CTD Data RV Heincke HE491
Data Processing Report

Contents

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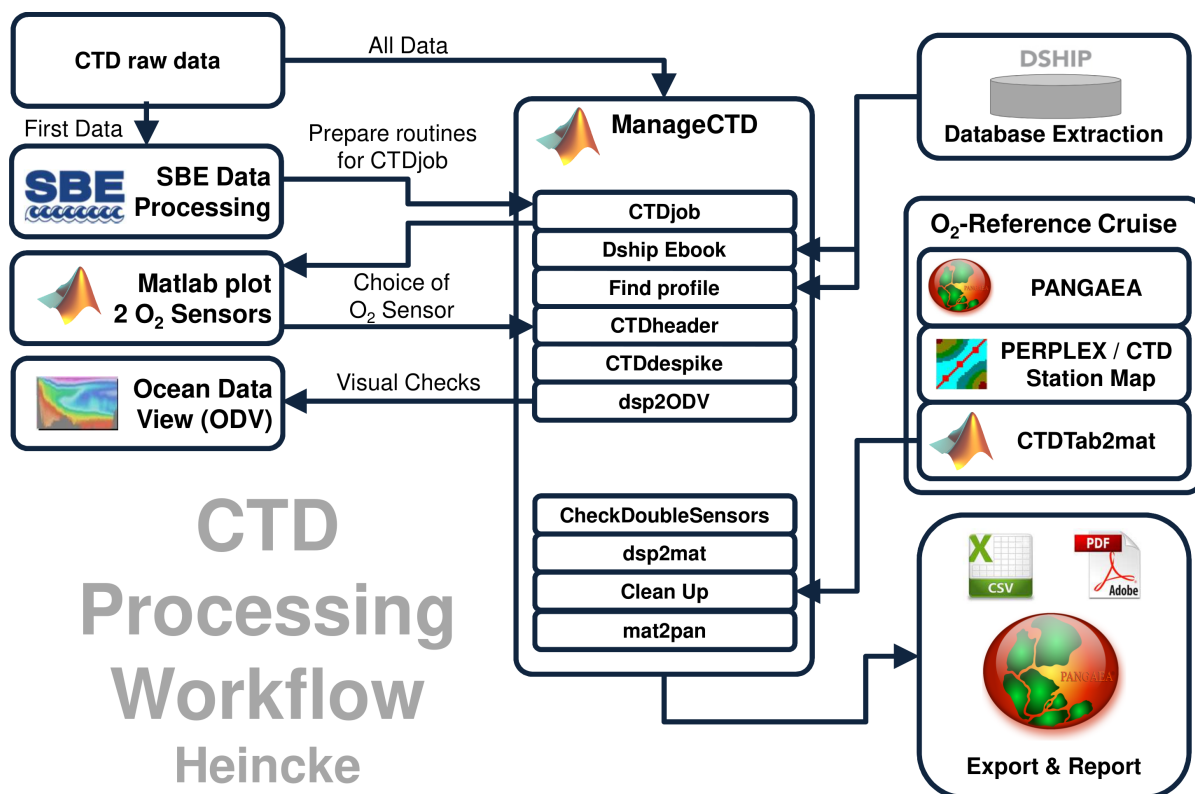| Ref.: CTD-HE491-report.pdf	Vers.: 1	Date: 2017/09/20	Status: final

1 Introduction

This report describes the processing of CTD raw data acquired by Seabird SBE 911plus CTD on board RV Heincke during expedition HE491.

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.

CTD raw data

All Data

First Data

Prepare routines
for CTDjob

**SBE Data
Processing**

ManageCTD

Choice of
O$_2$ Sensor

**Matlab plot
2 O$_2$ Sensors**

| CTDjob |
| Dship Ebook |
| Find profile |
| CTDheader |
| CTDdespike |
| dsp2ODV |

**Ocean Data
View (ODV)**

Visual Checks

| CheckDoubleSensors |
| dsp2mat |
| Clean Up |
| mat2pan |

DSHIP

Database Extraction

O$_2$-Reference Cruise

| PANGAEA |
| PERPLEX / CTD Station Map |
| CTDTab2mat |

CSV **PDF Adobe**

PANGAEA

Export & Report

**CTD
Processing
Workflow
Heincke**

Figure 1: CTD data Processing Workflow

3 Cruise details

Vessel name	RV Heincke
Cruise name	HE491
Cruise start	08.07.2017 Bremerhaven
Cruise end	27.07.2017 Trondheim
Cruise duration	20 days
No. of CTD casts	30

