CTD Data RV Heincke HE571

Data Processing Report

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Ref.: CTD-HE571-report.pdf	Vers.: 1	Date: 2021/04/08	Status: final

1 Introduction

This report describes the processing of CTD raw data acquired by Seabird SBE 911plus CTD on board RV Heincke during expedition HE571.

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.

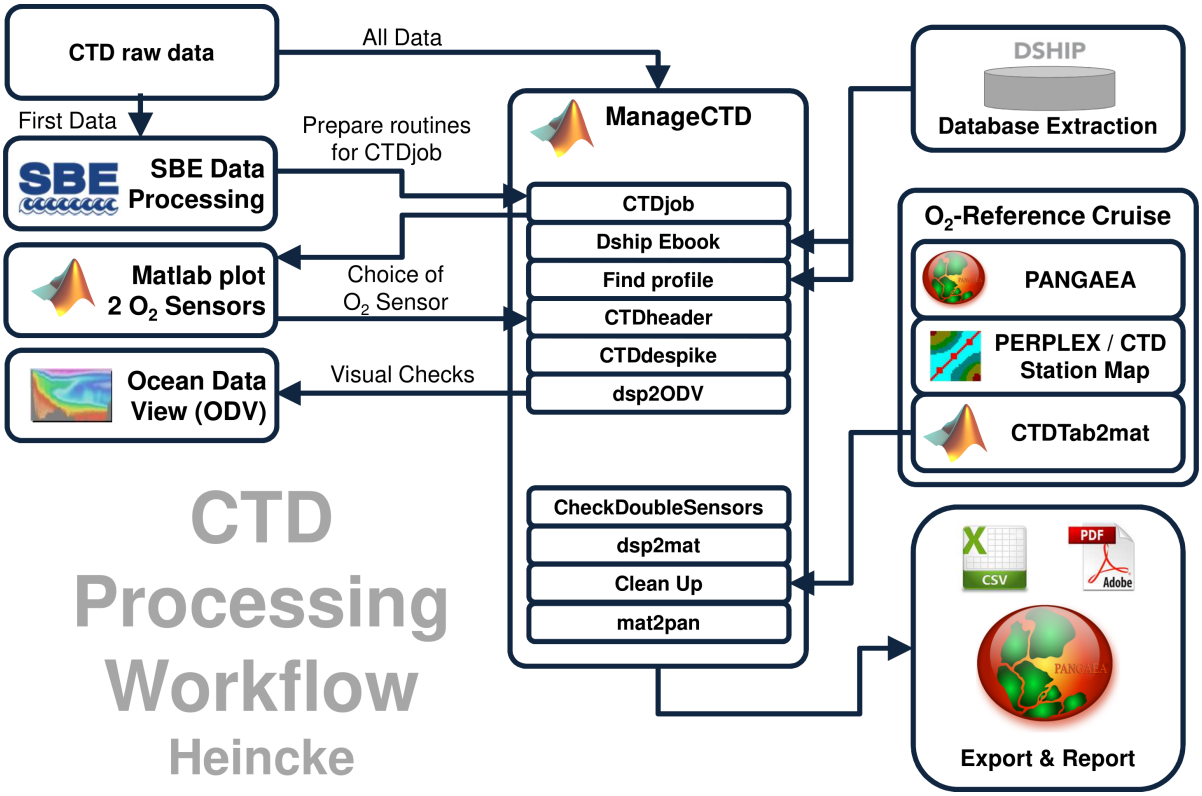

Figure 1: CTD data Processing Workflow

3 Cruise details

Vessel name	RV Heincke
Cruise name	HE571
Cruise start	21.03.2021 Bremerhaven
Cruise end	29.03.2021 Bremerhaven
Cruise duration	9 days
No. of CTD casts	33

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	1373	11-Oct-19
3	ConductivitySensor	1198	17-Sep-19
45	PressureSensor	1015	26-Jan-17
55	TemperatureSensor	2929	13-Sep-19
3	ConductivitySensor	1199	17-Sep-19
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	26-Aug-20
38	OxygenSensor	3654	13-Feb-20

