CTD Data RV Heincke HE517

Data Processing Report

Contents

Contact:
Gerd Rohardt
Alfred-Wegener-Institute
Am Handelshafen 12, D-27570 Bremerhaven, GERMANY
Mail: info@awi.de

Processing Agency:
FIELAX GmbH
Schleusenstr. 14, D-27568 Bremerhaven, GERMANY
Mail: info@fielax.de

Ref.: CTD-HE517-report.pdf	Vers.: 1	Date: 2018/11/19	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 HE517.

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.

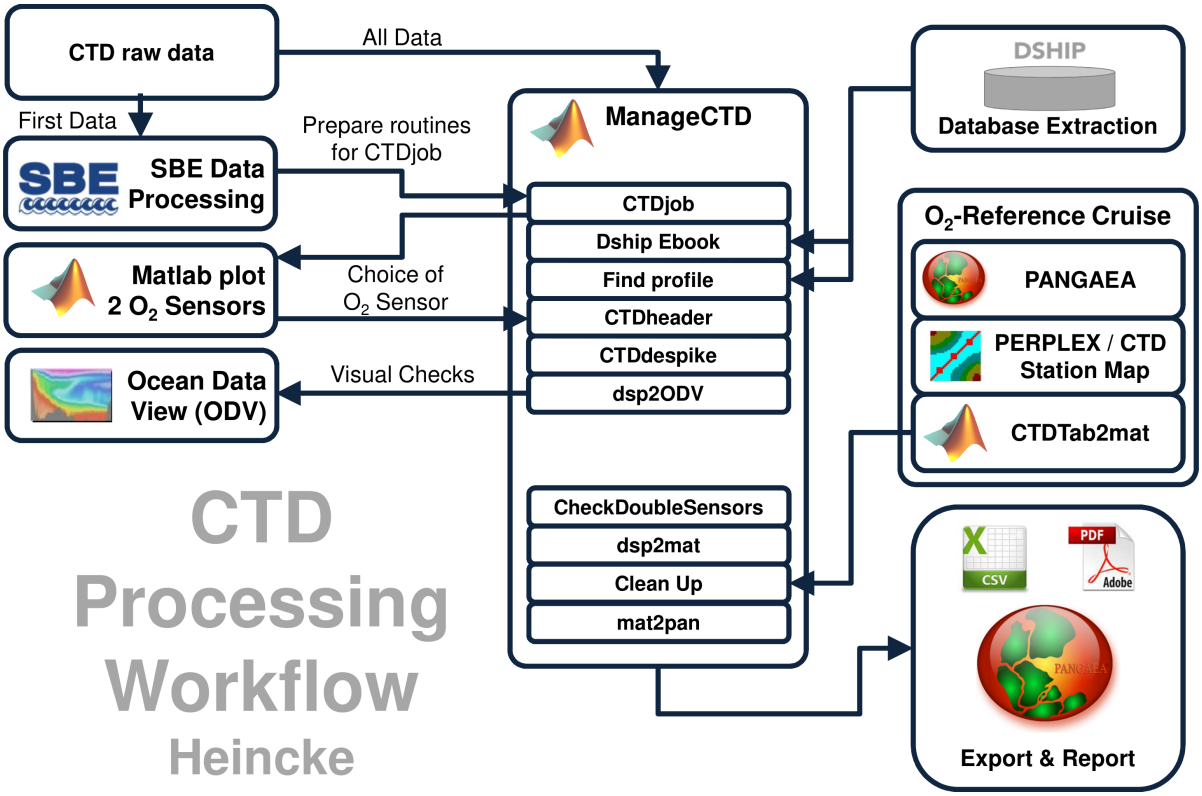

Figure 1: CTD data Processing Workflow

3 Cruise details

Vessel name	RV Heincke
Cruise name	HE517
Cruise start	19.08.2018 Bremerhaven
Cruise end	04.09.2018 Bergen
Cruise duration	17 days
No. of CTD casts in station book	121

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).

