CTD Data RV Heincke HE580

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 HE580.

2 Workflow

The different steps of processing and validation are visualized in Figure 1. The CTD raw data are delivered from Dr. Sandra Tippenhauer (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.

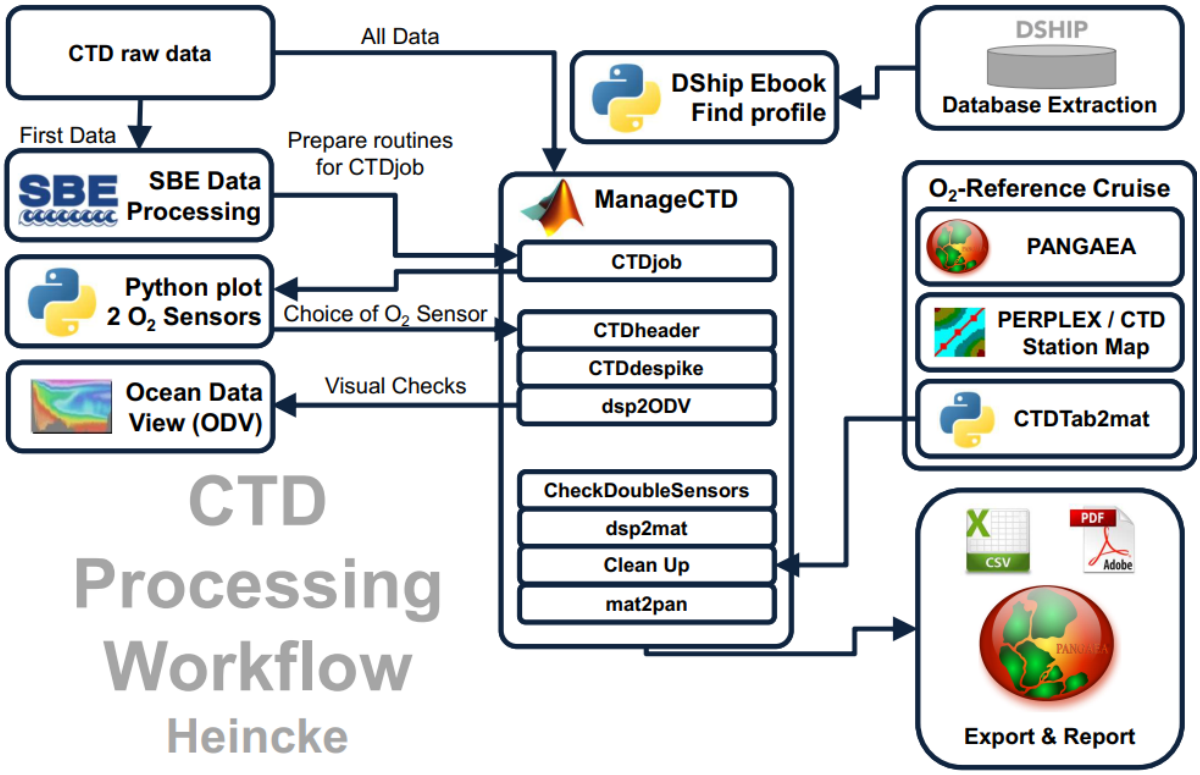

Figure 1: CTD data Processing Workflow

3 Cruise details

Vessel name	RV Heincke
Cruise name	HE580
Cruise start	17.07.2021 Bremerhaven
Cruise end	30.07.2021 Bremerhaven
Cruise duration	13 days
No. of CTD casts available	59

