are shown for the measured parameters *Temperature* and *Conductivity*, the derived parameter *Salinity* and the measured parameter *Oxygen*. Measurements in shallow water depths < 15 m (blue crosses) and gradients between two datapoints exceeding a defined threshold (red crosses) were omitted for accuracy calculation.

Parameter	**Accuracy** given by manufacturer	**Measurements removed** Surface 0-15m + gradient filter	**Remaining measurements** within accuracy specifications
Temperature	$\pm 0.001\ °C$	30.84%	80.66%
Conductivity	$\pm 0.003\ mS/cm$	22.27%	88.90%
Salinity	$\pm 0.0015\ PSU$	19.45%	14.22%
Oxygen	$\pm 2.0\ \%\ of saturation$	18.80%	99.53%

Comments

No suitable reference cruise for comparison of oxygen values was found because of large distances between HE533 an other cruises.

- 63 CTD/RO "max depth/on ground" or "in the water" entries in DShip station book
- 64 CTD raw data sets delivered
- 1 CTD cast was invalid or test (HE533_TEST_01.hex)
- 2 CTD casts had a wrong filename
- 63 CTD casts processed and uploaded
- of these 63 processed CTD casts:
  - 0 oxygen profiles deleted (spiky and not matching to reference casts)
  - 570 data points interpolated
  - 0 data points erased

Result files

Text File (HE533_phys_oce.tab):

The format is a plain text (tab-delimited values) file.

Column separator	Tabulator "\t"
Column 1	Event label
Column 2	Date/Time of event
Column 3	Latitude of event
Column 4	Longitude of event
Column 5	Elevation of event
Column 6	DEPTH, water
Column 7	Pressure, water
Column 8	Temperature, water
Column 9	Conductivity
Column 10	Salinity
Column 11	Temperature, water, potential
Column 12	Density, sigma-theta (0)
Column 13	Oxygen
Column 14	Oxygen, saturation
Column 15	Attenuation, optical beam transmission
Column 16	Fluorometer
Column 17	Number of observations

Processing Report (CTD-HE533-report.pdf):
This PDF document.