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

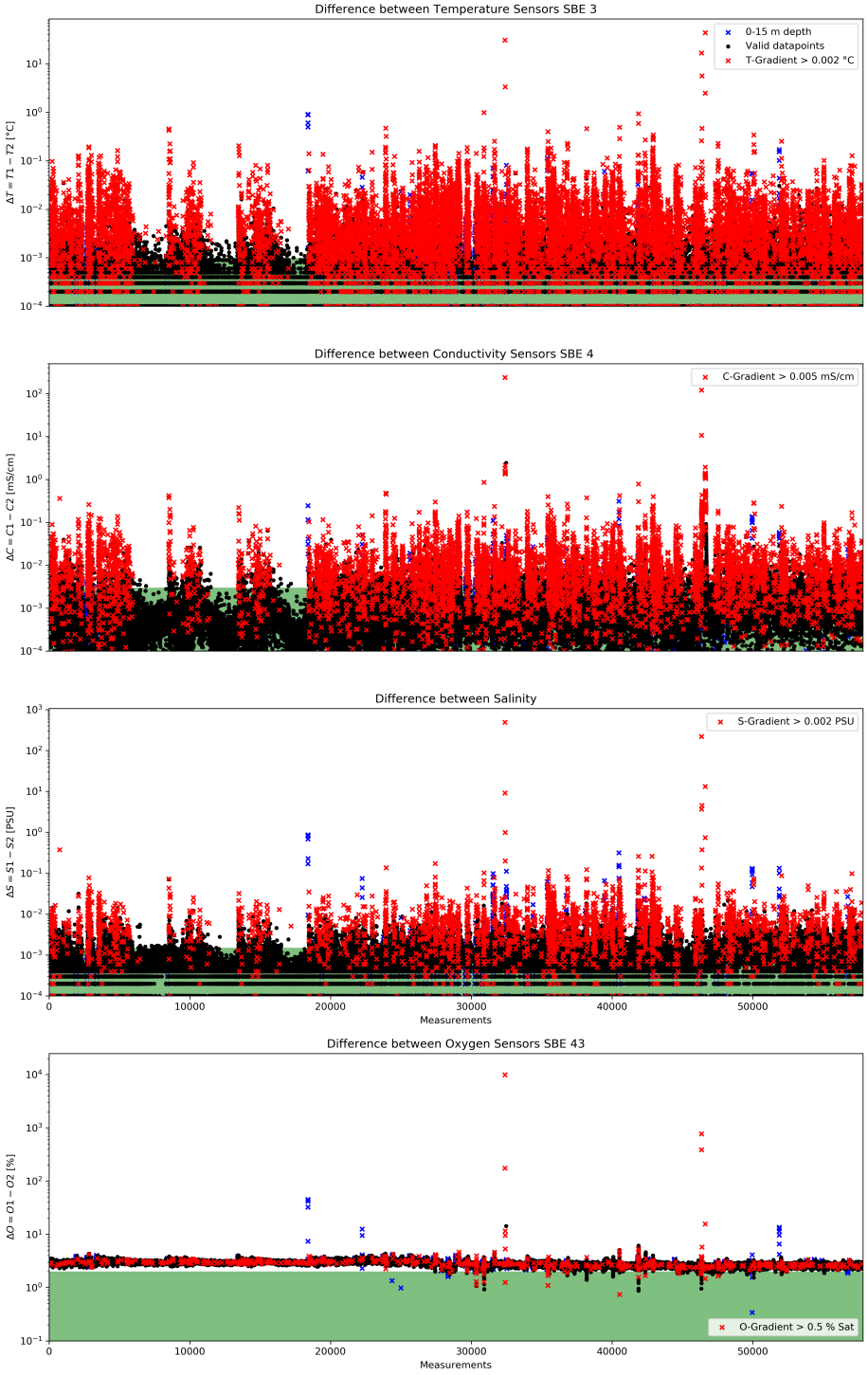

Figure 2: Data accuracy of sensor pairs HE517

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	$\pm 0.001\ °C$	25.19%	77.98%
Conductivity	$\pm 0.003\ mS/cm$	15.09%	89.67%
Salinity	$\pm 0.0015\ PSU$	8.53%	82.55%
Oxygen	$\pm 2.0\ \%\ of saturation$	4.84%	0.51%

