

# CTD Data RV Heincke HE515

## Data Processing Report

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Contact:

Gerd Rohardt

Alfred-Wegener-Institute

Am Handelshafen 12, D-27570 Bremerhaven, GERMANY

Mail: [info@awi.de](mailto:info@awi.de)

Processing Agency:

FIELAX GmbH

Schleusenstr. 14, D-27568 Bremerhaven, GERMANY

Mail: [info@fielax.de](mailto:info@fielax.de)

## 1 Introduction

This report describes the processing of CTD raw data acquired by Seabird SBE 911plus CTD on board RV Heincke during expedition HE515.

## 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.

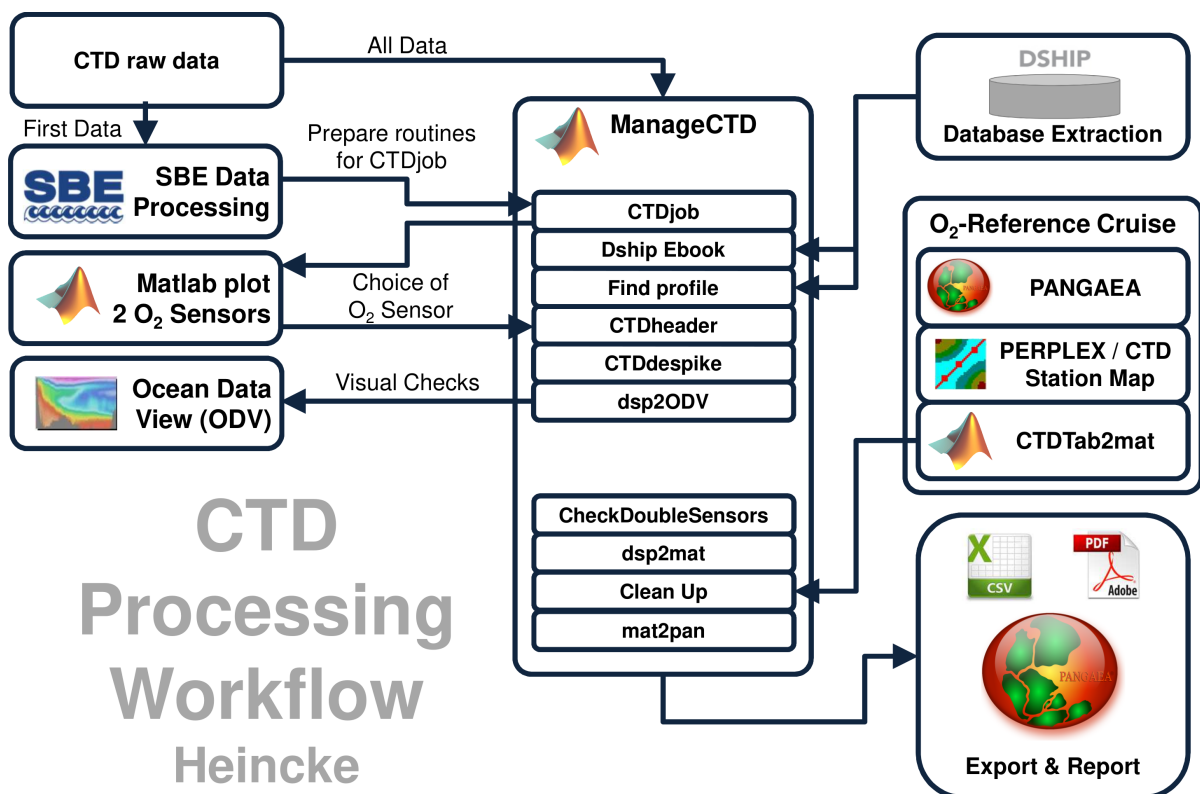


Figure 1: CTD data Processing Workflow

### 3 Cruise details

Vessel name       RV Heincke  
 Cruise name       HE515  
 Cruise start       26.06.2018 Bremerhaven  
 Cruise end         14.07.2018 Bremerhaven  
 Cruise duration    19 days  
 No. of CTD casts  47

