

CTD Data RV Heincke HE503

Data Processing Report

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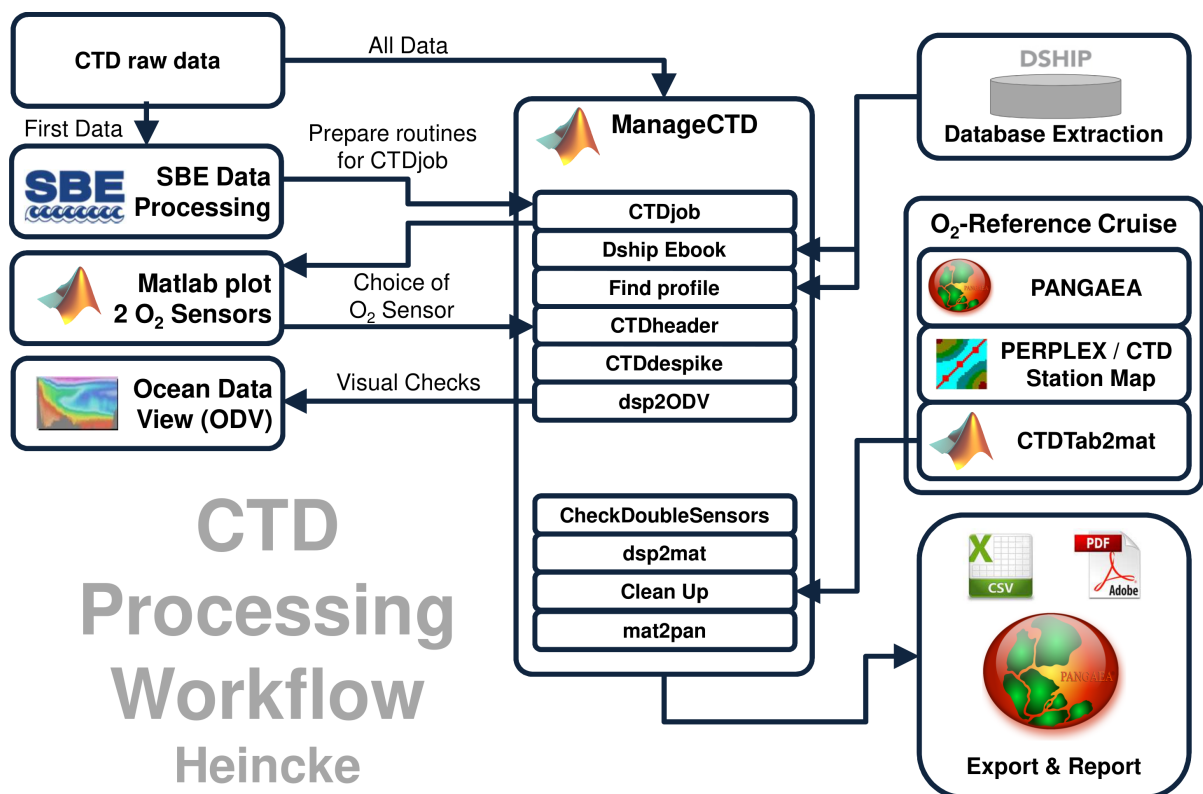
1 Introduction

This report describes the processing of CTD raw data acquired by Seabird SBE 911plus CTD on board RV Heincke during expedition HE503.

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.