Comments

- 121 CTD "max depth/on ground" entries in DShip station book
- 76 CTD raw data sets delivered (45 raw data sets for different scientific institution)
- 4 CTD raw data sets could not be processed: HE517_1901-2, HE517_1905-1, HE517_1934-0 and HE517_1942-1a
- most CTD raw data sets had names differing from the DSHIP entries; matching was achieved by comparing time entries in DSHIP and in the raw data header
- two different configuration were used: HE517_1901-1 till HE517_1917-1 with only 1 temperature and 1 conductivity sensor, HE517_1918-1 till HE517_1946-1 with 2 temperature and conductivity sensors
- 72 CTD casts processed and uploaded
- of these 72 processed CTD casts:
  - 0 oxygen profiles deleted
  - 2948 data points interpolated
  - 456 data points erased

Result files

Text File (HE517_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-HE517-report.pdf):
This PDF document.

Station HE517_	Gear Abbr.	Date	Time	Position Latitude	Position Longitude	Depth [m]	File HE517_	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	19.08.2018	10:49:00	54° 08.724' N	007° 51.634' E	51.1	1901-1	1	1		1		1		1		1		5	0	2292	0.20	468/01-1	12.21	~0.3	
1-4	CTD	19.08.2018	11:38:00	54° 08.510' N	007° 51.805' E	48.7	1901-2	1													2292	0.20	468/21-2	7.64	~0.3	
2-2	CTD	20.08.2018	06:41:00	55° 32.945' N	004° 08.285' E	28.1	1902-1	1													2292	0.19	468/21-1	101.64	~1.0	
3-1	CTD	20.08.2018	12:41:00	55° 59.686' N	002° 49.477' E	74.7	1903-1	1	4		4		4		4		4		20	0	2292	0.19	468/21-1	101.31	~1.0	
3-4	CTD	20.08.2018	13:28:00	55° 59.785' N	002° 49.959' E	74.2	1903-3	1	1		1		1		1		1		5	0	2292	0.19				no oxygen ref. --> dist. > 400km
4-1	CTD	21.08.2018	06:56:00	57° 47.190' N	001° 21.622' W	89.9	1904-1	1	2		2		2		2		2		10	0	2292	0.18				no oxygen ref. --> dist. > 400km
4-4	CTD	21.08.2018	07:40:00	57° 47.255' N	001° 22.368' W	88.4	1904-3	1	1		1		1		1		1		5	0	2292	0.18				no oxygen ref. --> dist. > 400km
4-5	CTD	21.08.2018	08:15:00	57° 47.348' N	001° 23.037' W	87.7	1904-4	1	2		2		2		2		2		10	0	2292	0.19				no oxygen ref. --> dist. > 400km
5-3	CTD	21.08.2018	13:13:00	58° 20.146' N	002° 18.963' W	57	1905-1a	1													2292	0.18				no oxygen ref. --> dist. > 400km
6-1	CTD	22.08.2018	04:06:00	58° 46.680' N	005° 27.647' W	78.6	1906-1	1	2		2		2		3		2		11	0	2292	0.18				no oxygen ref. --> dist. > 400km
6-3	CTD	22.08.2018	04:46:00	58° 46.484' N	005° 27.879' W	80.5	1906-3	1	3		3		3		3		3		15	0	2292	0.18				no oxygen ref. --> dist. > 400km
7-1	CTD	22.08.2018	10:27:00	58° 53.726' N	006° 45.281' W	150	1907-1	1	1		1		1		1		1		5	0	2292	0.19				no oxygen ref. --> dist. > 400km
10-1	CTD	23.08.2018	04:38:00	60° 05.461' N	005° 48.483' W	37.2	1909-1	1	49		49		49		49		49		245	0	2292	0.22				no oxygen ref. --> dist. > 400km
10-2	CTD	23.08.2018	05:43:00	60° 05.019' N	005° 48.476' W	20.1	1909-3	1	35		35		35		35		35		175	0	2292	0.22				no oxygen ref. --> dist. > 400km
10-7	CTD	23.08.2018	07:13:00	60° 04.998' N	005° 48.299' W	29.4	1909-4	1	7		7		7		7		7		35	0	2292	0.20				no oxygen ref. --> dist. > 400km