### 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	2292	02-Dec-17
38	OxygenSensor	3654	21-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

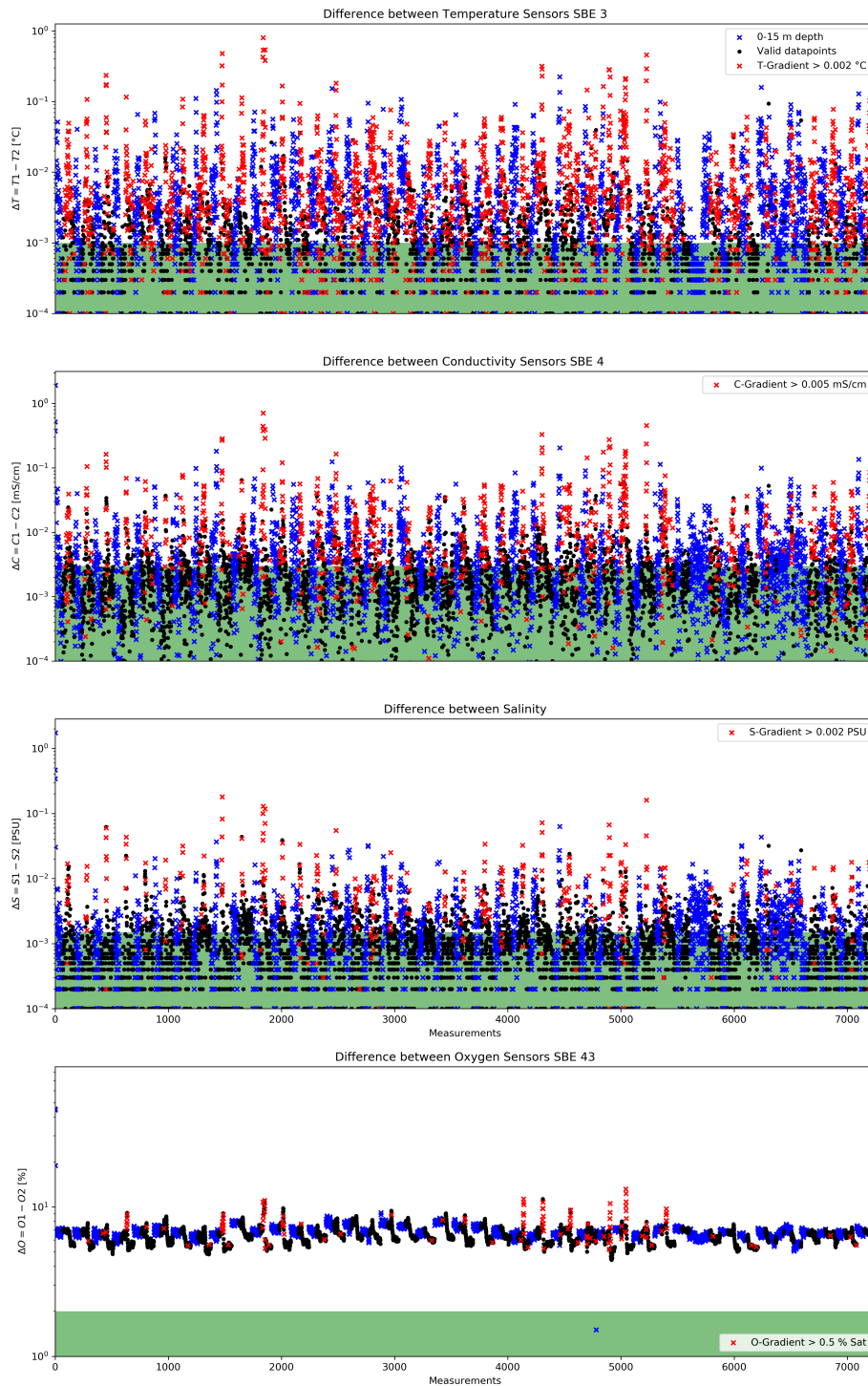


Figure 2: Data accuracy of sensor pairs HE515

## 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	$\pm 0.001 \text{ } ^\circ\text{C}$	65.78%	51.69%
Conductivity	$\pm 0.003 \text{ mS/cm}$	53.12%	76.16%
Salinity	$\pm 0.0015 \text{ PSU}$	45.90%	73.40%
Oxygen	$\pm 2.0 \text{ \% of saturation}$	42.72%	0.00%

### Comments

- 47 CTD "max depth/on ground" entries in DShip station book
- 47 CTD raw data sets delivered
- 2 CTD casts had a wrong cast number in filenames
- 47 CTD casts processed and uploaded
- of these 47 processed CTD casts:
  - 0 oxygen profiles deleted
  - 235 data points interpolated
  - 0 data points erased

## Result files

Text File (HE515\_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-HE515-report.pdf):

This PDF document.