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

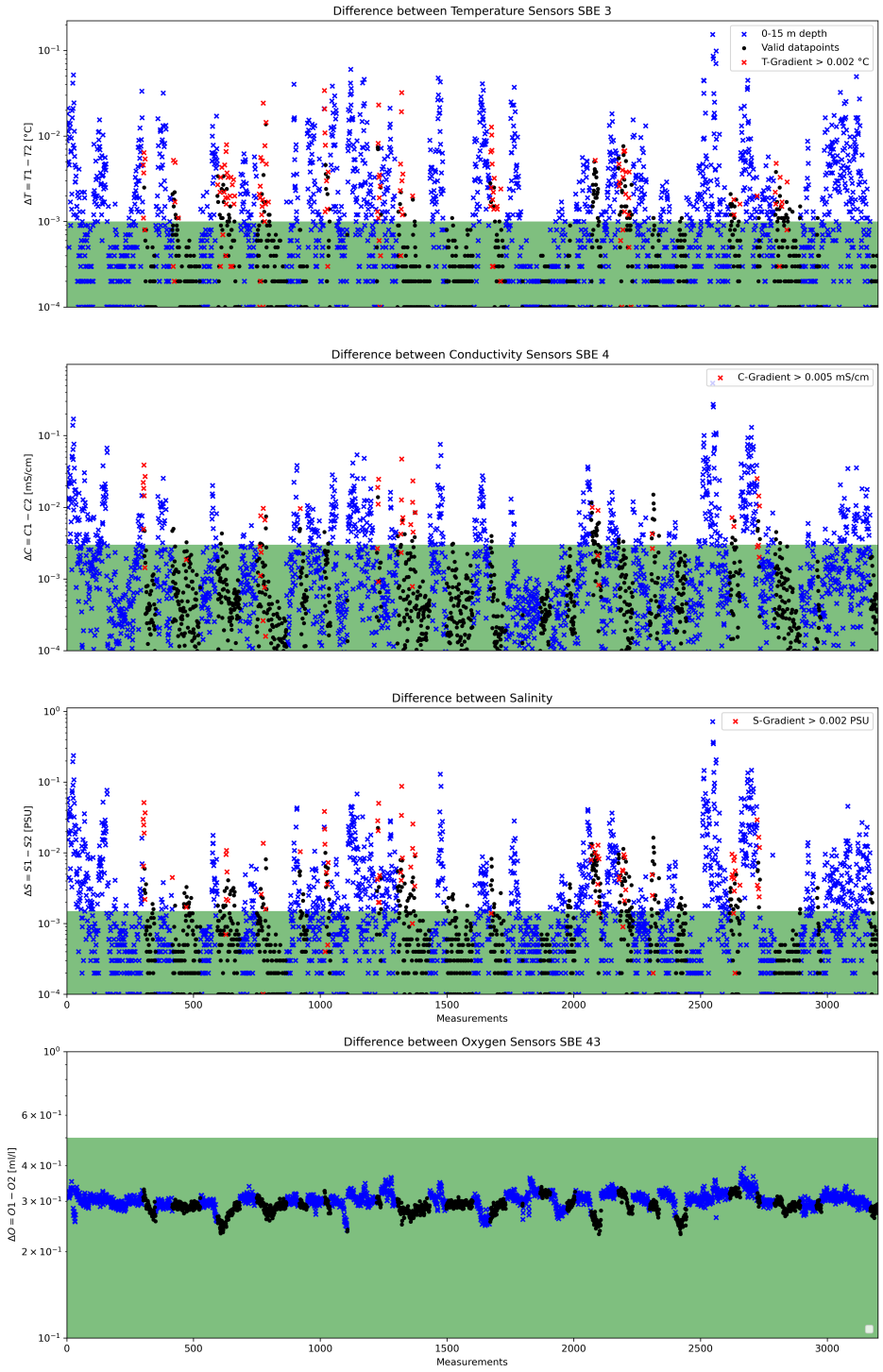

Figure 2: Data accuracy of sensor pairs HE571

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	$\pm 0.001\ °C$	66.97%	87.32%
Conductivity	$\pm 0.003\ mS/cm$	64.31%	94.22%
Salinity	$\pm 0.0015\ PSU$	65.34%	81.79%
Oxygen	$\pm 2.0\ \%\ of saturation$	62.69%	100.00%