11-2	CTD	23.08.2018	10:15:00	59° 59.852' N	005° 05.858' W	487.3	1910-1	1	20		20		20		20		20		100	0	2292	0.19				no oxygen ref. --> dist. > 400km
11-5	CTD	23.08.2018	11:36:00	60° 00.846' N	005° 04.452' W	154.0	1910-3	1	7		7		7		7		7		35	0	2292	0.18				no oxygen ref. --> dist. > 400km
12-1	CTD	23.08.2018	13:12:00	59° 57.587' N	004° 48.248' W	152.1	1911-1	1	6		6		6		6		6		30	0	2292	0.17				no oxygen ref. --> dist. > 400km
12-4	CTD	23.08.2018	14:09:00	59° 57.630' N	004° 47.926' W	153.7	1911-3	1	4		4		4		4		4		20	0	2292	0.19				no oxygen ref. --> dist. > 400km
13-2	CTD	23.08.2018	16:25:00	59° 53.547' N	004° 21.300' W	135.6	1912-1	1	8		8		8		8		8		40	0	2292	0.19				no oxygen ref. --> dist. > 400km
14-1	CTD	24.08.2018	04:39:00	60° 04.813' N	002° 41.593' W	81.6	1913-1	1	2		2		2		2		2		10	0	2292	0.19				no oxygen ref. --> dist. > 400km
15-1	CTD	24.08.2018	08:15:00	60° 20.542' N	003° 06.888' W	161.8	1914-1	1	4		4		4		4		4		20	0	2292	0.19				no oxygen ref. --> dist. > 400km
16-1	CTD	24.08.2018	11:37:00	60° 36.403' N	003° 32.591' W	503.4	1915-1	1	17		17		17		17		17		85	0	2292	0.19				no oxygen ref. --> dist. > 400km
17-1	CTD	24.08.2018	14:18:00	60° 49.283' N	003° 53.350' W	80	1916-1	1	35		36		35		35		35		176	0	2292	0.21				no oxygen ref. --> dist. > 400km
19-1	CTD	25.08.2018	04:35:00	61° 23.555' N	002° 15.158' W	20.8	1917-1	1	27		27		27		27		27		135	0	2292	0.21				no oxygen ref. --> dist. > 400km
20-1	CTD	25.08.2018	08:13:00	61° 17.601' N	001° 37.909' W	404.6	1918-1	1	11		11		11		16		11		60	0	2292	0.19				no oxygen ref. --> dist. > 400km
21-1	CTD	25.08.2018	11:31:00	61° 11.489' N	001° 03.706' W	155.9	1919-1	1	3		3		3		3		3		15	0	2292	0.19				no oxygen ref. --> dist. > 400km
22-1	CTD	25.08.2018	14:39:00	61° 03.228' N	000° 39.876' W	141.9	1920-1	1	4		4		4		4		4		20	0	2292	0.18				no oxygen ref. --> dist. > 400km
23-1	CTD	26.08.2018	04:58:00	62° 24.296' N	000° 03.496' W	39.5	1921-1	1	31		31		31		31		31		155	0	2292	0.23				no oxygen ref. --> dist. > 400km
23-4	CTD	26.08.2018	06:23:00	62° 23.869' N	000° 06.409' W	54.3	1921-3	1	45		45		45		45		45		225	0	2292	0.22				no oxygen ref. --> dist. > 400km
23-5	CTD	26.08.2018	07:37:00	62° 24.565' N	000° 00.713' W	107.3	1921-4	1	58		58		58		58		58		290	0	2292	0.23				no oxygen ref. --> dist. > 400km
23-6	CTD	26.08.2018	08:30:00	62° 24.653' N	000° 00.842' W	100.3	1921-5	1	6		6		6		6		6		30	0	2292	0.22				no oxygen ref. --> dist. > 400km
23-7	CTD	26.08.2018	08:57:00	62° 24.487' N	000° 00.673' W	106.5	1921-6	1	2		2		2		2		2		10	0	2292	0.19				no oxygen ref. --> dist. > 400km
24-1	CTD	26.08.2018	12:05:00	62° 02.914' N	000° 00.409' E	489.6	1922-1	1	15		15		15		15		15		75	0	2292	0.20				no oxygen ref. --> dist. > 400km
24-4	CTD	26.08.2018	13:05:00	62° 03.588' N	000° 01.442' E	504.4	1922-3	1	2		2		2		2		2		10	0	2292	0.20				no oxygen ref. --> dist. > 400km
24-5	CTD	26.08.2018	13:39:00	62° 04.079' N	000° 01.937' E	509.1	1922-4	1	2		2		2		2		2		10	0	2292	0.20				no oxygen ref. --> dist. > 400km
25-1	CTD	26.08.2018	16:30:00	61° 40.522' N	000° 00.085' E	205.4	1923-1	1	5		5		5		5		5		25	0	2292	0.20				no oxygen ref. --> dist. > 400km