Station	Gear	Date	Time	Position	Position	Depth	File	Sensor	Temp	Sal	Trans	Fluor	Oxy	complete	2 Oxy Sensors	Oxygen reference	Comments		
HE515_	Abbr.			Latitude	Longitude	[m]	HE515_	pair	interp	erased	interp	erased	interp	erased	Sensor	Offset	dist. (km)	Offset	
1-1	CTD	26.06.2018	17:00:24	54° 14.081' N	007° 26.648' E	34.8	1_ho11		1	1	1	1	1	5	2292	0.43	HE466/001-01	5.11	0.8
2-4	CTD	27.06.2018	06:46:14	54° 14.040' N	006° 19.164' E	33	4_3_ho12		1	1	1	1	1	5	2292	0.38	HE466/082-01	7.97	1.2
4-3	CTD	27.06.2018	11:38:29	54° 14.144' N	005° 38.406' E	34.6	4_3_ho13		1	1	1	1	1	5	2292	0.38	HE466/140-01	7.54	1.2
6-1	CTD	28.06.2018	07:36:14	54° 13.262' N	006° 00.032' E	34.4	6_1_ho14		1	1	1	1	1	5	2292	0.39	HE466/132-01	8.79	1.4
7-1	CTD	28.06.2018	08:43:58	54° 18.566' N	005° 59.833' E	36.5	7_1_ho15		1	2	2	2	2	10	2292	0.38	HE466/096-01	6.26	1.5
8-1	CTD	28.06.2018	09:25:53	54° 20.059' N	005° 59.086' E	36.1	8_1_ho16		1	2	2	2	2	10	2292	0.38	HE466/096-01	6.35	1.2
9-1	CTD	28.06.2018	10:19:25	54° 21.512' N	005° 58.314' E	36.3	9_1_ho17		1	1	1	1	1	10	2292	0.39	HE466/097-01	6.84	1.3
10-1	CTD	28.06.2018	11:03:13	54° 22.535' N	005° 57.966' E	36.6	10_1_ho18		1	1	1	1	1	10	2292	0.39	HE466/097-01	6.66	1.3
11-1	CTD	28.06.2018	11:42:56	54° 23.494' N	005° 57.513' E	36.9	11_1_ho19		2	2	2	2	2	10	2292	0.38	HE466/097-01	7.13	1.3
12-1	CTD	28.06.2018	12:43:40	54° 26.196' N	005° 55.432' E	37.7	12_1_ho110		2	1	1	1	1	5	2292	0.37	HE466/145-01	5.88	1.2
13-1	CTD	28.06.2018	14:24:42	54° 35.325' N	005° 37.761' E	38.3	13_1_ho111		1	1	1	1	1	5	2292	0.37	HE466/005-01	12.77	0.6
14-1	CTD	28.06.2018	16:02:52	54° 25.397' N	005° 37.695' E	38	14_1_ho112		1	1	1	1	1	5	2292	0.39	HE466/144-01	9.88	1.2
15-1	CTD	28.06.2018	17:13:42	54° 17.872' N	005° 37.868' E	35.8	15_1_ho113		1	1	1	1	1	5	2292	0.40	HE466/143-01	3.59	1.4
16-1	CTD	28.06.2018	18:30:46	54° 10.517' N	005° 37.816' E	34.8	16_1_ho114		1	1	1	1	1	5	2292	0.37	HE466/138-01	12.46	1.4
