CTD Data RV Heincke HE422
Data Processing Report

Contents

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| Ref.: CTD-HE422-report.pdf	Vers.: 1	Date: 2016/07/27	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 HE422.

2 Workflow

The different steps of processing and validation are visualized in Figure 1. The CTD raw data are delivered from Gerd Rohardt (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. 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.
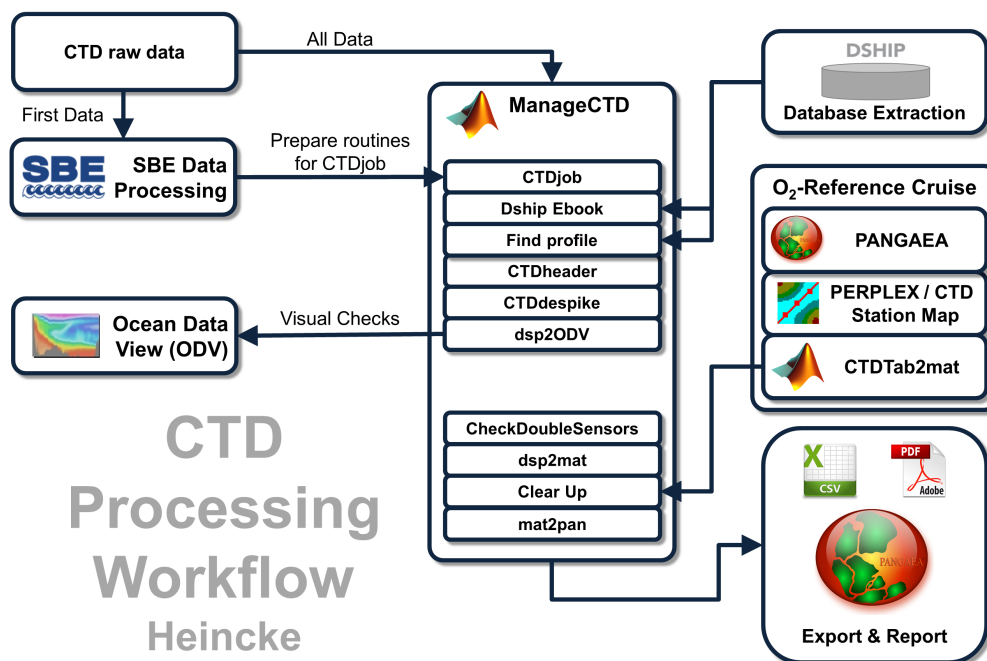
Figure 1: CTD data Processing Workflow

3 Cruise details

Vessel name	RV Heincke
Cruise name	HE422
Cruise start	02.05.2014 Bremerhaven
Cruise end	15.05.2014 Bremerhaven
Cruise duration	14 days
No. of CTD casts	55

4 Sensor Layout

This chapter describes the CTD sensors mounted during this cruise:

SBE 911plus CTD (SN: 0935), SBE Instrument Configuration Version 7.23.0.1.

ID	Sensor Name	Serial No.	Calibration Date
55	TemperatureSensor	5112	15-Oct-13
3	ConductivitySensor	3570	30-Oct-13
45	PressureSensor	0935	12-Mar-09
55	TemperatureSensor	5101	04-Jan-14
3	ConductivitySensor	3597	03-Jan-14
0	AltimeterSensor	46466	23-Mar-09
20	FluoroWetlabECO_AFL_FL_Sensor	FLRTD-1365	09-Aug-2011
59	TransChelseaSeatechWetlabCStarSensor	435DR	21. Dec 2011
38	OxygenSensor	0467	13-Nov-12