Figure 3: CTD data Processing Summary HE517

Station HE517_	Gear Abbr.	Date	Time	Position Latitude	Position Longitude	Depth [m]	File HE517_	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	
26-1	CTD	27.08.2018	06:09:00	61° 04.295' N	000° 00.045' E	138.5	1924-1	2	2		2		2		2		2		10	0	2292	0.19				no oxygen ref. --> dist. > 400km
26-4	CTD	27.08.2018	06:51:00	61° 04.355' N	000° 00.509' E	140.1	1924-3	2	3		3		3		3		3		15	0	2292	0.20				no oxygen ref. --> dist. > 400km
26-5	CTD	27.08.2018	07:26:00	61° 04.268' N	000° 00.096' E	141.2	1924-4	1	6		6		6		6	1	30	1	2292	0.20				no oxygen ref. --> dist. > 400km
27-1	CTD	27.08.2018	10:06:00	60° 41.045' N	000° 00.393' E	118.3	1925-1	1	5		5		5		5		25	0	2292	0.20				no oxygen ref. --> dist. > 400km
28-1	CTD	27.08.2018	12:58:00	60° 19.234' N	000° 00.024' W	124.9	1926-1	1	1		1		1		1		5	0	2292	0.19				no oxygen ref. --> dist. > 400km
29-1	CTD	29.08.2018	11:12:00	60° 00.100' N	000° 11.318' E	127.2	1927-1	2	2		2		2		2		10	0	2292	0.18				no oxygen ref. --> dist. > 400km
30-1	CTD	29.08.2018	13:38:00	59° 48.557' N	000° 09.302' E	123.5	1928-1	1	2		2		2		2		10	0	2292	0.20				no oxygen ref. --> dist. > 400km
32-1	CTD	30.08.2018	06:16:00	58° 25.359' N	000° 15.453' W	109.5	1929-1	1	3		3		3		3		15	0	2292	0.16				no oxygen ref. --> dist. > 400km
33-1	CTD	30.08.2018	10:17:00	58° 29.033' N	000° 14.294' W	119.4	1930-1	1	1		1		1		1		5	0	2292	0.15				no oxygen ref. --> dist. > 400km
34-1	CTD	30.08.2018	13:17:00	58° 28.846' N	000° 14.129' E	144.3	1931-1	1	2		2		2		2		10	0	2292	0.20				no oxygen ref. --> dist. > 400km
34-4	CTD	30.08.2018	15:58:00	58° 34.666' N	000° 09.100' E	145.3	1932-1	1	5		5		5		5		25	0	2292	0.18				no oxygen ref. --> dist. > 400km
36-2	CTD	31.08.2018	04:42:00	58° 57.306' N	002° 36.677' E	111.8	1933-1	1	4		4		4		4		20	0	2292	0.15				no oxygen ref. --> dist. > 400km
37-1	CTD	31.08.2018	08:12:00	59° 05.025' N	003° 12.602' E	158.4	1934-1	1	3		4		3		3		16	0	2292	0.16				no oxygen ref. --> dist. > 400km
38-1	CTD	31.08.2018	11:48:00	59° 14.864' N	003° 57.960' E	284	1935-1	1	4	91	4	91	4	91	4	91	20	455	2292	0.13				no oxygen ref. --> dist. > 400km
38-3	CTD	31.08.2018	12:14:00	59° 15.304' N	003° 57.930' E	285.1	1935-2	1	19		19		19		19		95	0	2292	0.18				no oxygen ref. --> dist. > 400km
39-1	CTD	01.09.2018	04:37:00	60° 00.179' N	002° 35.583' E	108.4	1936-1	1	2		2		2		2		10	0	2292	0.18				no oxygen ref. --> dist. > 400km
40-1	CTD	01.09.2018	07:42:00	60° 00.078' N	003° 15.232' E	213.2	1937-1	1	9		9		9		9		45	0	2292	0.17				no oxygen ref. --> dist. > 400km
41-1	CTD	01.09.2018	10:45:00	60° 00.120' N	003° 51.892' E	282.4	1938-1	1	8		8		8		8		40	0	2292	0.17				no oxygen ref. --> dist. > 400km
