

CTD Data RV Heincke HE431

Data Processing Report

Contents

1	Introduction	1
2	Workflow	1
3	Cruise details	3
4	Sensor Layout	3
5	Processing	3
6	Results	5

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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 HE431.

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.

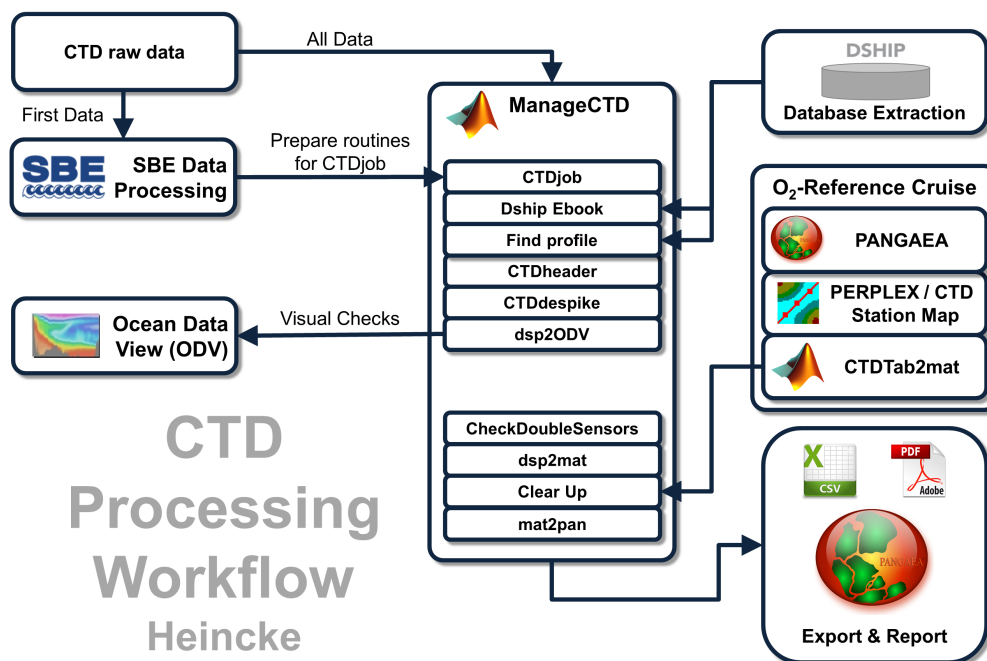


Figure 1: CTD data Processing Workflow

3 Cruise details

Vessel name RV Heincke
 Cruise name HE431
 Cruise start 18.08.2014 Bremerhaven
 Cruise end 08.09.2014 Bremerhaven
 Cruise duration 22 days
 No. of CTD casts 85

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](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 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