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

Obvius 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 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).
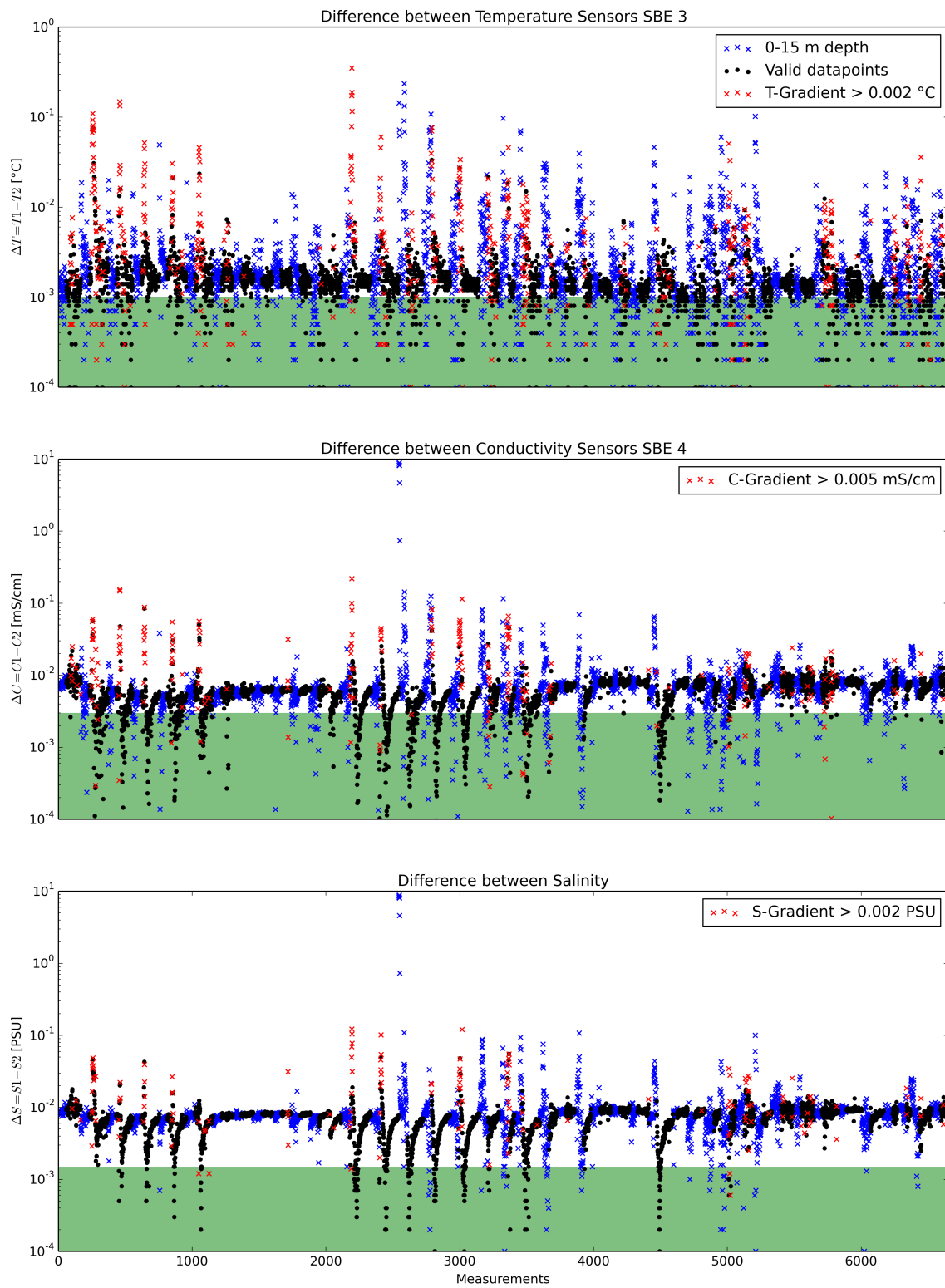
Sensor Differences

Figure 2: Data accuracy of sensor pairs HE422

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 two sensorpairs are shown for the measured parameters *Temperature* and *Conductivity* and the derived parameter *Salinity*. 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	$\pm 0.001^\circ C$	47.41%	19.47%
Conductivity	$\pm 0.003 mS/cm$	43.23%	14.91%
Salinity	$\pm 0.0015 PSU$	41.90%	3.78%