41-4	CTD	01.09.2018	11:53:00	60° 00.842' N	003° 51.826' E	284	1938-3	1	8		8		8		8		40	0	2292	0.17				no oxygen ref. --> dist. > 400km
41-5	CTD	01.09.2018	12:22:00	60° 00.873' N	003° 51.912' E	284.5	1938-4	1	10		10		10		10		50	0	2292	0.17				no oxygen ref. --> dist. > 400km
41-6	CTD	01.09.2018	12:49:00	60° 00.860' N	003° 52.079' E	283.8	1938-5	1	4		4		4		4		20	0	2292	0.17				no oxygen ref. --> dist. > 400km
41-7	CTD	01.09.2018	13:16:00	60° 00.865' N	003° 52.163' E	283.1	1938-6	1	2		2		2		2		10	0	2292	0.17				no oxygen ref. --> dist. > 400km
42-1	CTD	01.09.2018	15:14:00	60° 00.050' N	004° 13.516' E	285.5	1939-1	1	10		10		10		10		50	0	2292	0.17				no oxygen ref. --> dist. > 400km
42-4	CTD	01.09.2018	16:02:00	59° 59.858' N	004° 13.674' E	287	1939-3	1	3		3		3		3		15	0	2292	0.19				no oxygen ref. --> dist. > 400km
42-5	CTD	01.09.2018	16:30:00	59° 59.694' N	004° 13.729' E	285.4	1939-4	1	7		7		7		7		35	0	2292	0.18				no oxygen ref. --> dist. > 400km
44-1	CTD	02.09.2018	04:35:00	60° 59.951' N	004° 01.144' E	347	1940-1	1	9		9		9		9		45	0	2292	0.18				no oxygen ref. --> dist. > 400km
45-1	CTD	02.09.2018	08:00:00	61° 00.173' N	003° 24.528' E	350.1	1941-1	1	15		15		15		15		75	0	2292	0.16				no oxygen ref. --> dist. > 400km
46-1	CTD	02.09.2018	11:29:00	61° 00.406' N	002° 48.942' E	254.7	1942-1	1	14		14		14		14		70	0	2292	0.15				data > 250m depth deleted; no oxygen ref. --> dist. > 400km
47-4	CTD	02.09.2018	15:20:00	60° 59.718' N	002° 12.576' E	130.5	1943-2	1	3		3		3		3		15	0	2292	0.15				no oxygen ref. --> dist. > 400km
48-1	CTD	03.09.2018	06:16:00	62° 02.182' N	002° 32.663' E	402	1944-1	1	14		14		14		14		70	0	2292	0.17				no oxygen ref. --> dist. > 400km
48-4	CTD	03.09.2018	07:32:00	62° 01.960' N	002° 32.723' E	401.7	1944-3	1	22		22		22		22		110	0	2292	0.17				no oxygen ref. --> dist. > 400km
48-5	CTD	03.09.2018	08:05:00	62° 01.871' N	002° 32.735' E	399.8	1944-4	1	25		25		25		25		125	0	2292	0.17				no oxygen ref. --> dist. > 400km
48-6	CTD	03.09.2018	08:42:00	62° 01.820' N	002° 32.837' E	399.1	1944-5	1	6	35	6	35	6	35	6	35	30	175	2292	0.16				no oxygen ref. --> dist. > 400km
48-7	CTD	03.09.2018	09:09:00	62° 01.730' N	002° 33.045' E	397.4	1944-6	1	2		2		2		2		10	0	2292	0.17				no oxygen ref. --> dist. > 400km
49-1	CTD	03.09.2018	11:47:00	62° 04.071' N	003° 15.836' E	377.2	1945-1	1	17		17		17		17		85	0	2292	0.17				no oxygen ref. --> dist. > 400km
51-1	CTD	03.09.2018	14:53:00	62° 05.478' N	003° 44.791' E	221.3	1946-1	1	18		18		18		18		90	0	2292	0.17				no oxygen ref. --> dist. > 400km
									588	91	590	91	588	91	594	91	588	92	2948	456						