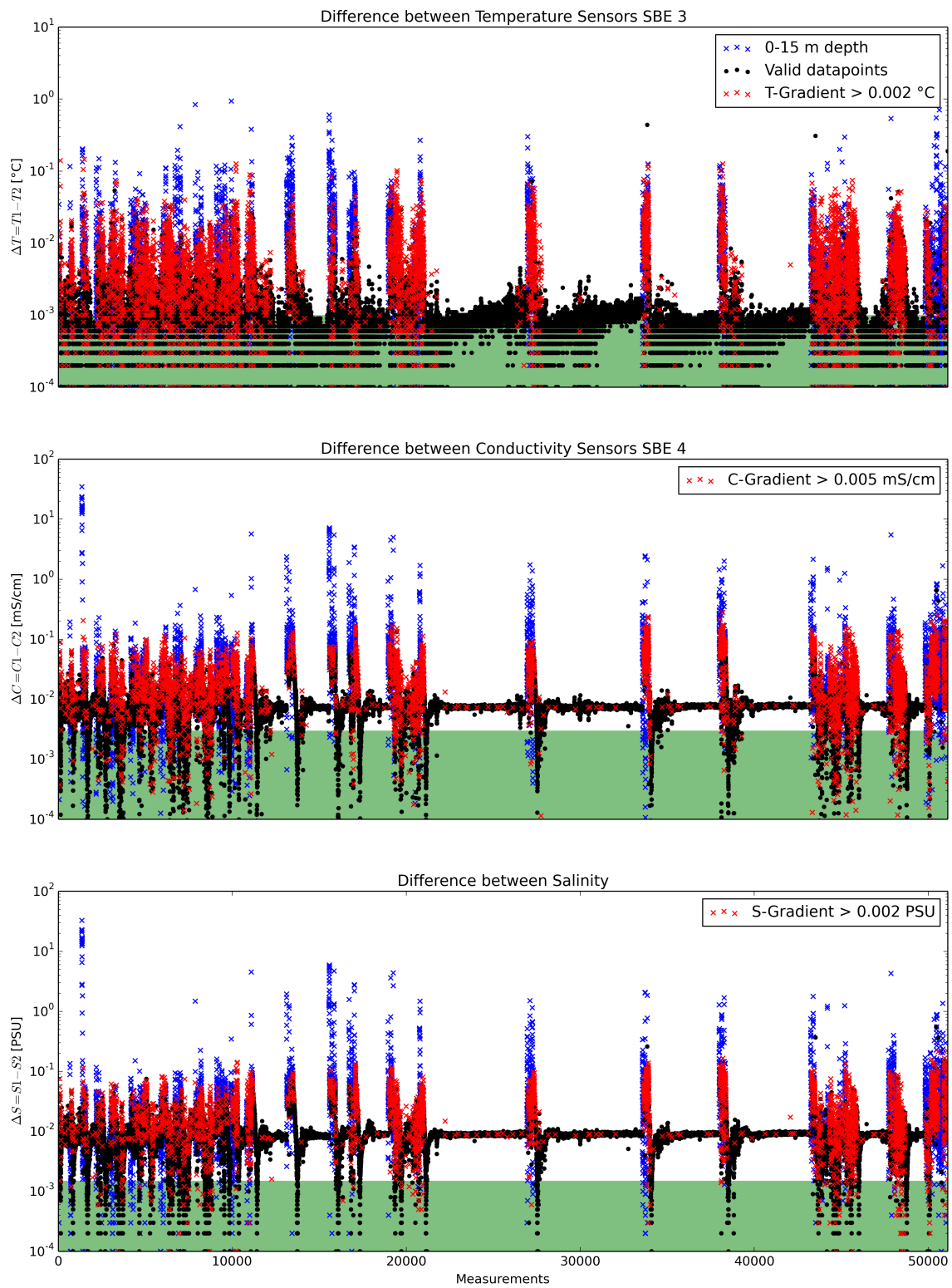


Figure 2: Data accuracy of sensor pairs HE431

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 re- moved Surface 0-15m + gradi- ent filter	Remaining measure- ments within accuracy specifi- cations
Temperature	$\pm 0.001^{\circ}C$	20.94%	74.00%
Conductivity	$\pm 0.003mS/cm$	18.24%	7.68%
Salinity	$\pm 0.0015PSU$	16.56%	3.35%

Comments

- 85 CTD/RO "on ground" entries in DShip station book
- 83 CTD raw data sets delivered
- 1 CTD cast was invalid or test (he431_004_a.hex)
- 2 CTD casts were made twice on a station (HE431/0019-2, HE431/0023-1)
- 1 CTD cast was made three times on a station (HE431/0007-1)
- 0 CTD casts had a wrong filename
- 82 CTD casts processed and uploaded
- of these 82 processed CTD casts:
 - 0 oxygen profiles deleted (spiky and not matching to reference casts)
 - 330 data points interpolated
 - 1026 data points erased

Result files

Text File (HE431_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-HE431-report.pdf):

This PDF document.