Station HE533	Gear Abbr.	Date	Time	Position Latitude	Position Longitude	Depth [m]	File HE533	Sensor pair	Temp		Sal		Trans		Fluor		Oxy		complete		2 Oxy Sensors		Oxygen reference			Comments
									interp	erased	interp	erased	interp	erased	interp	erased	interp	erased	interp	erased	Sensor	Offset	cruise/sss-cc	dist. (km)	Offset	
1-1	CTD	22.05.2019	6:06	68° 29.107' N	014° 18.136' E	67.1	01_01	1	1		1		1		1		1		5		2292	0.09				
1-2	CTD	22.05.2019	6:47	68° 29.295' N	014° 17.401' E	61.6	01_02	1	1		1		1		1		1		5		2292	0.10				
1-3	CTD	22.05.2019	7:22	68° 29.389' N	014° 16.969' E	60.3	01_03	1	2		2		2		2		2		10		2292	0.09				
1-10	CTD	22.05.2019	11:46	68° 28.968' N	014° 18.437' E	65.3	01_10	1	1		1		1		1		1		5		2292	0.07				
1-11	CTD	22.05.2019	12:07	68° 28.993' N	014° 18.468' E	67	01_11	1													2292	0.07				
2-1	CTD	23.05.2019	6:06	68° 28.958' N	014° 18.562' E	64.9	02_01	1	1		1		1		1		1		5		2292	0.09				
2-4	CTD	23.05.2019	6:38	68° 28.980' N	014° 18.425' E	65.4	02_04	1	1		1		1		1		1		5		2292	0.08				
3-1	CTD	23.05.2019	10:58	68° 28.768' N	014° 57.318' E	171.6	03_01	1	1		1		1		1		1		5		2292	0.08				
3-4	CTD	23.05.2019	11:36	68° 28.780' N	014° 57.314' E	171.7	03_04	1	2		2		2		2		2		10		2292	0.09				
4-1	CTD	24.05.2019	6:03	68° 40.726' N	015° 26.008' E	28.1	04_01	1													2292	0.08				
4-5	CTD	24.05.2019	6:32	68° 40.749' N	015° 25.982' E	26.7	04_05	1													2292	0.09				
5-2	CTD	24.05.2019	11:05	68° 56.660' N	015° 23.260' E	101.2	05_02	1	1		1		1		1		1		5		2292	0.13				
5-4	CTD	24.05.2019	11:43	68° 56.673' N	015° 23.269' E	102	05_04	1	1		1		1		1		1		5		2292	0.13				
6-1	CTD	24.05.2019	16:05	69° 09.939' N	015° 24.997' E	54.9	06_01	1	1		1		1		1		1		5		2292	0.10				
6-4	CTD	24.05.2019	16:37	69° 09.990' N	015° 24.878' E	56	06_04	1	2		2		2		2		2		10		2292	0.11				
7-1	CTD	25.05.2019	6:05	69° 38.178' N	017° 47.312' E	95.5	07_01	1	3		3		3		3		3		15		2292	0.09				
7-5	CTD	25.05.2019	6:42	69° 38.255' N	017° 46.990' E	79	07_05	1	2		2		2		2		2		10		2292	0.09				
8-1	CTD	25.05.2019	11:04	69° 30.516' N	018° 19.228' E	111	08_01	1	3		3		3		3		3		15		2292	0.09				
8-3	CTD	25.05.2019	11:41	69° 30.550' N	018° 19.159' E	114	08_03	1													2292	0.09				
9-2	CTD	26.05.2019	6:08	69° 15.605' N	019° 21.677' E	88.3	09_02	1													2292	0.11				
9-6	CTD	26.05.2019	6:41	69° 15.612' N	019° 21.697' E	89.8	09_05	1	1		1		1		1		1		5		2292	0.11				wrong file name
10-1	CTD	26.05.2019	11:54	69° 25.677' N	019° 01.420' E	126.8	10_01	1	2		2		2		2		2		10		2292	0.09				
10-3	CTD	26.05.2019	12:32	69° 25.682' N	019° 01.433' E	127.5	10_03	1													2292	0.09				
11-1	CTD	27.05.2019	6:05	70° 17.162' N	019° 24.835' E	107.9	11_01	1	2		2		2		2		2		10		2292	0.09				
11-5	CTD	27.05.2019	6:36	70° 17.148' N	019° 24.903' E	108.5	11_05	1													2292	0.08				
12-1	CTD	27.05.2019	11:07	70° 05.860' N	019° 37.777' E	126.4	12_01	1	3		3		3		3		3		15		2292	0.08				
12-3	CTD	27.05.2019	11:41	70° 05.791' N	019° 37.674' E	136.3	12_03	1	1		1		1		1		1		5		2292	0.08				
13-1	CTD	27.05.2019	16:05	70° 04.507' N	020° 07.296' E	115.3	13_01	1													2292	0.07				
13-4	CTD	27.05.2019	16:37	70° 04.488' N	020° 07.087' E	110	13_04	1	1		1		1		1		1		5		2292	0.09				
14-2	CTD	28.05.2019	6:02	69° 21.630' N	020 04.062' E	64	14_02	1	2		2		2		2		2		10		2292	0.11				