Comments

- 55 CTD/RO "on ground" entries in DShip station book

- 43 CTD raw data sets delivered

- 12 CTD casts had no data available

- 1 CTD cast was invalid or test (14-1.hex)

- 1 CTD cast was made twice on a station (HE422/0018-2)

- 2 CTD casts had a wrong filename (18-1.hex, 57-1.hex)

- 42 CTD casts processed and uploaded

- of these 42 processed CTD casts:
    - 0 oxygen profiles deleted (spiky and not matching to reference casts)
    - 50 data points interpolated
    - 0 data points erased

Result files

Text File (HE422_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-HE422-report.pdf):

This PDF document.

Station HE422/	Gear Abbr.	Date	Time	Position Latitude	Position Longitude	Depth [m]	File HE422_	Sensor pair	Temp interp	Temp erased	Sal interp	Sal erased	Trans interp	Trans erased	Chloro interp	Chloro erased	Oxy interp	Oxy erased	complete interp	complete erased	Oxygen reference cruise/sss-cc	Oxygen reference dist. (km)	Offset	Comments
0003-1	CTD/RO	03.05.2014	09:24	54° 25.40' N	6° 8.69' E	36.5																		no data available
0004-1	CTD/RO	03.05.2014	10:24	54° 25.49' N	6° 15.99' E	36.9																		no data available
0005-1	CTD/RO	03.05.2014	11:13	54° 29.96' N	6° 15.83' E	36.4	5-1.*	2					1		1		1		0	0	HE395/23-2	5.63	0.5	no btl file available
0006-1	CTD/RO	03.05.2014	12:04	54° 30.03' N	6° 8.46' E	38	6-1.*	2	1		1		1		1			1	5	0	HE395/22-1	0.08	0.5	no btl file available
0008-1	CTD/RO	03.05.2014	13:15	54° 28.08' N	6° 11.70' E	37.1																		no data available
0008-2	CTD/RO	03.05.2014	13:23	54° 28.10' N	6° 11.71' E	37.3	8-2.*	2											0	0	HE395/23-2	0.06	0.5	no btl file available
0018-1	CTD/RO	04.05.2014	09:24	54° 52.02' N	5° 38.69' E	38.6																		no data available
0018-2	CTD/RO	04.05.2014	09:26	54° 52.00' N	5° 38.71' E	38.4	18-1.*	2											0	0	HE356/074-1	4.05	0.3	no btl file available
0018-4	CTD/RO	04.05.2014	09:35	54° 51.96' N	5° 38.90' E	39.6																		no data available
0020-1	CTD/RO	04.05.2014	10:42	54° 47.63' N	5° 38.61' E	38.9	20-1.*	1											0	0	HE356/074-1	4.62	0.3	no btl file available
0021-1	CTD/RO	04.05.2014	11:42	54° 47.63' N	5° 30.99' E	39	21-1.*	2											0	0	HE356/074-1	10.65	0.3	no btl file available