CTD Processing Workflow

Heincke

Figure 1: CTD data Processing Workflow

3 Cruise details

Vessel name RV Heincke
 Cruise name HE503
 Cruise start 21.02.2018 Bremerhaven
 Cruise end 03.03.2018 Bremerhaven
 Cruise duration 11 days
 No. of CTD casts 44

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	11-Nov-17
3	ConductivitySensor	2470	08-Nov-17
45	PressureSensor	1015	26-Jan-17
55	TemperatureSensor	5375	11-Nov-17
3	ConductivitySensor	3573	08-Nov-17
0	AltimeterSensor	46466	23-Mar-09
71	WET_LabsCStar	1348DR	28-Jan-2016
20	FluoroWetlabECO_AFL_FL_Sensor	1365	15-Jan-2016
38	OxygenSensor	1597	06-Dec-17
38	OxygenSensor	2007	06-Dec-17

5 Processing

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

Density Inversions and Manual Validation

Obvious outliers were removed manually. For the visual check density inversions $> 0.005 \text{ kg/m}^3$ and $> 0.01 \text{ kg/m}^3$ 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](https://hdl.handle.net/10013/epic.47427)).

Sensor Differences

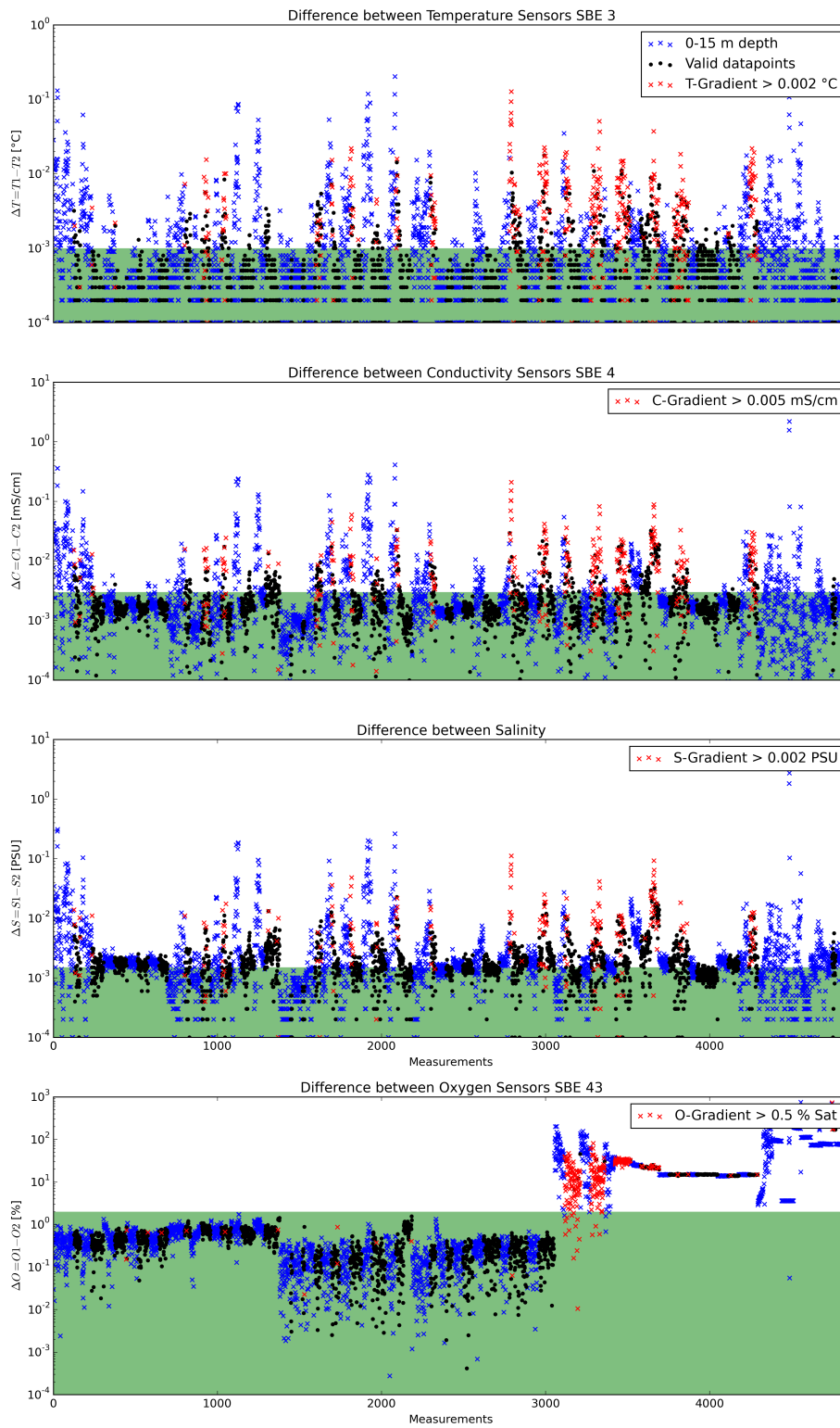


Figure 2: Data accuracy of sensor pairs HE503