Station HE431/ Abbr.	Gear	Date	Time	Position Latitude	Position Longitude	Depth [m]	File HE431_	Sensor pair	Temp		Sal		Trans		Chlorophyll		Oxy		complete		Oxygen reference		Comments			
									interp	erased	interp	erased	interp	erased	interp	erased	interp	erased	interp	erased	dist. (km)	Offset				
0001-1	CTD/RO	23.08.2014	12:03	69° 15.12' N	15° 0.43' E	137.6	001a.*	1														HE450/42-1	230.82	0.3		
0001-2	CTD/RO	23.08.2014	12:29	69° 15.44' N	15° 1.36' E	140.5	001b.*	2															HE450/42-1	229.99	0.4	
0001-3	CTD/RO	23.08.2014	13:03	69° 15.92' N	15° 2.45' E	143.5	001c.*	2															HE450/42-1	228.85	0.3	
0002-1	CTD/RO	23.08.2014	16:03	69° 4.97' N	15° 16.07' E	134.2	002a.*	2															HE450/42-1	240.38	0.3	
0002-2	CTD/RO	23.08.2014	16:27	69° 5.02' N	15° 15.79' E	131.1	002b.*	2															HE450/42-1	240.40	0.1	
0002-3	CTD/RO	23.08.2014	16:48	69° 5.01' N	15° 15.86' E	133.2	002c.*	2	1														HE450/42-1	240.39	0.2	
0003-1	CTD/RO	24.08.2014	3:57	68° 47.19' N	15° 24.36' E	101.6	003a.*	2															HE450/42-1	266.07	0.4	
0003-2	CTD/RO	24.08.2014	4:14	68° 47.22' N	15° 24.38' E	103.4	003b.*	1															HE450/42-1	266.01	0.1	
0003-3	CTD/RO	24.08.2014	4:33	68° 47.20' N	15° 24.33' E	100.8	003c.*	2															HE450/42-1	266.06	0.1	
0004-1	CTD/RO	24.08.2014	8:28	68° 28.43' N	14° 54.79' E	189.8	004b.*	2															HE450/42-1	306.14	0.1	
0004-2	CTD/RO	24.08.2014	8:45	68° 28.49' N	14° 54.90' E	189.2	004c.*	2															HE450/42-1	306.01	0.1	
0005-1	CTD/RO	24.08.2014	12:03	68° 27.16' N	14° 33.38' E	56.0	005a.*	2															HE450/42-1	315.19	0.1	
0005-2	CTD/RO	24.08.2014	12:19	68° 27.17' N	14° 33.85' E	60.2	005b.*	2															HE450/42-1	315.02	0.1	
0005-3	CTD/RO	24.08.2014	12:36	68° 27.17' N	14° 32.80' E	61.3	005c.*	2															HE450/42-1	315.37	0.1	
0006-1	CTD/RO	24.08.2014	16:22	68° 33.00' N	14° 26.86' E	182.8	006a.*	1	4														HE450/42-1	308.09	0.2	
0006-2	CTD/RO	24.08.2014	16:41	68° 32.96' N	14° 26.86' E	181.7	006b.*	2															HE450/42-1	308.16	0.1	
0006-3	CTD/RO	24.08.2014	16:57	68° 32.94' N	14° 26.81' E	182.0	006c.*	2															HE450/42-1	308.21	0.1	
0007-1	CTD/RO	25.08.2014	6:07	68° 43.03' N	15° 5.05' E	109.7	007a.*	2															HE450/42-1	279.04	0.1	
0007-2	CTD/RO	25.08.2014	6:25	68° 42.93' N	15° 4.90' E	112.6	007b.*	2															HE450/42-1	279.26	0.2	
0007-3	CTD/RO	25.08.2014	6:43	68° 42.94' N	15° 4.91' E	112.6	007c.*	2															HE450/42-1	279.24	0.3	
0008-1	CTD/RO	25.08.2014	10:14	68° 40.50' N	14° 54.81' E	166.2	008a.*	2															HE450/42-1	286.56	0.2	