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

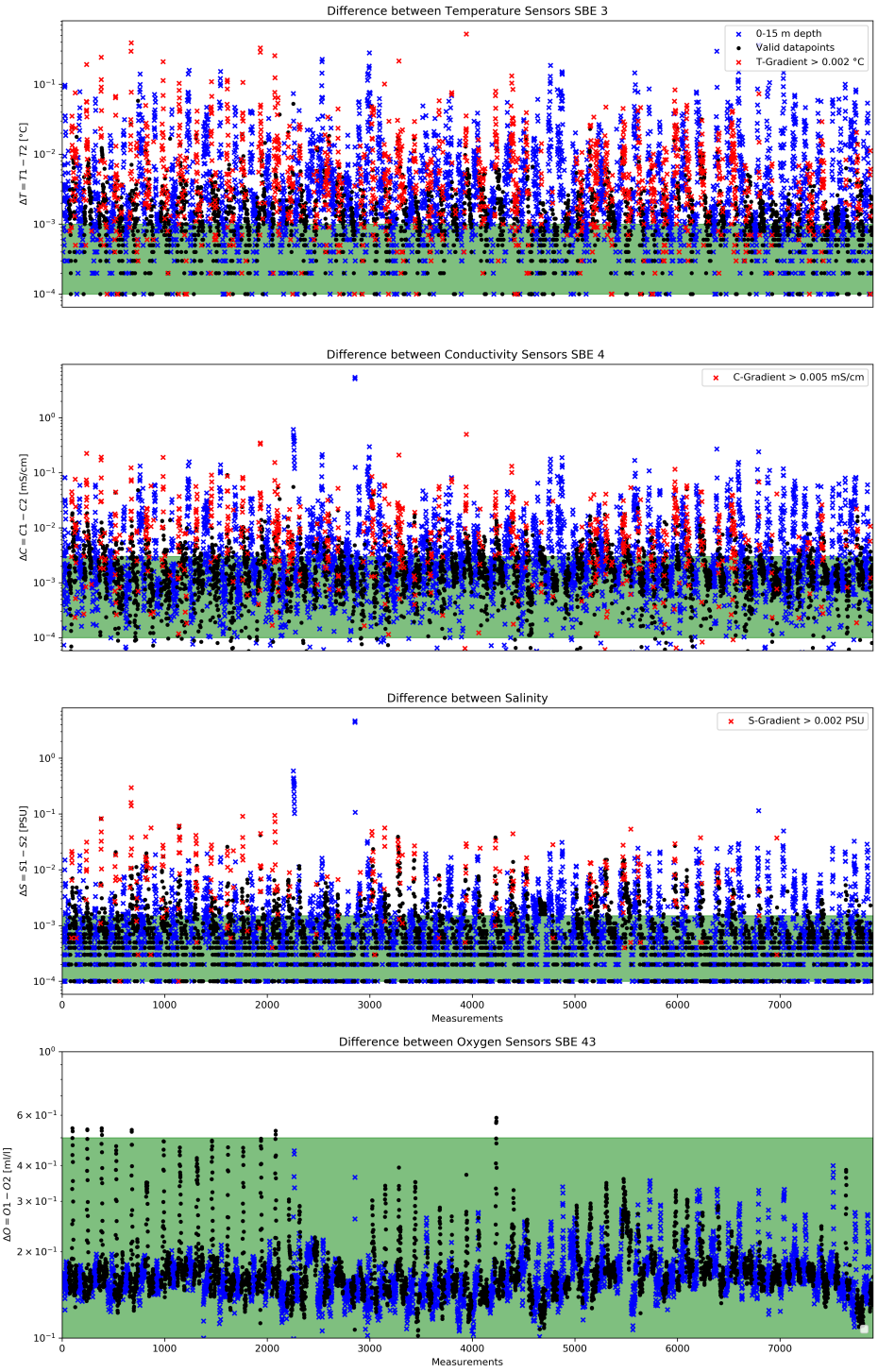

Figure 2: Data accuracy of sensor pairs HE580

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	$\pm 0.001\ °C$	66.80%	44.42%
Conductivity	$\pm 0.003\ mS/cm$	58.63%	79.09%
Salinity	$\pm 0.0015\ PSU$	52.67%	81.40%
Oxygen	$\pm 2.0\ \%\ of saturation$	49.30%	100.00%

Comments

- 50 CTD "max depth/on ground" entries in DShip station book
- 59 CTD raw data sets delivered
- all 59 casts are without bottle files
- 59 CTD casts processed and uploaded
- of these 59 processed CTD casts:
  - 0 oxygen profiles deleted (spiky and not matching to reference casts)
  - 204 data points interpolated
  - 43 data points erased

Result files

Text File (HE580_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-HE580-report.pdf):
This PDF document.