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 re- moved Surface 0-15m + gradi- ent filter	Remaining measure- ments within accuracy specifi- cations
Temperature	$\pm 0.001 \text{ } ^\circ\text{C}$	62.54%	80.68%
Conductivity	$\pm 0.003 \text{ mS/cm}$	60.80%	83.38%
Salinity	$\pm 0.0015 \text{ PSU}$	58.35%	43.27%
Oxygen	$\pm 2.0 \text{ \% of saturation}$	60.37%	73.41%

Comments

- 44 CTD "max depth/on ground" entries in DShip station book
- 45 CTD "in the water" and "on deck" entries in DShip station book (HE503_37-1 aborted due to frozen pump)
- 48 CTD raw data sets delivered
- 1 CTD cast was invalid (P037a1.hex, cast aborted due to frozen pump)
- 3 CTD casts were on deck tests (P000a01.hex, P000a02.hex, test.hex)
- 4 CTD casts had a wrong cast number in filenames
- 44 CTD casts processed and uploaded
- of these 44 processed CTD casts:
 - 18 oxygen profiles deleted (stations 28 to 46: too high differences between 2 oxygen sensors and to reference casts, see figures 2 and 3)
 - 74 data points interpolated
 - 16 data points erased

Result files

Text File (HE503_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-HE503-report.pdf):

This PDF document.