17-4	CTD	29.06.2018	07:40:17	54° 40.440' N	005° 56.831' E	38.3	17_4_ho115		1	1	1	1	1	5	2292	0.36	HE466/007-01	2.2	0.8
19-3	CTD	30.06.2018	07:07:00	54° 41.697' N	005° 24.089' E	39.7	19_3_ho116		1	4	4	4	4	20	2292	0.37	HE466/005-01	12.12	0.9
20-5	CTD	30.06.2018	11:18:52	54° 40.151' N	006° 33.417' E	36	20_2_ho117		2	1	1	1	1	5	2292	0.41	HE466/128-01	0.82	1.4
22-1	CTD	01.07.2018	12:04:44	54° 09.067' N	005° 24.096' E	37.1	22_1_ho118		1	1	1	1	1	5	2292	0.40	HE466/141-01	25.4	1.7
23-1	CTD	01.07.2018	13:42:36	54° 10.302' N	005° 41.695' E	34.9	23_1_ho119		1	1	1	1	1	5	2292	0.38	HE466/136-01	9.76	1.5
24-1	CTD	01.07.2018	14:50:24	54° 11.205' N	005° 50.457' E	32.6	24_1_ho120		1	2	2	2	2	10	2292	0.38	HE466/133-01	1.5	1.3
25-1	CTD	01.07.2018	15:39:41	54° 13.986' N	005° 48.590' E	34.3	25_1_ho121		1	1	1	1	1	5	2292	0.43	HE466/136-01	0.39	1.7
26-1	CTD	01.07.2018	16:30:05	54° 14.408' N	005° 43.131' E	34.5	26_1_ho122		1	1	1	1	1	5	2292	0.43	HE466/138-01	3.45	2
27-1	CTD	01.07.2018	17:27:09	54° 16.847' N	005° 46.336' E	35.3	27_1_ho123		1	1	1	1	1	5	2292	0.39	HE466/139-01	2.24	1.6
28-1	CTD	01.07.2018	18:18:47	54° 17.242' N	005° 41.316' E	34.9	28_1_ho124		1	1	1	1	1	5	2292	0.43	HE466/141-01	1.36	1.8
29-1	CTD	01.07.2018	19:10:06	54° 19.702' N	005° 44.896' E	36.1	29_1_ho125		1	1	1	1	1	5	2292	0.42	HE466/142-01	4.65	1.3
30-1	CTD	01.07.2018	19:56:46	54° 20.028' N	005° 39.720' E	37.1	30_1_ho126		1	1	1	1	1	5	2292	0.44	HE466/144-01	0.95	1.2
31-1	CTD	01.07.2018	20:45:25	54° 22.452' N	005° 43.210' E	38.3	31_1_ho127		1	1	1	1	1	5	2292	0.41	HE466/144-01	6.4	1.5
32-1	CTD	01.07.2018	21:34:01	54° 25.243' N	005° 41.153' E	37.5	32_1_ho128		1	1	1	1	1	5	2292	0.35	HE466/144-01	9.83	1.4
33-3	CTD	02.07.2018	06:06:00	54° 14.026' N	006° 02.542' E	34.3	33_2_ho129		1	1	1	1	1	5	2292	0.39	HE466/095-01	6.1	1.7
37-1	CTD	05.07.2018	04:35:48	55° 05.821' N	004° 59.288' E	35.7	37_1_ho130		1	1	1	1	1	5	2292	0.38	HE466/005-01	58.45	1.2
38-4	CTD	05.07.2018	12:18:01	55° 16.427' N	004° 40.079' E	44.5	38_4_ho131		2	1	1	1	1	5	2292	0.40	HE466/005-01	86.66	1