Station HE580_	Gear Abbr.	Date	Time	Position Latitude	Position Longitude	Depth [m]	File Name HE580_	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	
1-2	CTD	17.07.2021	13:42	54° 20,272' N	007° 18,637' E	25.0	REWIND21-01	1																		no data
2-1	CTD	18.07.2021	05:56	55° 08,748' N	003° 11,442' E	25.0	REWIND21-01	1													3654	-0.15	HE517/2-2	74.83	0.3	
3-1	CTD	18.07.2021	08:20	55° 01,989' N	003° 04,313' E	20.4	REWIND21-03	1													3654	-0.16	HE517/2-2	88.59	0.2	
4-1	CTD	18.07.2021	10:55	54° 55,656' N	003° 06,236' E	21.4	REWIND21-04	1	3		3		2		2		2		12		3654	-0.20	HE517/2-2	95.26	0.2	
5-1	CTD	18.07.2021	13:10	55° 04,548' N	002° 58,298' E	26.3	REWIND21-02	1		13	13							13		39	3654	-0.16	HE517/2-2	90.66	0.8	
6-1	CTD	18.07.2021	15:17	54° 59,074' N	002° 56,771' E	28.2	REWIND21-05	2	2		2		2		2		2		10		3654	-0.16	HE517/2-2	98.19	0.2	
7-1	CTD	19.07.2021	06:00	54° 57,005' N	002° 48,323' E	19.2	REWIND21-06	2	1		1		1		1		1		5		3654	-0.14	HE517/2-2	107.57	0.3	
8-1	CTD	19.07.2021	08:00	55° 01,984' N	002° 48,413' E	21.2	REWIND21-07	1		2								2		4	3654	-0.16	HE517/2-2	101.96	0.8	
9-1	CTD	19.07.2021	09:54	55° 07,611' N	002° 49,178' E	22.8	REWIND21-08	2	1		1		1		1		1		5		3654	-0.16	HE517/2-2	95.69	0.3	
10-1	CTD	19.07.2021	11:59	55° 04,250' N	002° 40,532' E	23.0	REWIND21-09	2													3654	-0.16	HE517/3-1	103.17	0.3	
11-1	CTD	19.07.2021	13:55	55° 08,652' N	002° 30,382' E	29.5	REWIND21-10	2	1		1										3654	-0.16	HE517/3-1	96.67	0.4	
12-1	CTD	20.07.2021	05:50	55° 02,649' N	002° 33,952' E	24.6	REWIND21-11	2													3654	-0.15	HE517/3-1	106.95	0.3	
13-1	CTD	20.07.2021	07:38	54° 59,404' N	002° 40,461' E	20.7	REWIND21-12	2	1		1		1		1		1		5		3654	-0.16	HE517/2-2	111.63	0.3	
14-1	CTD	20.07.2021	09:42	54° 56,377' N	002° 30,846' E	23.6	REWIND21-13	2													3654	-0.16	HE517/3-1	118.95	0.3	
15-2	CTD	20.07.2021	11:33	54° 53,984' N	002° 24,229' E	23.3	REWIND21-14	1	1		1										3654	-0.16	HE517/3-1	124.63	0.3	
16-1	CTD	20.07.2021	13:32	54° 58,951' N	002° 22,691' E	26.1	REWIND21-15	2	2		2		2		2		2		10		3654	-0.15	HE517/3-1	116.02	0.3	
17-1	CTD	21.07.2021	05:47	55° 03,714' N	002° 21,586' E	30.3	REWIND21-16	2	1		1		1		1		1		5		3654	-0.15	HE517/3-1	107.78	0.5	
18-1	CTD	21.07.2021	08:08	55° 10,351' N	002° 09,904' E	30.4	REWIND21-17	2			5										3654	-0.17	HE517/3-1	100.39	0.5	
19-1	CTD	21.07.2021	10:28	55° 03,304' N	002° 11,390' E	26.7	REWIND21-18	2	1		1		1		1		1		5		3654	-0.17	HE517/3-1	111.87	0.4	
20-2	CTD	21.07.2021	12:21	54° 59,427' N	002° 12,814' E	24.9	REWIND21-19	2													3654	-0.18	HE517/3-1	118.12	0.4	
21-1	CTD	21.07.2021	14:30	54° 54,191' N	002° 14,929' E	23.2	REWIND21-20	2													3654	-0.14	HE517/3-1	126.69	0.3	
22-1	CTD	22.07.2021	05:49	54° 55,162' N	002° 05,984' E	21.6	REWIND21-21	1	1		1										3654	-0.17	HE517/3-1	128.01	0.3	
23-1	CTD	22.07.2021	07:39	54° 55,015' N	001° 58,897' E	19.6	REWIND21-22	1	10		12		7		7		7		7		3654	-0.16	HE517/3-1	131.11	0.2	
24-1	CTD	22.07.2021	09:46	54° 59,981' N	002° 04,960' E	24.8	REWIND21-23	2													3654	-0.19	HE517/3-1	120.11	0.3	