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	5375	10-Feb-17
3	ConductivitySensor	2470	25-Jan-17
45	PressureSensor	1015	26-Jan-17
55	TemperatureSensor	5354	10-Feb-17
3	ConductivitySensor	3573	25-Jan-17
0	AltimeterSensor	46466	23-Mar-2009
71	WET_LabsCStar	1348DR	13-Oct-2010
20	FluoroWetlabECO_AFL_FL_Sensor	1365	08-Sep-2011
38	OxygenSensor	2007	01-Feb-17
38	OxygenSensor	1597	25-Jan-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).
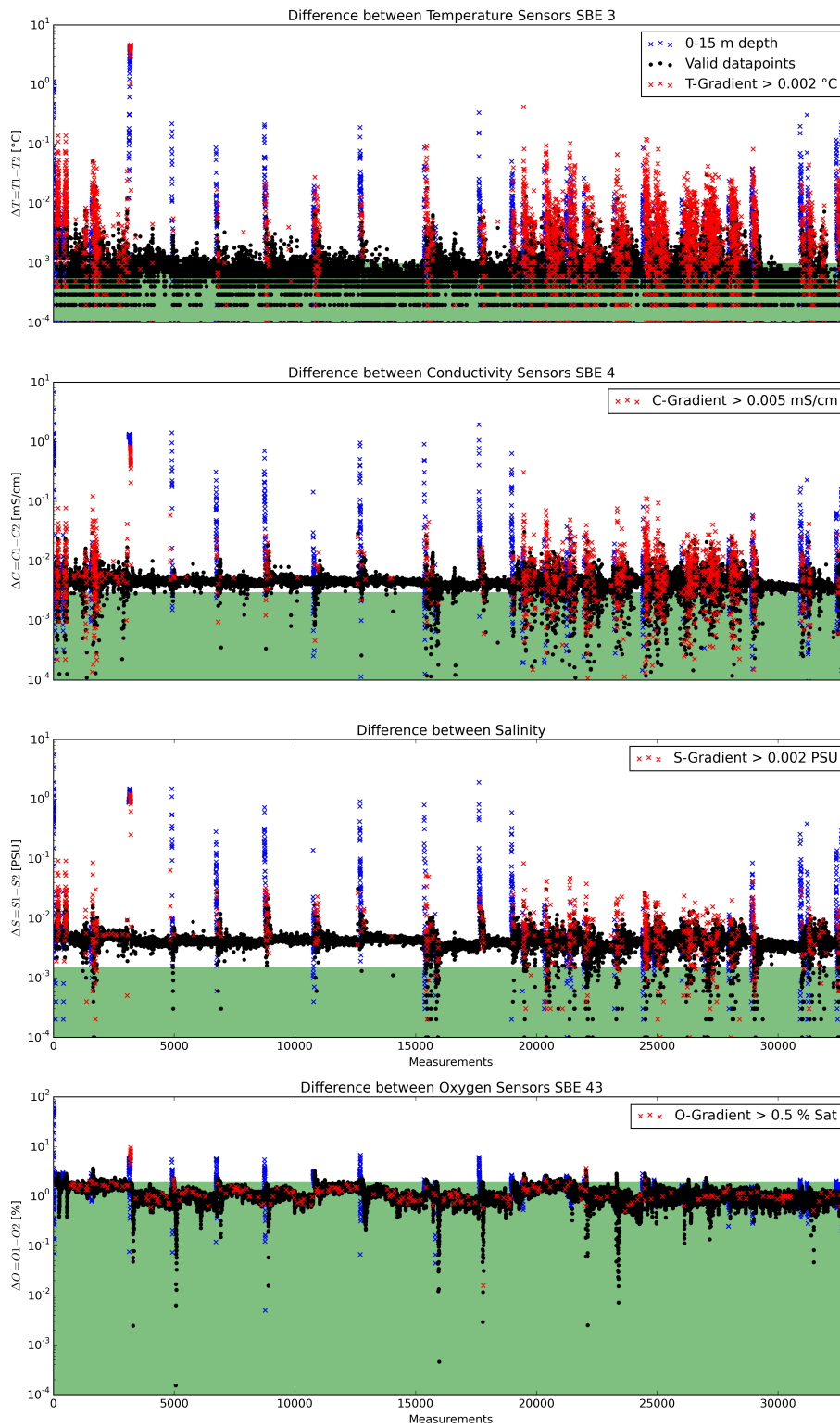
Sensor Differences

Figure 2: Data accuracy of sensor pairs HE491

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 re-moved Surface 0-15m + gradient filter	Remaining measure-ments within accuracy specifications
Temperature	$\pm 0.001 \,^\circ C$	14.57%	83.12%
Conductivity	$\pm 0.003 \, mS/cm$	9.38%	6.07%
Salinity	$\pm 0.0015 \, PSU$	7.84%	2.11%
Oxygen	$\pm 2.0 \,\% \, of \, saturation$	6.92%	97.98%

Comments

- 29 CTD "in the water" entries in DShip station book

- 29 CTD "on ground" entries in DShip station book

- 29 CTD "on deck" entries in DShip station book

- 1 CTD "profile start" entry in DShip station book

- 33 CTD raw data sets delivered

- 2 CTDs cast were invalid or test (HE491_test_.hex and HE491_TEST01_.hex)

- 1 CTD cast with two data files (HE491_03-3 and HE491_03-4 contain same header information and data)

- 30 CTD casts processed and uploaded

- of these 30 processed CTD casts:
    - 0 oxygen profile deleted (spiky and not matching to reference casts)
    - 1287 data points interpolated
    - 199 data points erased

Result files

Text File (HE491_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-HE491-report.pdf):

This PDF document.