0008-2	CTD/RO	25.08.2014	10:34	68° 40.63' N	14° 55.60' E	173.4	008b.*	2															HE450/42-1	286.05	0.3	
0008-3	CTD/RO	25.08.2014	10:49	68° 40.58' N	14° 55.85' E	165.8	008c.*	2															HE450/42-1	286.05	0.3	
0009-1	CTD/RO	25.08.2014	14:04	68° 36.95' N	14° 40.90' E	187.6	009a.*	2	2														HE450/42-1	296.94	0.4	
0009-2	CTD/RO	25.08.2014	14:26	68° 36.97' N	14° 40.85' E	183.4	009b.*	2	1														HE450/42-1	296.92	0.2	
0009-3	CTD/RO	25.08.2014	14:42	68° 36.98' N	14° 40.64' E	173.3	009c.*	2	1														HE450/42-1	296.98	0.2	
0010-1	CTD/RO	26.08.2014	6:05	66° 50.86' N	13° 1.39' E	39.0	010a.*	2	1														HE448/54-1	334.11	0.2	no bit file available
0011-1	CTD/RO	26.08.2014	10:06	66° 32.76' N	12° 40.53' E	75.0	011a.*	2	1														HE448/54-1	297.44	0.2	no bit file available
0011-2	CTD/RO	26.08.2014	10:12	66° 32.83' N	12° 40.62' E	57.3	011b.*	1															HE448/54-1	297.59	0.4	
0012-1	CTD/RO	26.08.2014	14:05	66° 9.97' N	12° 15.95' E	41.3	012a.*	2															HE448/54-1	251.84	0.2	no bit file available
0013-1	CTD/RO	26.08.2014	6:18	61° 58.12' N	4° 40.06' E	138.6	013a.*	2															HE448/37-1	7.79	1.0	
0013-2	CTD/RO	26.08.2014	6:39	61° 58.16' N	4° 39.85' E	125.5	013b.*	1															HE448/37-1	7.58	0.8	
0013-3	CTD/RO	26.08.2014	6:58	61° 58.18' N	4° 39.49' E	117.5	013c.*	1															HE448/37-1	7.79	1.0	
0014-1	CTD/RO	28.08.2014	10:14	61° 55.62' N	5° 25.32' E	423.8	014a.*	2	3														HE448/38-1	33.35	0.4	
0014-2	CTD/RO	28.08.2014	10:46	61° 55.54' N	5° 25.13' E	414.1	014b.*	2	2														HE448/38-1	33.35	0.4	
0014-3	CTD/RO	28.08.2014	10:59	61° 55.51' N	5° 25.21' E	82.5	014c.*	1															HE448/38-1	33.44	0.4	
0015-1	CTD/RO	28.08.2014	13:47	61° 51.93' N	5° 46.84' E	447.6	015a.*	2	1														HE448/38-1	51.79	0.4	
0015-2	CTD/RO	28.08.2014	14:11	61° 51.89' N	5° 46.96' E	446.1	015b.*	2	2														HE448/38-1	51.92	1.0	
0015-3	CTD/RO	28.08.2014	14:28	61° 51.89' N	5° 47.03' E	449.3	015c.*	1															HE448/38-1	51.96	0.6	
0016-1	CTD/RO	29.08.2014	6:10	61° 51.95' N	6° 46.98' E	178.8	016a.*	1															HE448/25-1	59.89	0.5	
0016-2	CTD/RO	29.08.2014	6:32	61° 51.92' N	6° 47.35' E	171.5	016b.*	2															HE448/25-1	59.63	1.5	
0016-3	CTD/RO	29.08.2014	6:48	61° 51.89' N	6° 47.57' E	168.4	016c.*	1	1														HE448/25-1	59.45	0.5	
0017-1	CTD/RO	29.08.2014	10:01	61° 51.10' N	6° 15.87' E	411.9	017a.*	1	4														HE448/40-1	70.03	5.5	
0017-2	CTD/RO	29.08.2014	10:29	61° 51.12' N	6° 16.15' E	406.8	017b.*	2															HE448/40-1	70.13	0.7	
0017-3	CTD/RO	29.08.2014	10:46	61° 51.12' N	6° 16.30' E	418.5	017c.*	2															HE450/42-1	279.24	0.5	