0025-1	CTD/RO	05.05.2014	08:06	54° 49.90' N	5° 34.91' E	39.3	25-1.*	2			2		1						3	0	HE356/074-1	5.54	0.3	no btl file available
0027-1	CTD/RO	05.05.2014	16:15	55° 30.06' N	4° 10.11' E	27.7																		no data available
0031-1	CTD/RO	06.05.2014	08:15	55° 32.30' N	4° 6.27' E	29.4	31-1.*	2											0	0	HE447/029-1	5.98	0.1	no btl file available
0032-1	CTD/RO	06.05.2014	09:06	55° 32.26' N	4° 13.87' E	28.6	32-1.*	1					2						2	0	HE447/029-1	5.52	0.1	no btl file available
0033-1	CTD/RO	06.05.2014	09:57	55° 27.87' N	4° 13.88' E	27.5	33-1.*	1									1		1	0	HE447/029-1	5.48	1.0	no btl file available
0034-1	CTD/RO	06.05.2014	10:43	55° 27.86' N	4° 6.29' E	27.4	34-1.*	1					1						1	0	HE447/029-1	5.89	0.2	no btl file available
0035-1	CTD/RO	06.05.2014	11:20	55° 30.07' N	4° 10.11' E	27.5	35-1.*	1					1		1				1	0	HE447/029-1	0.26	0.1	no btl file available
0040-1	CTD/RO	07.05.2014	07:28	55° 30.14' N	4° 10.00' E	27.9	40-1.*	2	1		1		1				1		4	0	HE447/029-1	0.40	0.1	no btl file available
0042-1	CTD/RO	07.05.2014	16:06	55° 2.21' N	6° 24.25' E	42.3																		no data available
0046-1	CTD/RO	08.05.2014	08:04	55° 4.57' N	6° 20.40' E	42.9	46-1.*	2	1		1		1		1		1		5	0	HE356/077-1	8.60	0.0	no data available; offset is nearly zero, but the pressure interval of the HE422 data is only half as large as the the reference interval
0047-1	CTD/RO	08.05.2014	08:55	55° 4.48' N	6° 28.15' E	44.3	47-1.*	2	1		1		1		1		1		5	0	HE356/077-1	12.17	0.2	no btl file available
0049-1	CTD/RO	08.05.2014	10:08	55° 0.03' N	6° 28.00' E	42.1	49-1.*	2											0	0	HE356/077-1	8.64	0.2	no btl file available
0050-1	CTD/RO	08.05.2014	10:56	55° 0.00' N	6° 20.36' E	41.3	50-1.*	2											0	0	HE356/077-1	0.53	0.2	no btl file available
0051-1	CTD/RO	08.05.2014	11:34	55° 2.26' N	6° 24.21' E	42.7	51-1.*	1											0	0	HE395/15-1	0.20	0.7	no btl file available
0053-1	CTD/RO	09.05.2014	18:13	54° 26.37' N	7° 25.30' E	25.5																		no data available
0057-1	CTD/RO	10.05.2014	08:00	54° 28.56' N	7° 21.60' E	27.2																		no data available
0057-2	CTD/RO	10.05.2014	08:05	54° 28.54' N	7° 21.57' E	26.7	57-1.*	1											0	0	HE356/077-1	6.31	0.1	no btl file available
0058-1	CTD/RO	10.05.2014	08:58	54° 28.54' N	7° 29.22' E	21.2	58-1.*	1											0	0	HE395/14-1	0.21	0.3	no btl file available