Comments

- 32 CTD "max depth/on ground" entries in DShip station book
- 1 CTD "in the water" entries in DShip station book without comment "max depth/ on ground" (HE571_Stat25_Dship21_1)
- 33 CTD raw data sets delivered
- 33 CTD casts processed and uploaded
- of these 33 processed CTD casts:
  - 0 oxygen profiles deleted (spiky and not matching to reference casts)
  - 80 data points interpolated
  - 3 data points erased

Result files

Text File (HE571_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-HE571-report.pdf):
This PDF document.

Station HE571_	Gear Abbr.	Date	Time	Position Latitude	Position Longitude	Depth [m]	File_Name HE571_	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	22.03.2021	10:46	53° 50,533' N	008° 04,863' E	3.0	Stat02_Dship1_1														3654	0.301	479/3-1	8.61	0.4	
2-1	CTD	22.03.2021	12:26	53° 49,465' N	007° 44,184' E	12.5	StatD1_Dship2_1														3654	0.310	HE479/23-1	11.44	0.6	
3-1	CTD	22.03.2021	13:19	53° 52,840' N	007° 43,960' E	19.1	StatD2_Dship3_1														3654	0.291	HE479/23-1	6.02	0.5	
4-1	CTD	22.03.2021	14:04	53° 55,097' N	007° 48,315' E	20.0	Stat34_Dship4_1														3654	0.299	HE479/23-1	0.92	0.5	
5-1	CTD	22.03.2021	15:41	54° 06,155' N	007° 53,240' E	1.9	Stat27_Dship5_1		2		2		2		2		2		10		3654	0.294	HE479/12-1	16.73	0.6	
6-1	CTD	23.03.2021	5:33	54° 32,220' N	008° 10,887' E	10.4	Stat12_Dship6_1														3654	0.290	HE479/9-1	51.29	0.3	
7-1	CTD	23.03.2021	6:53	54° 42,478' N	008° 09,763' E	10.6	Stat11_Dship7_1											3		3	3654	0.133	HE479/5-1	0.07	0.2	
8-1	CTD	23.03.2021	8:54	54° 36,743' N	007° 42,288' E	17.9	Stat9_Dship8_1														3654	0.289	HE479/7-1	0.08	0.4	
9-1	CTD	23.03.2021	12:03	54° 29,874' N	007° 10,403' E	34.6	Stat7_Dship9_1														3654	0.293	HE479/8-1	26.18	0.5	
10-1	CTD	23.03.2021	13:30	54° 19,133' N	007° 07,277' E	37.4	Stat16_Dship10_1		2		2		2		2		2		10		3654	0.290	HE479/18-1	16.26	0.3	
11-1	CTD	23.03.2021	15:30	54° 22,536' N	007° 34,882' E	24.5	Stat14_Dship11_1		1		1		1		1		1		5		3654	0.297	HE479/8-1	13.61	0.5	
12-1	CTD	23.03.2021	16:51	54° 18,461' N	007° 49,612' E	19.5	Stat22_Dship12_1														3654	0.298	HE479/15-1	1.16	0.5	
13-1	CTD	24.03.2021	10:27	53° 50,294' N	008° 05,858' E	10.8	Stat02_Dship13_1														3654	0.310	HE479/3-1	7.69	0.5	
14-1	CTD	24.03.2021	12:03	53° 55,609' N	007° 48,127' E	22.9	Stat34_Dship14_1														3654	0.288	HE479/23-1	0.84	0.5	