Figure 3: CTD data Processing Summary HE431

Station HE431/ Abbr.	Gear Abbr.	Date	Time	Position Latitude	Position Longitude	Depth [m]	File HE431_ 018a*	Sensor pair	Temp		Sal		Trans		Chlorophyll		Oxy		complete		Oxygen reference		Comments	
									interp	erased	interp	erased	interp	erased	interp	erased	interp	erased	interp	erased	interp	erased		interp
0018-1	CTD/RO	30.08.2014	4:02	60° 53.00' N	4° 29.93' E	255.7	018a*	2	2						1001	2			8	1001	HE450/42-1	286.56	0.2	Fluorescence mostly invalid
0018-2	CTD/RO	30.08.2014	4:25	60° 53.49' N	4° 29.29' E	254.5	018b*	1											0	0	HE448/15-5	4.88	1.2	
0018-3	CTD/RO	30.08.2014	4:42	60° 53.88' N	4° 29.03' E	251.8	018c*	1											0	0	HE448/15-5	5.33	0.9	
0019-1	CTD/RO	30.08.2014	9:06	61° 2.88' N	5° 23.39' E	509.3	019a*	2	13										52	0	HE448/31-1	1.76	0.2	
0019-2	CTD/RO	30.08.2014	9:46	61° 2.92' N	5° 23.28' E	156.4	019b*	2											0	0	HE448/31-1	1.85	0.2	
0019-3	CTD/RO	30.08.2014	9:56	61° 2.87' N	5° 23.39' E	443.2	019c*	1											1	0	HE448/31-1	1.76	0.2	
0020-1	CTD/RO	30.08.2014	14:19	61° 8.59' N	6° 0.00' E	1268.3	020a*	2	10										20	0	HE448/30-1	3.75	0.2	
0020-2	CTD/RO	30.08.2014	14:57	61° 8.60' N	5° 59.87' E	1268.3	020b*	2											0	0	HE448/30-1	3.64	1.0	
0020-3	CTD/RO	30.08.2014	15:15	61° 8.58' N	5° 59.83' E	1268.1	020c*	1											0	0	HE448/30-1	3.60	1.0	
0021-1	CTD/RO	31.08.2014	4:11	61° 8.99' N	7° 18.90' E	818.7	021a*	2	10										40	0	HE448/22-1	1.86	1.5	
0021-2	CTD/RO	31.08.2014	4:38	61° 9.00' N	7° 18.96' E	806.2	021b*	2											0	0	HE448/22-1	1.83	1.5	
0021-3	CTD/RO	31.08.2014	5:03	61° 8.99' N	7° 18.97' E	806.8	021c*	1	1										5	0	HE448/22-1	1.81	1.5	
0022-1	CTD/RO	31.08.2014	10:00	61° 10.07' N	6° 44.40' E	1000.1	022a*	1	9										37	0	HE450/42-1	1204.02	1.3	
0022-2	CTD/RO	31.08.2014	10:47	61° 10.10' N	6° 44.45' E	997.9	022b*	1											0	0	HE450/42-1	1203.95	0.2	
0022-3	CTD/RO	31.08.2014	11:06	61° 10.08' N	6° 44.37' E	1001.3	022c*	1											0	0	HE450/42-1	1204.01	0.2	
0023-1	CTD/RO	02.09.2014	12:59	59° 25.06' N	5° 4.58' E	84.4	023a*	2											0	0	HE448/09-1	13.56	1.0	
0023-2	CTD/RO	02.09.2014	13:14	59° 25.15' N	5° 4.25' E	149.1	023b*	1											0	0	HE448/09-1	13.56	0.7	