39-1	CTD	06.07.2018	04:33:02	55° 45.454' N	003° 31.943' E	50.1	39_1_ho131		1	4	4	4	4	20	2292	0.39	HE466/005-01	175.54	1.2
41-4	CTD	06.07.2018	14:38:36	55° 37.274' N	004° 09.875' E	32.3	41_4_ho133		1	3	3	3	3	15	2292	0.37	HE466/005-01	136.59	1.4
42-1	CTD	07.07.2018	04:23:02	54° 57.821' N	006° 02.193' E	35.2	42_1_ho134		1	2	2	2	2	10	2292	0.37	HE466/126-01	32.72	1.5
43-5	CTD	07.07.2018	14:43:41	54° 47.893' N	006° 07.334' E	38.1	43_5_ho135		1	1	1	1	1	10	2292	0.41	HE466/008-01	15.33	0.6
44-1	CTD	08.07.2018	04:26:43	54° 41.495' N	005° 30.315' E	40.6	44_1_ho136		1	2	2	2	2	10	2292	0.37	HE466/005-01	5.54	0.8
45-5	CTD	08.07.2018	13:49:21	54° 31.670' N	005° 23.281' E	39.7	45_5_ho137		1	2	2	2	2	10	2292	0.40	HE466/132-01	23.26	0.9
46-1	CTD	09.07.2018	04:32:23	53° 52.545' N	006° 15.970' E	28	46_1_ho138		1	1	1	1	1	5	2292	0.36	HE466/002-01	59.62	0.3
47-6	CTD	10.07.2018	12:54:20	53° 43.103' N	006° 37.385' E	15.5	47_6_ho139		1	1	1	1	1	5	2292	0.34	HE466/001-01	46.34	0.3
48-1	CTD	10.07.2018	04:32:02	53° 49.162' N	007° 31.487' E	86	48_1_ho140		1	1	1	1	1	5	2292	0.39	HE466/001-01	13.15	1
49-6	CTD	10.07.2018	13:40:49	54° 06.741' N	007° 25.444' E	34.6	49_6_ho141		1	1	1	1	1	5	2292	0.34	HE466/001-01	25.47	0.7
50-1	CTD	11.07.2018	04:34:37	54° 07.715' N	007° 43.291' E	35.6	50_1_ho142		1	2	2	2	2	10	2292	0.34	HE466/001-01	31.87	0.4
51-3	CTD	11.07.2018	10:53:12	54° 19.204' N	007° 49.825' E	20.3	51_3_ho143		2	1	1	1	1	5	2292	0.37	HE466/001-01	47.57	0.8
52-4	CTD	11.07.2018	16:55:19	54° 09.137' N	008° 05.239' E	17.5	52_4ho144		2	1	1	1	1	5	2292	0.36	HE466/001-01	61.17	0.4
53-1	CTD	12.07.2018	04:32:51	54° 43.939' N	007° 44.168' E	15.4	53_1ho145		1	1	1	1	1	5	2292	0.40	HE466/001-01	41.75	1.7
54-4	CTD	12.07.2018	12:03:10	54° 44.752' N	007° 18.135' E	19.8	54_4_ho146		1	1	1	1	1	5	2292	0.31	HE466/001-01	56.77	0.4
55-1	CTD	13.07.2018	04:31:31	53° 57.265' N	008° 06.267' E	16.2	55_1_ho147		1	1	1	1	1	5	2292	0.31	HE466/001-01	56.77	0.4
									47	0	47	0	47	0	235				