15-1	CTD	24.03.2021	13:31	54° 04,602' N	007° 37,784' E	35.3	Stat28_Dship15_1		1		1		1		1		5				3654	0.299	HE479/15-1	5.32	0.7	
16-1	CTD	24.03.2021	15:58	53° 59,745' N	007° 04,695' E	27.2	Stat30_Dship16_1														3654	0.281	HE479/19-1	1.77	0.5	
17-2	CTD	25.03.2021	6:38	54° 10,621' N	007° 05,579' E	32.2	Stat19_Dship17_1		2		2		2		2		2		10		3654	0.278	HE479/18-1	0.38	0.5	
18-1	CTD	25.03.2021	8:41	54° 14,225' N	007° 29,641' E	38.5	Stat21_Dship18_1		1		1		1		1		1		5		3654	0.295	HE479/17-1	2.73	0.6	
19-1	CTD	25.03.2021	10:25	54° 18,434' N	007° 49,580' E	19.6	Stat22_Dship19_1														3654	0.300	HE479/15-1	1.09	0.6	
20-1	CTD	25.03.2021	12:00	54° 22,373' N	008° 09,492' E	14.8	Stat23_Dship20_1		1		1		1		1		1		5		3654	0.288	HE479/10-1	0.78	0.3	
21-1	CTD	25.03.2021	13:27	54° 13,974' N	008° 20,981' E	9.9	Stat25_Dship21_1														3654	0.312	HE479/11-1	0.55	0.4	no "maxdepth/on ground" entry in station book, entry "in the water" used instead
22-1	CTD	25.03.2021	14:28	54° 08,222' N	008° 19,963' E	9.3	Stat37_Dship22_1														3654	0.308	HE479/11-1	10.19	0.5	
23-1	CTD	25.03.2021	15:38	54° 10,803' N	008° 06,780' E	18.3	Stat26_Dship23_1														3654	0.304	HE479/12-1	0.32	0.6	
24-1	CTD	26.03.2021	11:41	53° 50,132' N	008° 06,372' E	11.4	Stat02_Dship24_1		1		1		1		1		5				3654	0.306	479/3-1	7.18	0.6	
25-1	CTD	26.03.2021	13:15	53° 49,331' N	007° 43,528' E	13.7	Stat01_Dship25_1		1		1		1		1		5				3654	0.311	HE479/23-1	11.91	0.6	
26-1	CTD	26.03.2021	15:52	53° 47,562' N	006° 59,839' E	14.4	Stat31_Dship26_1		1		1		1		1		5				3654	0.311	HE479/20-1	1.76	0.7	
27-1	CTD	27.03.2021	6:34	53° 50,386' N	007° 15,411' E	23.2	Stat32_Dship27_1														3654	0.320	HE479/21-1	1.57	0.6	
28-1	CTD	27.03.2021	7:55	53° 53,288' N	007° 32,522' E	20.8	Stat33_Dship28_1														3654	0.291	HE479/22-1	1.29	0.5	
29-1	CTD	27.03.2021	9:13	53° 56,160' N	007° 48,642' E	27.5	Stat34_Dship29_1		2		2		2		2		10				3654	0.313	HE479/23-1	1.98	0.6	
30-1	CTD	27.03.2021	10:30	53° 57,419' N	008° 03,955' E	23.3	Stat35_Dship30_1														3654	0.290	HE479/14-1	0.77	0.5	
31-1	CTD	27.03.2021	11:43	54° 02,684' N	008° 13,678' E	13.0	Stat36_Dship31_1		1		1		1		1		5				3654	0.304	HE479/13-1	0.13	0.5	
32-1	CTD	27.03.2021	12:56	53° 58,920' N	008° 24,647' E	22.8	Stat37_Dship32_1														3654	0.322	HE479/13-1	13.93	0.6	
33-1	CTD	27.03.2021	14:12	53° 57,355' N	008° 37,106' E	16.3	Stat39_Dship33_1														3654	0.335	HE479/13-1	27.47	0.6	
									16	0	16	0	16	0	16	0	16	3	80	3						