14-6	CTD	28.05.2019	6:40	69° 21.700' N	020° 04.251' E	65.5	14_06	1	1		1		1		1		1		5		2292	0.10				
15-1	CTD	28.05.2019	11:10	69° 35.719' N	020° 20.894' E	215.8	15_01	1	7		7		7		7		7		35		2292	0.06				
15-3	CTD	28.05.2019	11:42	69° 35.683' N	020° 20.758' E	176.4	15_03	1	2		2		2		2		2		10		2292	0.07				
16-1	CTD	28.05.2019	16:08	69° 49.504' N	020° 27.769' E	166.8	16_01	1	1		1		1		1		1		5		2292	0.07				
16-5	CTD	28.05.2019	16:42	69° 49.496' N	020° 27.722' E	170	16_05	1	1		1		1		1		1		5		2292	0.08				
17-2	CTD	30.05.2019	6:04	70° 15.917' N	025° 09.908' E	80.9	17_02	1	3		3		3		3		3		15		2292	0.07				
17-5	CTD	30.05.2019	6:30	70° 16.007' N	025° 09.989' E	81.2	17_04	1													2292	0.08				wrong file name
18-1	CTD	30.05.2019	11:10	70° 30.765' N	025° 27.700' E	109.4	18_01	1	3		3		3		3		3		15		2292	0.07				
18-3	CTD	30.05.2019	11:44	70° 30.748' N	025° 27.730' E	110.7	18_03	1													2292	0.09				
19-1	CTD	30.05.2019	15:50	70° 44.310' N	025° 54.577' E	2	19_01	1	1		1		1		1		1		5		2292	0.07				
19-2	CTD	31.05.2019	6:08	70° 44.353' N	025° 54.368' E	144.4	19_02	1	3		3		3		3		3		15		2292	0.08				
19-6	CTD	31.05.2019	6:43	70° 44.306' N	025° 54.454' E	123.1	19_06	1	1		1		1		1		1		5		2292	0.06				
20-1	CTD	31.05.2019	11:07	70° 55.325' N	026° 15.359' E	210.1	20_01	1	15		15		15		15		15		75		2292	0.07				
20-3	CTD	31.05.2019	11:44	70° 55.295' N	026° 15.085' E	212.3	20_03	1													2292	0.07				
21-1	CTD	31.05.2019	17:26	70° 28.340' N	026° 40.684' E	86.4	21_01	1													2292	0.06				
21-3	CTD	01.06.2019	6:05	70° 28.391' N	026° 40.606' E	90.3	21_03	1	2		2		2		2		2		10		2292	0.06				
21-7	CTD	01.06.2019	6:35	70° 28.372' N	026° 40.592' E	88.7	21_07	1	2		2		2		2		2		10		2292	0.07				
22-1	CTD	01.06.2019	11:07	70° 40.497' N	026° 47.075' E	191.8	22_01	1	4		4		4		4		4		20		2292	0.08				
22-3	CTD	01.06.2019	11:41	70° 40.507' N	026° 47.192' E	191.8	22_03	1													2292	0.08				
23-1	CTD	02.06.2019	6:05	70° 51.552' N	027° 16.621' E	94.5	23_01	1	1		1		1		1		1		5		2292	0.07				
23-5	CTD	02.06.2019	6:40	70° 51.554' N	027° 16.504' E	98.4	23_05	1													2292	0.09				
24-1	CTD	02.06.2019	16:57	70° 31.651' N	028° 13.545' E	130.9	24_01	1	1		1		1		1		1		5		2292	0.07				
25-1	CTD	03.06.2019	6:06	70° 30.699' N	028° 04.777' E	176.8	25_01	1	6		6		6		6		6		30		2292	0.07				
25-5	CTD	03.06.2019	6:41	70° 30.716' N	028° 04.706' E	176.8	25_05	1	1		1		1		1		1		5		2292	0.07				
25-10	CTD	03.06.2019	10:15	70° 30.665' N	028° 04.768' E	175.3	25_10	1													2292	0.07				
25-11	CTD	03.06.2019	10:38	70° 30.685' N	028° 04.747' E	176.3	25_11	1													2292	0.06				
26-2	CTD	03.06.2019	16:37	70° 42.031' N	028° 27.011' E	121.3	26_02	1	3		3		3		3		3		15		2292	0.06				
26-6	CTD	03.06.2019	17:21	70° 42.055' N	028° 27.520' E	146.9	26_06	1	3		3		3		3		3		15		2292	0.07				
27-1	CTD	04.06.2019	6:09	70° 52.125' N	028° 42.087' E	210.4	27_01	1	10		10		10		10		10		50		2292	0.07				
27-5	CTD	04.06.2019	6:45	70° 52.086' N	028° 42.322' E	193.5	27_05	1													2292	0.07				
28-1	CTD	04.06.2019	10:04	71° 01.696' N	028° 49.265' E	175.1	28_01	1	6		6		6		6		6		30		2292	0.05				
28-3	CTD	04.06.2019	10:37	71° 01.703' N	028° 49.209' E	182.7	28_03	1	2		2		2		2		2		10		2292	0.01				
29-2	CTD	06.06.2019	16:36	70° 16.812' N	019° 22.958' E	130	29_02	1													2292	0.05				
									114	0	114	0	114	0	114	0	114	0	570	0						