Station HE503_Abbr.	Date	Time	Position Latitude	Position Longitude	Depth [m]	File	Sensor pair	Temp [erased] [interp]	Sal [erased] [interp]	Trans [erased] [interp]	Fluor [erased] [interp]	Oxy [erased] [interp]	complete [erased] [interp]	2 Oxy Sensors [erased] [interp]	Oxy Sensors [erased] [interp]	Offset	Offset	Comments	
2-1	22.02.2018	07:14:53	07°52'N	004°42'03"E	11.2	P002a01.hdr	2	0	0	0	0	0	0	0	0	0	0.0	0.4	
4-3	22.02.2018	10:08:53	09°04'N	004°33'78"E	21.8	P009a01.hdr	1	0	0	0	0	0	0	0	0	0	0.0	-0.4	no BTL-File for this cast
5-1	22.02.2018	11:27:53	10°51'N	004°28'30"E	26.0	P005a01.hdr	2	0	1	0	0	0	0	1	0	0.0	0.0	file name: wrong cast number	
6-1	22.02.2018	13:44:53	11°98'N	004°21'31"E	27.4	P006a01.hdr	2	0	0	0	0	0	0	0	0	0.0	0.3		
7-1	22.02.2018	14:56:53	13°99'N	004°13'42"E	25.2	P007a01.hdr	2	2	0	2	0	2	0	10	0	0.0	-0.1		
8-1	22.02.2018	17:16:53	15°86'N	004°05'24"E	23.0	P008a01.hdr	2	1	0	1	0	1	0	5	0	0.0	-0.1	no BTL-File for this cast	
9-1	23.02.2018	09:23:53	34°54'N	005°44'46"E	7.4	P010a01.hdr	2	1	0	1	0	1	0	5	0	0.0	-0.3	no BTL-File for this cast	
11-1	23.02.2018	10:51:53	39°35'N	005°42'34"E	24.7	P011a01.hdr	1	0	0	0	0	0	0	0	0	0.0	-0.4		
12-1	23.02.2018	13:14:53	44°58'N	005°39'86"E	25.6	P012a01.hdr	1	0	1	0	0	0	0	1	0	0.0	-0.4	no BTL-File for this cast	
13-1	23.02.2018	15:00:53	53°21'N	005°34'78"E	28.8	P013a01.hdr	2	0	0	0	0	0	0	0	0	0.0	-0.5		
14-1	23.02.2018	17:24:53	58°02'N	005°31'98"E	32.1	P014a01.hdr	2	0	0	0	0	0	0	0	0	0.0	-0.4	no BTL-File for this cast	
15-1	24.02.2018	07:06:53	43°35'N	006°41'60"E	16.6	P015a01.hdr	2	0	0	0	0	0	0	1	0	0.0	-0.5		
16-1	24.02.2018	09:20:53	49°38'N	006°40'55"E	16.5	P016a01.hdr	2	0	0	0	0	0	0	0	0	0.0	-0.4	no BTL-File for this cast	
17-1	24.02.2018	10:33:53	54°30'N	006°39'24"E	22.7	P017a01.hdr	1	0	0	0	0	0	0	0	0	0.0	-0.3		
18-1	24.02.2018	12:25:53	58°59'N	006°39'17"E	24.7	P018a01.hdr	1	0	0	0	0	0	0	0	0	0.0	-0.3	no BTL-File for this cast	
19-1	24.02.2018	13:31:54	02°98'N	006°38'43"E	29.1	P019a01.hdr	1	0	0	0	0	0	0	0	0	0.0	-0.4		
20-1	24.02.2018	15:24:54	07°31'N	006°36'66"E	32.1	P020a01.hdr	1	2	0	3	0	0	0	0	0	0.0	-0.4	no BTL-File for this cast	
21-1	24.02.2018	16:55:54	12°98'N	006°34'99"E	33.6	P021a01.hdr	2	2	0	0	1	0	1	0	7	0	0.0	-0.4	
22-1	25.02.2018	07:02:53	47°45'N	007°29'81"E	9.2	P022a01.hdr	1	0	0	0	0	0	0	0	0	0.0	-0.3		
23-1	25.02.2018	08:58:53	51°08'N	007°27'26"E	20.7	P023a01.hdr	1	0	0	0	0	0	0	0	0	0.0	-0.2		
24-1	25.02.2018	10:12:53	56°25'N	007°24'74"E	21.8	P024a01.hdr	2	0	0	0	0	0	0	0	0	0.0	-0.1		
25-1	25.02.2018	13:39:54	06°91'N	007°22'39"E	26.4	P025a01.hdr	2	1	0	1	0	1	0	5	0	0.0	-0.2	no BTL-File for this cast	
26-1	25.02.2018	16:45:54	14°23'N	007°14'92"E	35.2	P026a01.hdr	2	0	0	0	0	0	0	0	0	0.0	-0.2		
28-2	25.02.2018	19:02:54	26°15'N	007°08'44"E	36.4	P028a01.hdr	1	0	0	0	0	0	0	0	0	0.0	-0.2	file name: wrong cast number	