0024-1	CTD/RO	02.09.2014	13:32	59° 25.24' N	5° 3.90' E	111.4	023c*	2											0	0	HE448/09-1	13.57	0.8	
0024-2	CTD/RO	03.09.2014	6:06	59° 4.93' N	5° 10.09' E	142.8	024a*	2	1										5	0	HE448/08-1	3.51	1.0	
0024-3	CTD/RO	03.09.2014	6:44	59° 5.14' N	5° 10.02' E	148.0	024b*	1											1	0	HE448/08-1	3.73	1.2	
0025-1	CTD/RO	03.09.2014	10:44	59° 19.92' N	5° 54.86' E	509.3	025a*	2	7										3	0	HE448/08-1	3.33	0.8	
0025-2	CTD/RO	03.09.2014	11:17	59° 20.00' N	5° 55.11' E	517.6	025b*	1											28	0	HE448/09-1	53.85	1.0	
0025-3	CTD/RO	03.09.2014	11:17	59° 20.00' N	5° 55.20' E	520.9	025c*	2											0	0	HE448/09-1	54.09	0.6	
0026-1	CTD/RO	03.09.2014	14:34	59° 28.70' N	6° 9.98' E	368.9	026a*	2											0	0	HE448/10-5	65.70	0.5	
0026-2	CTD/RO	03.09.2014	14:56	59° 28.70' N	6° 9.98' E	368.8	026b*	1							1				0	0	HE448/10-5	65.70	1.2	
0026-3	CTD/RO	03.09.2014	15:15	59° 28.70' N	6° 9.97' E	369.0	026c*	1											0	0	HE448/10-5	65.70	1.2	
0027-1	CTD/RO	05.09.2014	3:54	57° 54.85' N	11° 30.99' E	24.6	027a*	2											0	0	HE448/01-1	231.88	0.8	
0027-2	CTD/RO	05.09.2014	4:13	57° 54.83' N	11° 31.03' E	24.6	027b*	2											0	0	HE448/01-1	231.93	0.7	
0028-1	CTD/RO	05.09.2014	7:33	57° 56.30' N	11° 41.77' E	27.6	028a*	1											3	0	HE448/01-1	242.40	2.0	
0028-2	CTD/RO	05.09.2014	7:53	57° 56.30' N	11° 41.77' E	27.7	028b*	2	2										2	0	HE448/01-1	242.40	2.0	
0029-1	CTD/RO	05.09.2014	10:33	58° 5.01' N	11° 47.02' E	11.7	029a*	1											0	0	HE448/01-1	247.62	2.0	
0029-2	CTD/RO	05.09.2014	10:50	58° 5.01' N	11° 47.02' E	11.7	029b*	2	1										0	0	HE448/01-1	247.62	2.0	
0030-1	CTD/RO	05.09.2014	14:22	58° 14.88' N	11° 50.44' E	16.7	030a*	1											0	0	HE448/01-1	252.27	3.0	
0030-2	CTD/RO	05.09.2014	14:38	58° 14.89' N	11° 50.40' E	16.8	030b*	1											0	0	HE448/01-1	252.23	3.0	
0031-1	CTD/RO	06.09.2014	6:02	58° 19.03' N	11° 46.24' E	32.3	031a*	2											0	0	HE448/01-1	249.17	5.0	
0031-2	CTD/RO	06.09.2014	6:19	58° 19.03' N	11° 46.24' E	32.1	031b*	1											0	0	HE448/01-1	249.17	5.0	
									80	0	87	0	80	0	16	1001	67	25	330	1026				

Figure 4: CTD data Processing Summary HE431 (continuation)