25-1	CTD	22.07.2021	11:45	55° 04,819' N	002° 03,466' E	27.7	REWIND21-24	2													3654	-0.17	HE517/3-1	112.55	0.3	
26-1	CTD	22.07.2021	13:37	55° 07,830' N	001° 55,135' E	32.2	REWIND21-25	2	2		2		1		1		1		7		3654	-0.19	HE517/3-1	111.71	0.3	
27-1	CTD	23.07.2021	05:49	55° 06,423' N	001° 41,003' E	2.9	REWIND21-26	2	1		1		1		1		1		5		3654	-0.23	HE517/3-1	127.2	0.3	
28-1	CTD	23.07.2021	07:48	55° 01,758' N	001° 44,466' E	24.4	REWIND21-27	2													3654	-0.17	HE517/3-1	128.26	0.2	
29-1	CTD	23.07.2021	09:58	54° 58,582' N	001° 52,115' E	19.6	REWIND21-28	2													3654	-0.20	HE517/3-1	138.27	0.2	
30-1	CTD	23.07.2021	12:06	54° 54,107' N	001° 46,731' E	21.2	REWIND21-29	2													3654	-0.16	HE517/3-1	136.87	0.2	
31-1	CTD	23.07.2021	14:22	55° 01,226' N	001° 35,118' E	25.5	REWIND21-31	2	1		1		1		1		1		5		3654	-0.18	HE517/3-1	133.52	0.3	
32-1	CTD	24.07.2021	05:46	55° 06,307' N	001° 27,122' E	33.3	REWIND21-32	2	2		3		2		2		2		11		3654	-0.20	HE517/3-1	131.3	0.5	
33-1	CTD	24.07.2021	07:37	54° 58,204' N	001° 30,356' E	24.2	REWIND21-33	2													3654	-0.19	HE517/3-1	141.01	0.3	
34-1	CTD	24.07.2021	09:44	54° 57,939' N	001° 37,976' E	21.2	REWIND21-30	2													3654	-0.19	HE517/3-1	136.87	0.2	
35-1	CTD	24.07.2021	11:10	54° 55,169' N	001° 33,738' E	23.9	REWIND21-34	2	1		1		1		1		1		5		3654	-0.18	HE517/3-1	143.63	0.2	
36-1	CTD	24.07.2021	13:36	54° 49,460' N	001° 24,788' E	27.4	REWIND21-35	2	2		2		2		2		2		10		3654	-0.18	HE517/3-1	157.72	0.3	
37-1	CTD	25.07.2021	05:47	54° 47,215' N	001° 34,320' E	22.8	REWIND21-36	2													3654	-0.17	HE517/3-1	155.87	0.3	
38-1	CTD	25.07.2021	07:32	54° 52,516' N	001° 40,277' E	28.6	REWIND21-37	2	2		3		1		1		1		8		3654	-0.17	HE517/3-1	144.18	0.3	
39-1	CTD	25.07.2021	09:12	54° 47,411' N	001° 42,781' E	3.6	REWIND21-38	2													3654	-0.18	HE517/3-1	151.22	0.3	
40-2	CTD	25.07.2021	11:41	54° 40,481' N	001° 46,179' E	18.5	REWIND21-39	2													3654	-0.18	HE517/3-1	161.23	0.2	
41-1	CTD	25.07.2021	13:36	54° 42,263' N	001° 56,862' E	24.6	REWIND21-40	2	2		2		2		2		2		10		3654	-0.18	HE517/3-1	153.82	0.3	
42-1	CTD	26.07.2021	05:51	54° 45,448' N	001° 54,024' E	25.7	REWIND21-41	2	1		1		1		1		1		5		3654	-0.16	HE517/3-1	149.46	0.3	
43-1	CTD	26.07.2021	08:02	54° 51,986' N	001° 56,405' E	19.9	REWIND21-42	2													3654	-0.18	HE517/3-1	137.32	0.2	
43-2	CTD	26.07.2021	08:08	54° 51,981' N	001° 56,411' E	20.0																				no data
44-1	CTD	26.07.2021	10:05	54° 47,479' N	002° 05,349' E	19.3	REWIND21-43	2													3654	-0.16	HE517/3-1	141.65	0.3	
45-1	CTD	26.07.2021	11:45	54° 42,624' N	002° 08,074' E	25.1	REWIND21-44	2	1		1		1		1		1		5		3654	-0.14	HE517/3-1	149.33	0.3	
46-2	CTD	26.07.2021	14:07	54° 47,682' N	002° 16,999' E	18.2	REWIND21-45	2	1		2										3654	-0.16	HE517/3-1	137.75	0.3	
47-1	CTD	27.07.2021	05:48	55° 33,961' N	004° 00,015' E	31.2	MGF-DOG21-15	2													3654	-0.19	HE517/2-2	8.87	0.3	
48-1	CTD	27.07.2021	07:11	55° 33,955' N	004° 01,987' E	30.7	MGF-DOG21-16	2	1		3		1		1		1		7		3654	-0.20	HE517/2-2	6.86	0.3	
49-1	CTD	27.07.2021	08:37	55° 33,954' N	004° 03,998' E	29.8	MGF-DOG21-14	1	2		2		2		2		2		10		3654	-0.18	HE517/2-2	4.87	0.3	