29-2	26.02.2018	12:39:54	22°59'N	007°10'53"E	36.2	P029a01.hdr	1	1	0	1	0	1	0	4	0	1.74	-15.0	file name: wrong cast number; O2 offsets too high; O2 data deleted	
30-1	26.02.2018	15:10:54	26°17'N	007°01'58"E	34.2	P030a01.hdr	2	1	0	1	0	0	0	2	0	0.75	-12.0	file name: wrong cast number; O2 offsets too high; O2 data deleted	
31-2	26.02.2018	17:22:54	29°18'N	006°53'99"E	33.4	P031a01.hdr	2	0	0	0	0	0	0	0	0	1.75	-6.0	file name: wrong cast number; no BTL-File for this cast; O2 offsets too high; O2 data deleted	
32-1	27.02.2018	07:10:54	57°20'N	006°06'89"E	39.7	P032a01.hdr	2	0	0	0	0	0	0	0	1.66	-1.6	O2 offsets too high; O2 data deleted		
33-1	27.02.2018	09:36:54	57°98'N	006°19'67"E	39.9	P033a01.hdr	2	1	0	1	0	1	0	4	0	1.05	-1.2	O2 offsets too high; O2 data deleted	
34-1	27.02.2018	11:19:54	58°07'N	006°32'53"E	41.6	P034a01.hdr	2	0	0	0	0	0	0	0	1.07	-1.1	no BTL-File for this cast; O2 offsets too high; O2 data deleted		
35-1	27.02.2018	13:24:54	58°15'N	006°43'97"E	31.0	P035a01.hdr	2	2	0	2	0	2	0	8	0	0.98	-1.0	no BTL-File for this cast; O2 offsets too high; O2 data deleted	
36-1	27.02.2018	15:04:54	58°13'N	006°57'18"E	26.0	P036a01.hdr	1	1	0	1	0	1	0	4	0	1.07	-0.9	O2 offsets too high; O2 data deleted	
37-1	28.02.2018	07:00:54	57°67'N	008°08'21"E	10.0	P037a01.hdr	2	0	0	0	0	0	0	0	0	0	0	Pump was frozen (-7°C), cast aborted	
37-2	28.02.2018	07:16:54	57°82'N	008°08'53"E	10.4	P037a02.hdr	2	0	0	0	0	0	0	0	0	0.37	-0.9	O2 offsets too high; O2 data deleted	
38-1	28.02.2018	09:21:54	57°54'N	007°55'31"E	13.3	P038a01.hdr	2	1	0	1	0	0	0	2	0	5.74	-1.5	no BTL-File for this cast; O2 offsets too high; O2 data deleted	
39-1	28.02.2018	11:02:54	50°56'N	007°54'93"E	15.4	P039a01.hdr	1	0	0	0	0	0	0	0	7.09	-2.0	O2 offsets too high; O2 data deleted		
40-1	28.02.2018	13:05:54	50°39'N	008°07'25"E	10.4	P040a01.hdr	2	0	0	0	0	0	0	0	0.28	-9.0	no BTL-File for this cast; O2 offsets too high; O2 data deleted		
41-1	28.02.2018	14:31:54	44°31'N	008°06'01"E	6.5	P041a01.hdr	1	0	4	0	4	0	4	16	0	1.06	-9.0	O2 offsets too high; O2 data deleted	
42-1	01.03.2018	07:06:54	29°20'N	008°08'27"E	10.9	P042a01.hdr	2	1	0	1	0	0	0	2	0	15.88	-7.0	O2 offsets too high; O2 data deleted	
43-1	01.03.2018	09:13:54	29°45'N	007°58'38"E	12.5	P043a01.hdr	2	0	0	0	0	0	0	0	8.88	-0.4	no BTL-File for this cast; O2 offsets too high; O2 data deleted		
44-1	01.03.2018	10:56:54	33°13'N	007°47'55"E	15.8	P044a01.hdr	1	0	0	0	0	0	0	0	5.54	-3.5	no BTL-File for this cast; O2 offsets too high; O2 data deleted		
45-1	01.03.2018	13:15:54	33°03'N	007°36'44"E	20.8	P045a01.hdr	1	0	0	0	0	0	0	0	0.02	-3.0	no BTL-File for this cast; O2 offsets too high; O2 data deleted		
46-1	01.03.2018	14:57:54	26°37'N	007°33'91"E	23.6	P046a01.hdr	1	2	0	2	0	2	0	8	0	2.09	-3.0	O2 offsets too high; O2 data deleted	
								19	4	23	4	13	4	6	74	16			