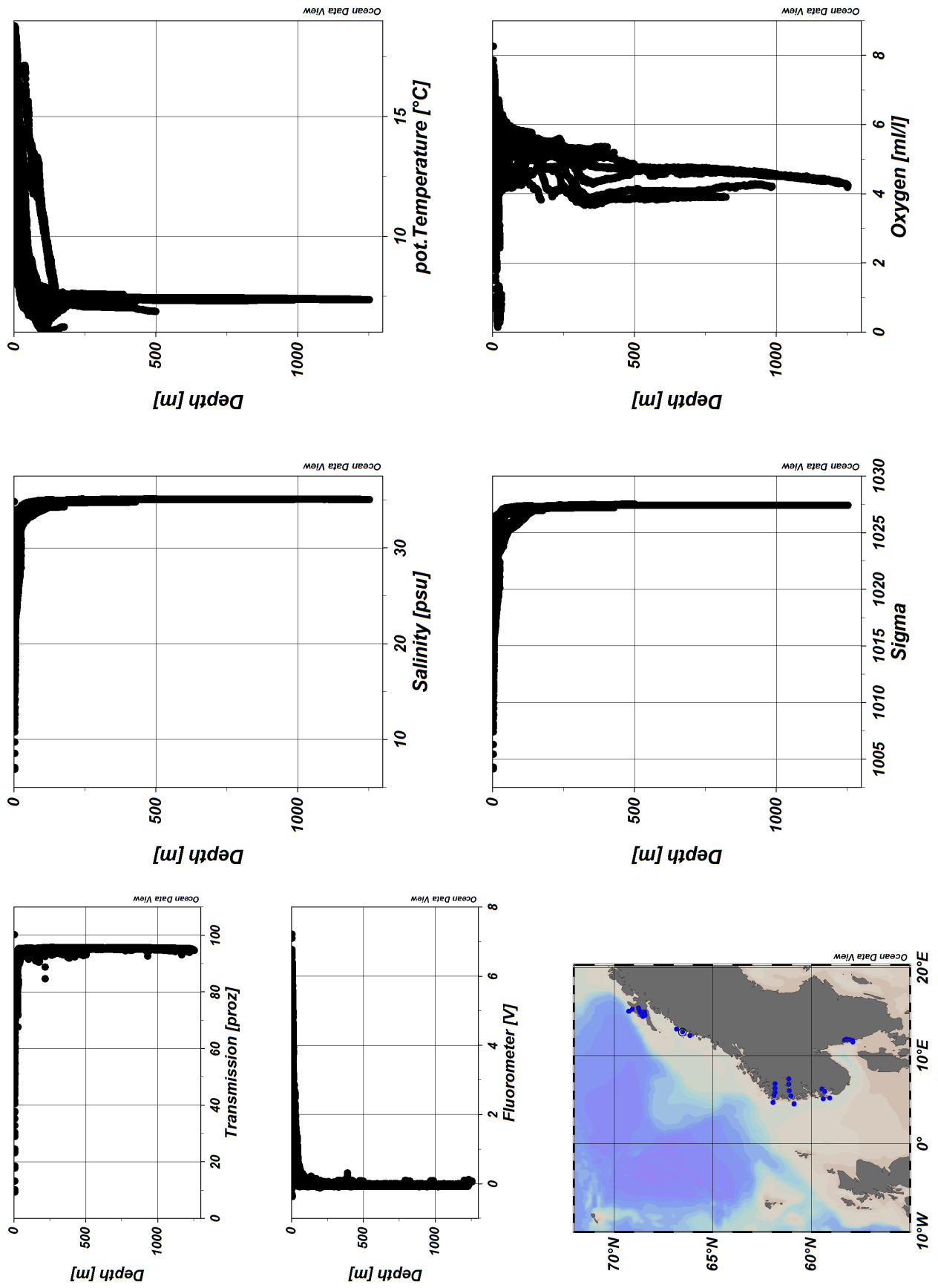


Figure 5: ODV Screenshot of HE431 CTD data
Page 9 of 9