Figure 3: CTD data Processing Summary HE580

Station HE580_	Gear Abbr.	Date	Time	Position Latitude	Position Longitude	Depth [m]	File Name HE580_	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	
50-1	CTD	27.07.2021	09:57	55° 33,935' N	004° 06,033' E	29.5	MGF-DOG21-17	1													3654	-0.18	HE517/2-2	2.99	0.4	
51-1	CTD	27.07.2021	11:07	55° 33,954' N	004° 07,977' E	28.9	MGF-DOG21-13	2	1		3										3654	-0.18	HE517/2-2	1.9	0.3	
52-1	CTD	27.07.2021	12:22	55° 31,980' N	004° 10,022' E	28.0	MGF-DOG21-12	1	2		5		2		2		2		13		3654	-0.18	HE517/2-2	2.55	0.4	
53-1	CTD	27.07.2021	13:34	55° 31,982' N	004° 07,952' E	28.3	MGF-DOG21-18	2	1		1		1		1		1		5		3654	-0.17	HE517/2-2	1.82	0.3	
54-1	CTD	27.07.2021	14:54	55° 31,995' N	004° 03,896' E	28.4	MGF-DOG21-19	2	1		4										3654	-0.17	HE517/2-2	4.93	0.3	
55-2	CTD	28.07.2021	05:51	55° 31,968' N	004° 06,077' E	28.5	MGF-DOG21-11	1	1		1		1		1		1		5		3654	-0.17	HE517/2-2	2.94	0.3	
56-1	CTD	28.07.2021	07:31	55° 31,969' N	004° 01,997' E	28.8	MGF-DOG21-10	1	1		1										3654	-0.18	HE517/2-2	6.84	0.3	
57-1	CTD	28.07.2021	08:56	55° 29,991' N	004° 04,001' E	27.3	MGF-DOG21-09	2	1		1		1		1		1		5		3654	-0.17	HE517/2-2	7.08	0.3	
58-1	CTD	28.07.2021	10:21	55° 30,040' N	004° 06,042' E	27.7	MGF-DOG21-20	2	1		5		1		1		1		9		3654	-0.18	HE517/2-2	5.87	0.3	
59-1	CTD	28.07.2021	11:32	55° 30,027' N	004° 08,014' E	27.2	MGF-DOG21-08	1			2										3654	-0.18	HE517/2-2	5.41	0.3	
60-1	CTD	28.07.2021	13:02	55° 30,015' N	004° 10,041' E	27.2	MGF-DOG21-21	2	2		7		2		2		2		15		3654	-0.18	HE517/2-2	5.73	0.4	
									55	13	86	15	42	0	42	0	42	15	204	43						