Figure 3: CTD data Processing Summary HE515  
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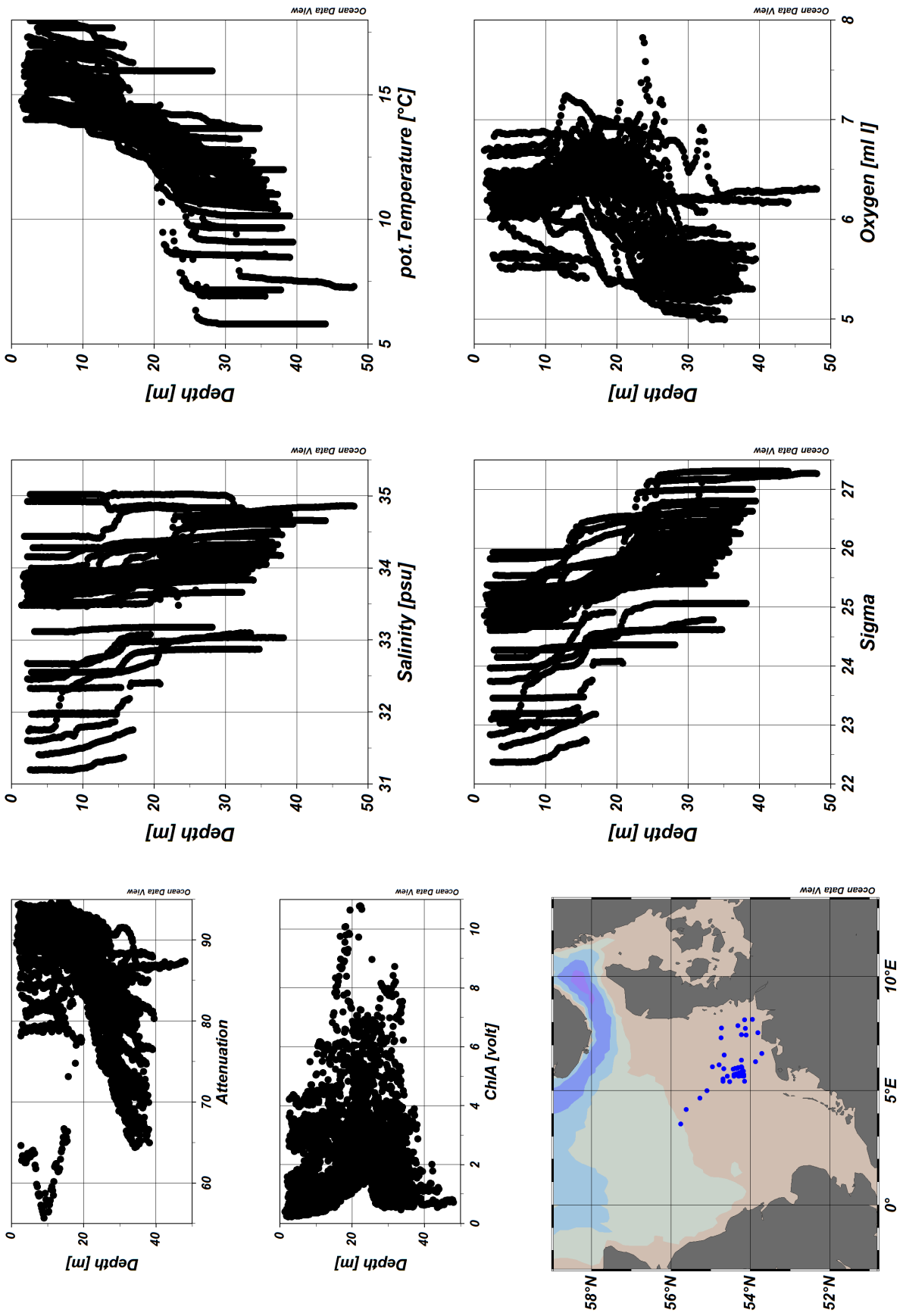


Figure 4: ODV Screenshot of HE515 CTD data  
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