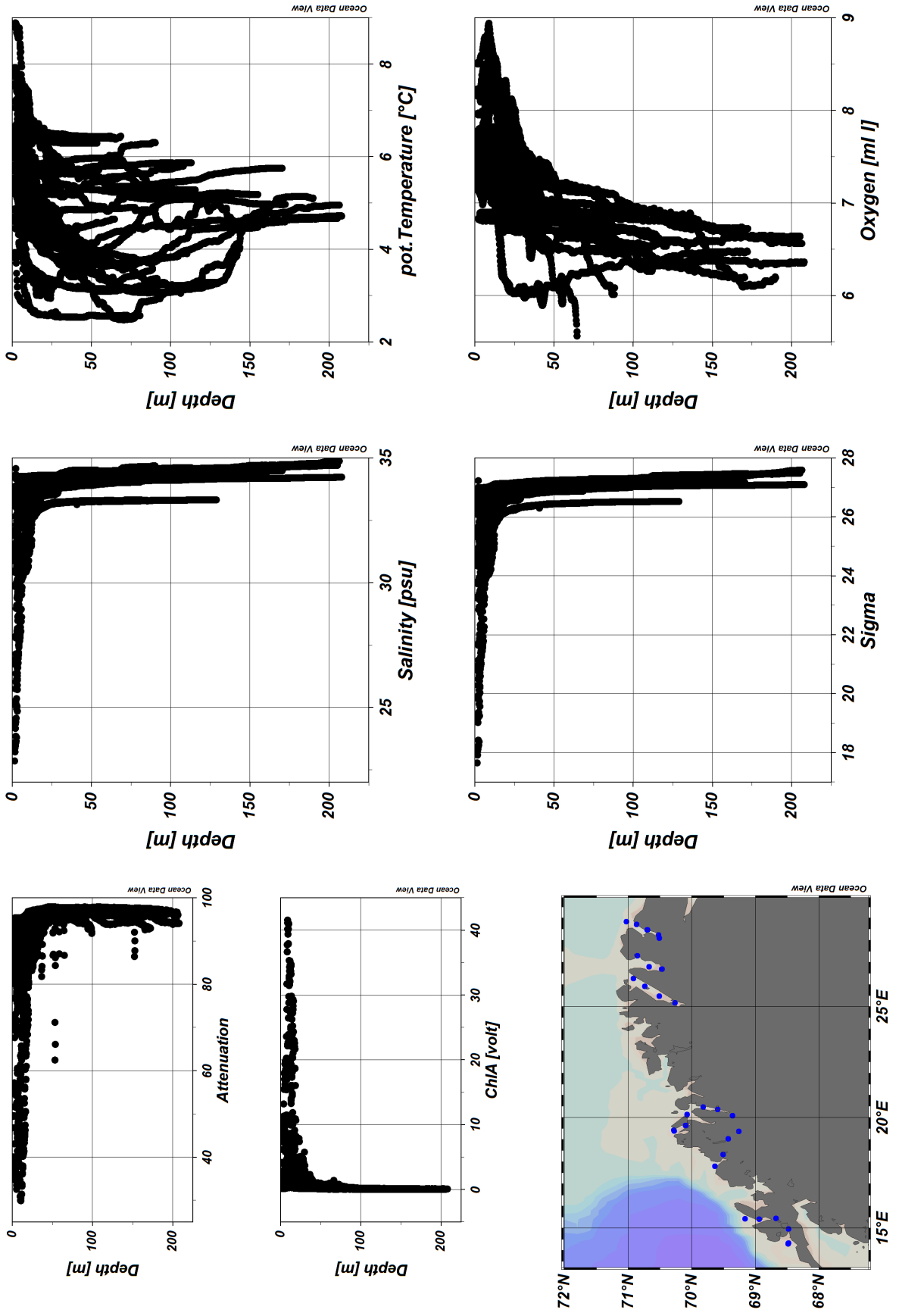

Figure 4: ODV Screenshot of HE533 CTD data