Figure 4: CTD data Processing Summary HE580

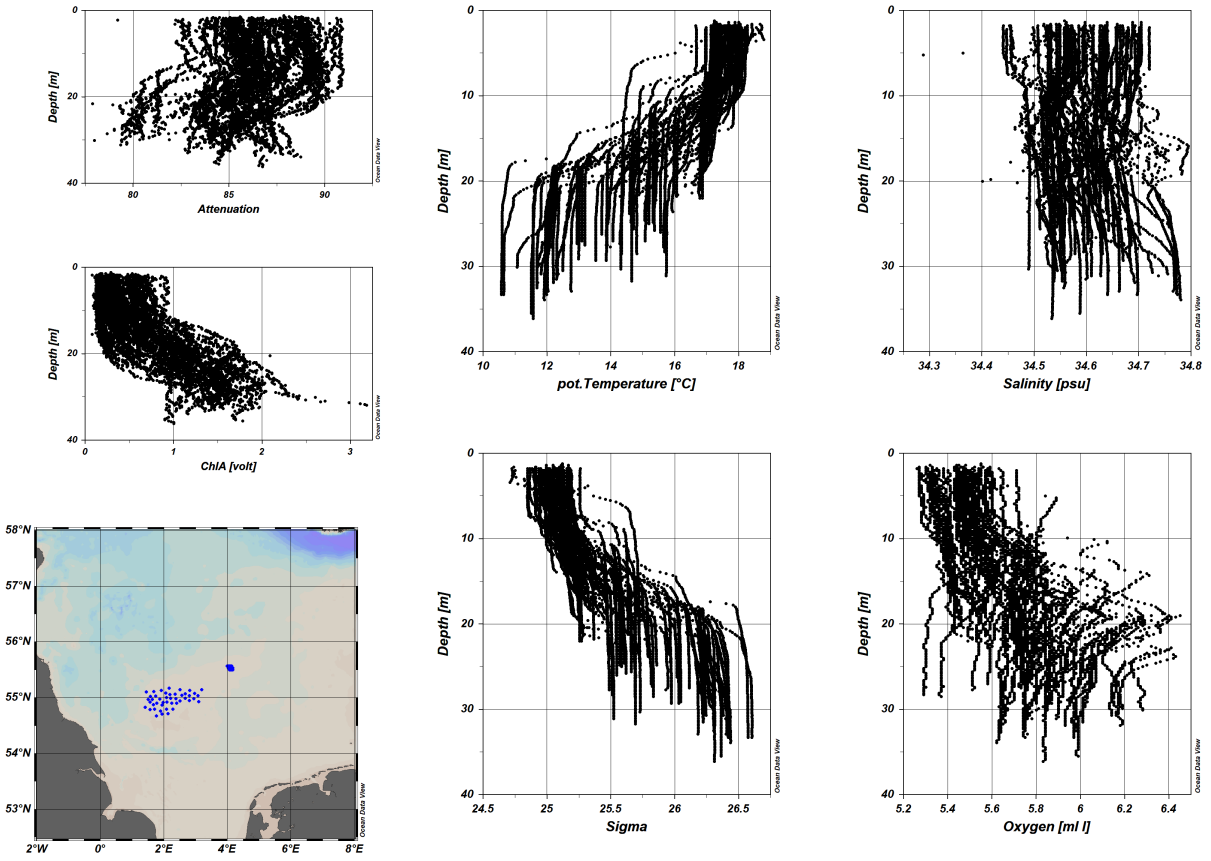

Figure 5: ODV Screenshot of HE580 CTD data