Figure 3: CTD data Processing Summary HE503
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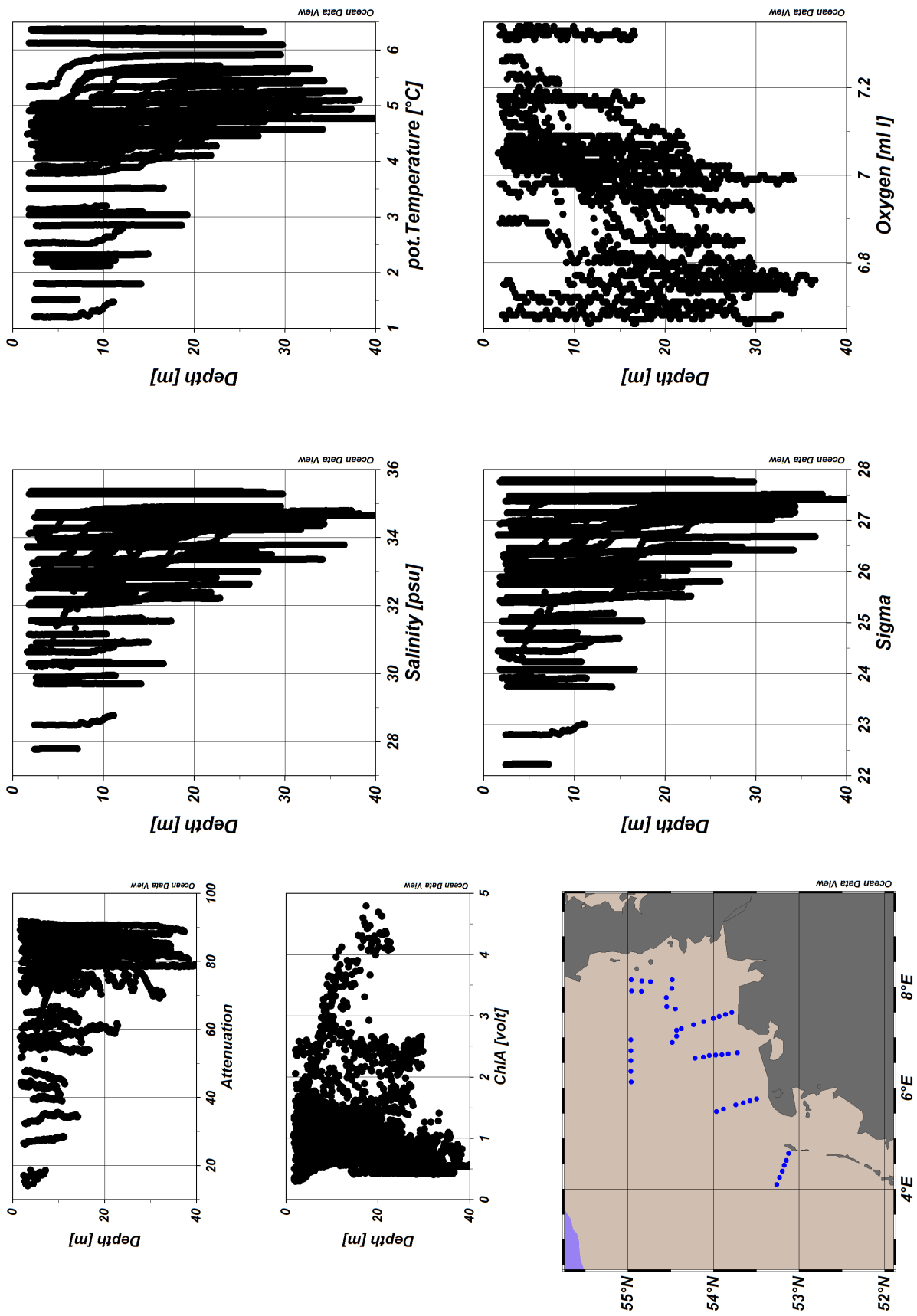


Figure 4: ODV Screenshot of HE503 CTD data