0060-1	CTD/RO	10.05.2014	10:04	54° 24.02' N	7° 29.10' E	24.5	60-1.*	2											0	0	HE395/13-1	0.02	0.3	no btl file available
0061-1	CTD/RO	10.05.2014	10:57	54° 23.99' N	7° 21.51' E	26.1	61-1.*	1											0	0	HE395/16-1	0.22	0.3	no btl file available
0062-1	CTD/RO	10.05.2014	11:38	54° 26.25' N	7° 25.32' E	25	62-1.*	1			1								2	0	HE395/17-2	0.14	0.1	
0074-1	CTD/RO	12.05.2014	07:17	53° 59.23' N	6° 14.24' E	27.5	74-1.*	1			1								0	0	HE395/25-2	0.37	0.6	
0076-1	CTD/RO	12.05.2014	08:40	53° 56.99' N	6° 18.02' E	25.9	76-1.*	2											0	0	HE395/28-1	0.27	0.3	no btl file available
0078-1	CTD/RO	12.05.2014	09:22	53° 57.00' N	6° 10.22' E	28.3	78-1.*	1											0	0	HE395/27-1	0.08	0.3	no btl file available
0081-1	CTD/RO	12.05.2014	10:36	54° 1.48' N	6° 10.15' E	28.4	81-1.*	2											0	0	HE395/26-1	0.06	0.4	no btl file available
0082-1	CTD/RO	12.05.2014	11:20	54° 1.51' N	6° 17.77' E	27.9	82-1.*	2	1		1		1		1		1		5	0	HE395/24-1	0.07	0.4	no btl file available
0083-1	CTD/RO	12.05.2014	13:38	53° 57.02' N	6° 48.31' E	21.9	83-1.*	2											0	0	HE395/30-1	0.25	0.5	no btl file available
0084-1	CTD/RO	12.05.2014	14:19	53° 57.04' N	6° 56.06' E	23.4	84-1.*	1											0	0	HE395/31-1	1.02	0.6	no btl file available
0085-1	CTD/RO	12.05.2014	15:01	54° 1.51' N	6° 55.94' E	27.1	85-1.*	2											0	0	HE395/32-1	0.20	0.5	no btl file available
0086-1	CTD/RO	12.05.2014	15:51	54° 1.49' N	6° 48.45' E	27																		no data available
0087-1	CTD/RO	12.05.2014	16:26	53° 59.23' N	6° 52.23' E	25.6	87-1.*	2	1		1		2				1		5	0	HE395/33-3	0.47	0.6	
0088-1	CTD/RO	12.05.2014	20:55	54° 5.48' N	7° 21.50' E	32																		no data available
0091-1	CTD/RO	13.05.2014	09:05	54° 3.21' N	7° 17.32' E	31	91-1.*	2											1	0	HE395/08-1	0.45	0.2	no btl file; hdr time not consistent with DSHIP, probaly UTC fault
0092-1	CTD/RO	13.05.2014	09:40	54° 3.21' N	7° 25.32' E	32	92-1.*	2											0	0	HE395/08-1	0.45	0.2	no btl file; hdr time not consistent with DSHIP, probaly UTC fault
0093-1	CTD/RO	13.05.2014	10:30	54° 7.10' N	7° 25.32' E	32	93-1.*	1											0	0	HE395/08-1	0.45	0.4	no btl file; hdr time not consistent with DSHIP, probaly UTC fault
0094-1	CTD/RO	13.05.2014	11:10	54° 7.71' N	7° 17.68' E	0	94-1.*	2											0	0	HE395/08-1	0.45	0.3	no btl file; hdr time not consistent with DSHIP, probaly UTC fault