Figure 4: CTD data Processing Summary HE517

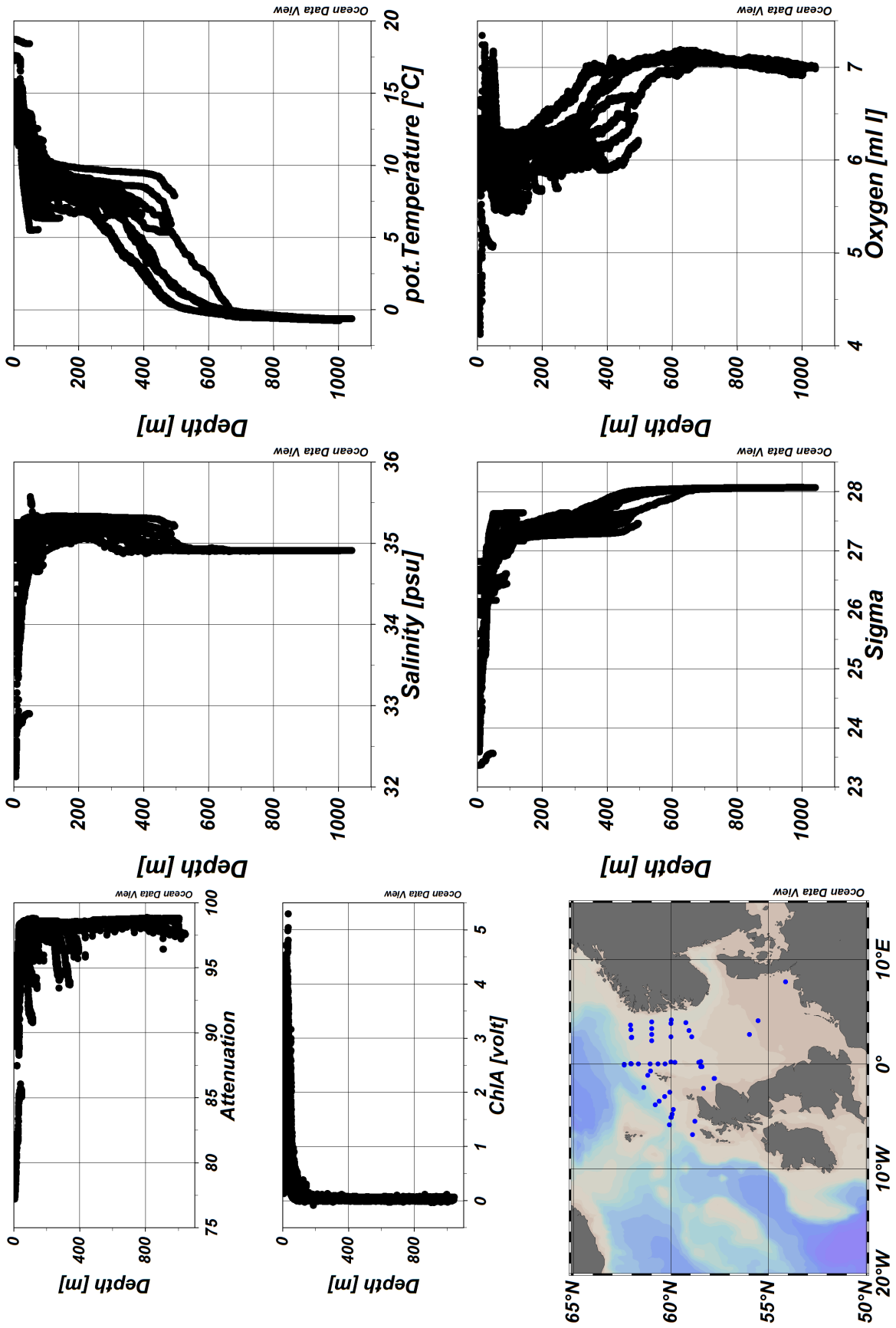

Figure 5: ODV Screenshot of HE517 CTD data