Figure 3: CTD data Processing Summary HE571

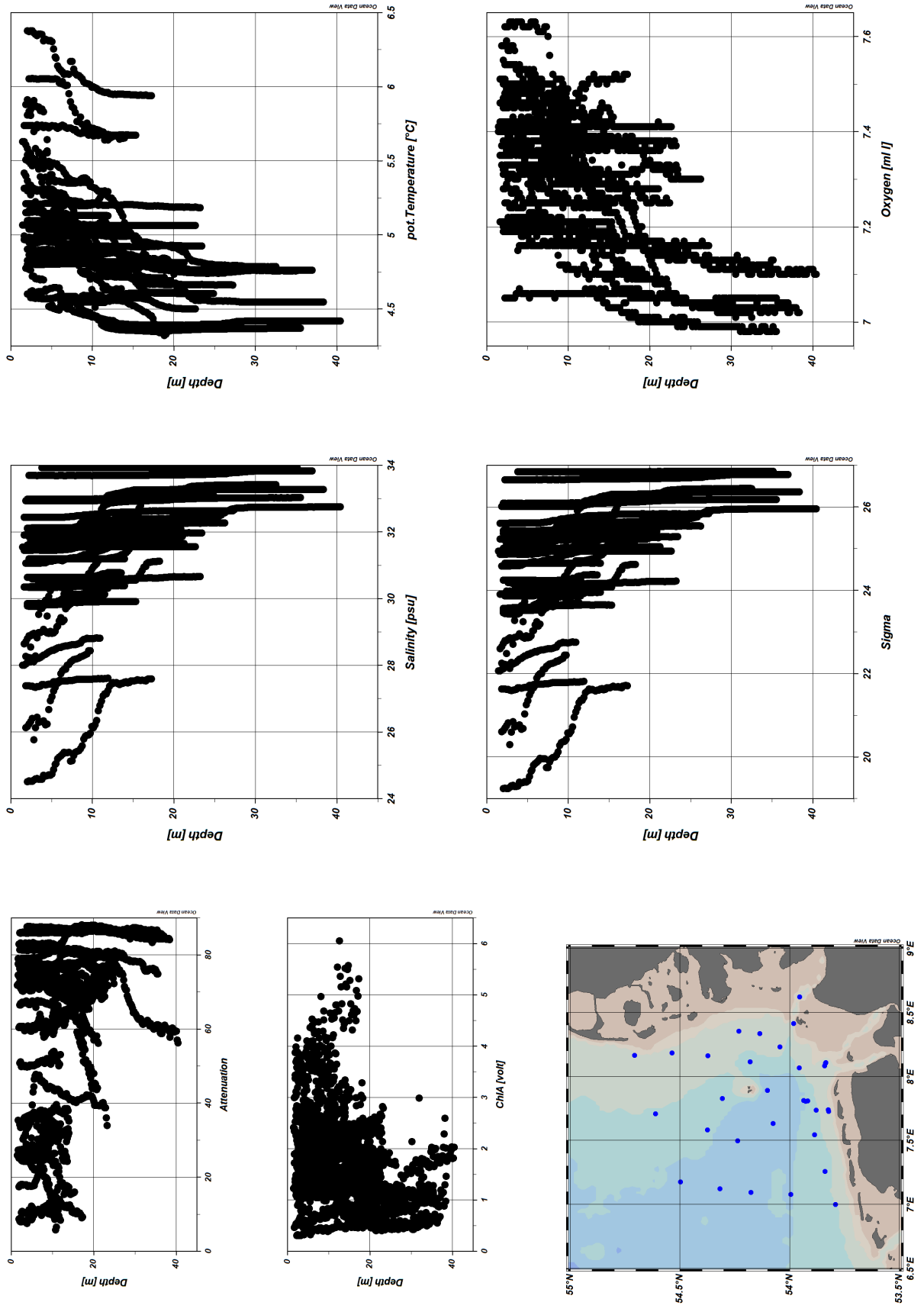

Figure 4: ODV Screenshot of HE571 CTD data