Figure 3: CTD data Processing Summary HE422

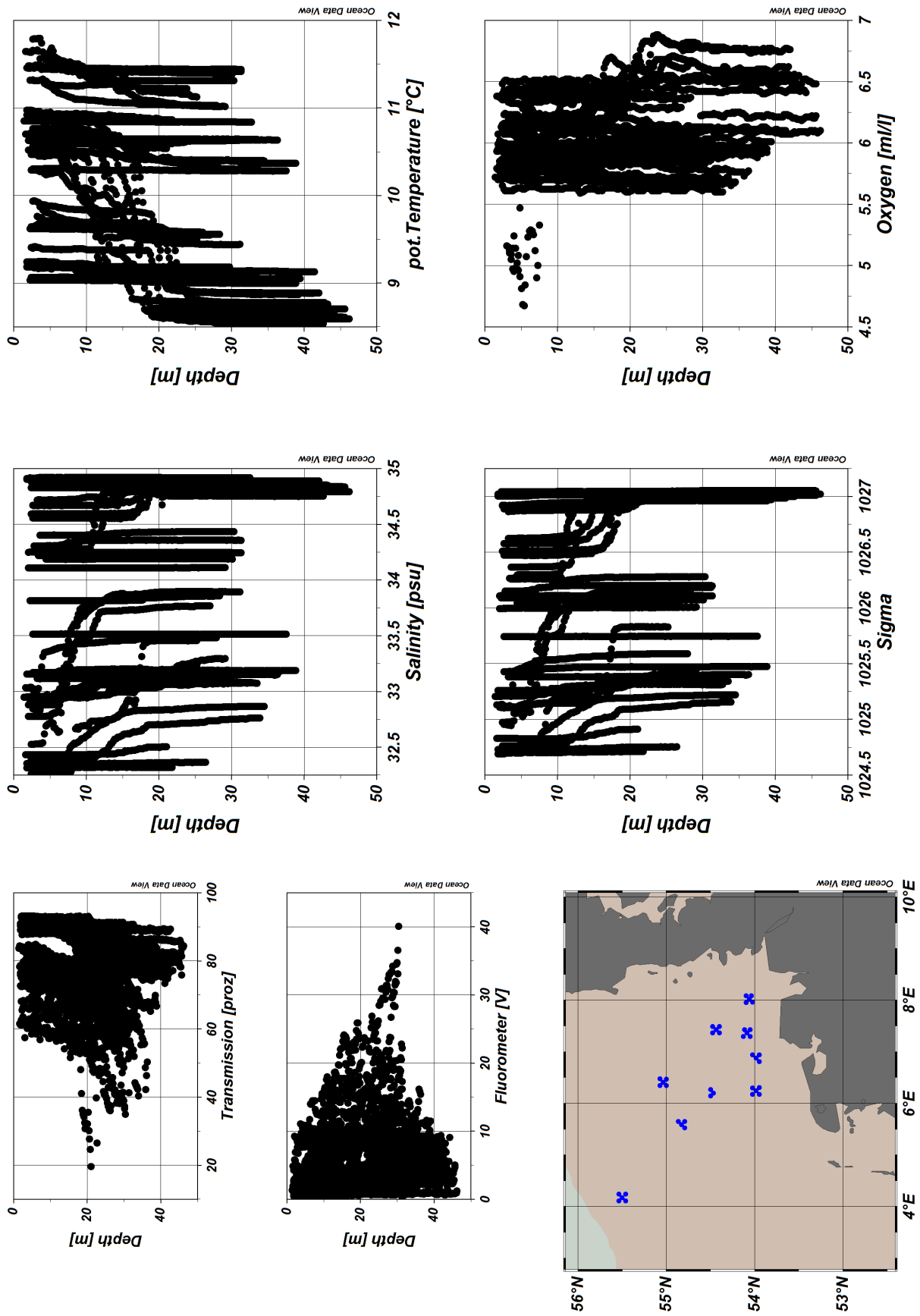| Station HE422/	Gear Abbr.	Date	Time	Position Latitude	Position Longitude	Depth [m]	File HE422_	Sensor pair	Temp interp	Temp erased	Sal interp	Sal erased	Trans interp	Trans erased	Chloro interp	Chloro erased	Oxy interp	Oxy erased	complete interp	complete erased	Oxygen reference cruise/sss-cc	dist. (km)	Offset	Comments
0095-1	CTD/RO	13.05.2014	11:47	54° 1.51' N	7° 57.22' E	31.9	95-1.*	2	1		1		1		1		1		5	0	HE395/01-1	0.05	0.3	no blt file available
0096-1	CTD/RO	13.05.2014	12:31	54° 2.51' N	8° 4.77' E	21.1	96-1.*	1											0	0	HE395/05-1	1.92	0.3	no blt file available
0097-1	CTD/RO	13.05.2014	13:07	54° 6.01' N	8° 4.72' E	20.8	97-1.*	1											0	0	HE395/04-1	0.03	0.3	no blt file available
0098-1	CTD/RO	13.05.2014	13:47	54° 6.02' N	7° 57.09' E	31.2	98-1.*	2											0	0	HE395/02-1	0.14	0.2	no blt file available
0099-1	CTD/RO	13.05.2014	14:26	54° 3.74' N	8° 0.85' E	24	99-1.*	2											0	0	HE356/010-1	6.87	1.9	no blt file available
0104-1	CTD/RO	13.05.2014	19:22	54° 4.29' N	7° 21.61' E	31.5																		no data available
0106-1	CTD/RO	14.05.2014	06:27	54° 5.44' N	7° 21.71' E	34.6	106-1.*	1	1		1		1		1		1		5	0	HE395/11-1	5.58	0.3	
									9	0	12	0	13	0	7	0	9	0	50	0				

Figure 4: CTD data Processing Summary HE422 (continuation)

Figure 5: ODV Screenshot of HE422 CTD data