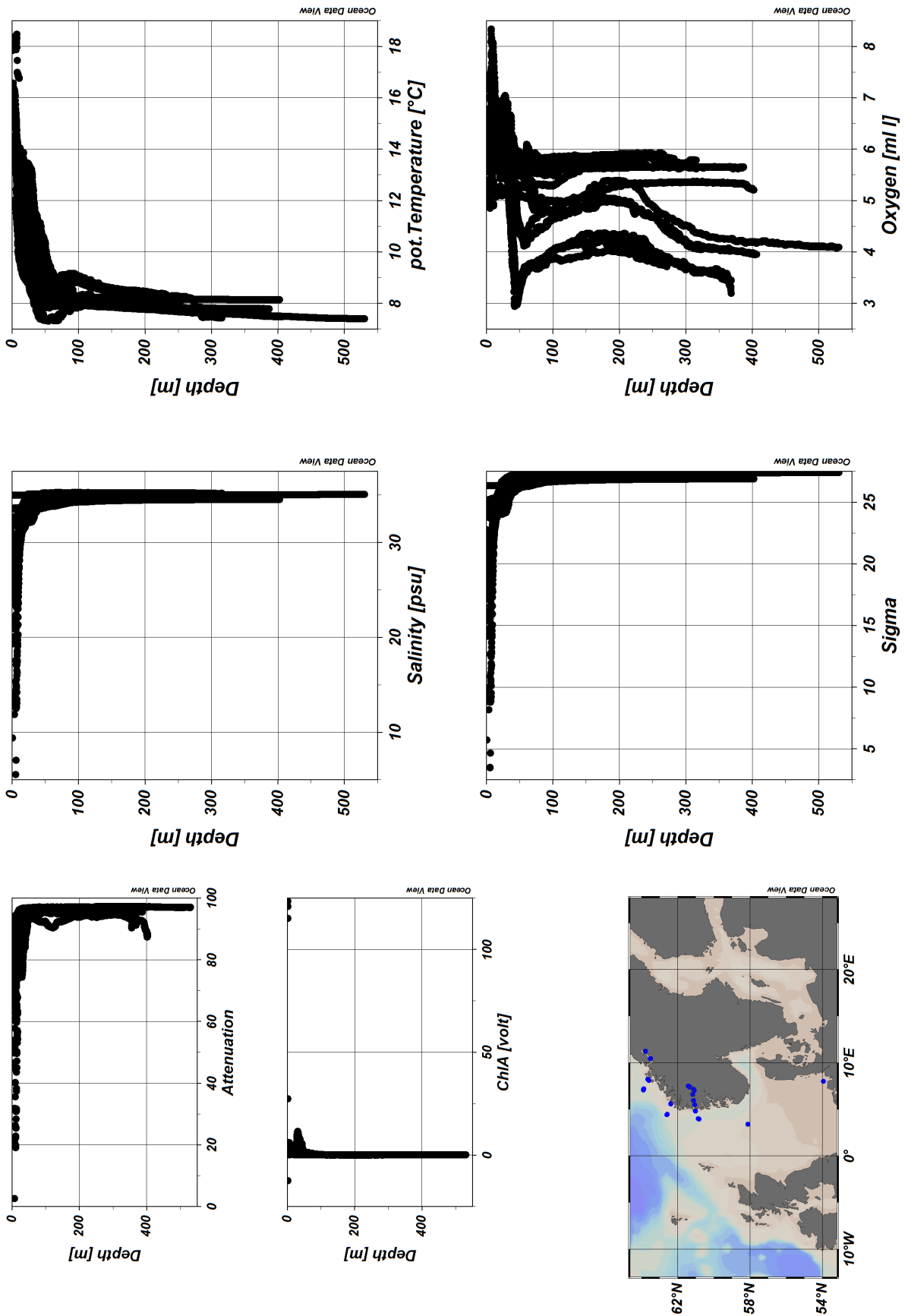| Station HE491_	Gear Abbr.	Date	Time	Position Latitude	Position Longitude	Depth [m]	File HE491_	Sensor pair	Temp interp	Temp erased	Sal interp	Sal erased	Trans interp	Trans erased	Fluor interp	Fluor erased	Oxy interp	Oxy erased	complete interp	complete erased	2 Oxy Sensors Sensor	Offset	Oxygen reference cruise/sss-cc	dist. (km)	Offset	Comments
1-2	CTD	08.07.2017	12:45	53° 56.148' N	007° 58.427' E	13.4	01-2_.*	2	8	0	0	0	1	0	1	0	1	15	14	15	2007	~0.73	HE448/01-1	445	~1.0	delivered raw data set 03-3_.* (stored in: conf1/raw/unused) contains same header information and data as 03-4_.*
3-4	CTD	10.07.2017	08:28	58° 07.227' N	003° 21.259' E	77.4	03-4_.*	2	0	0	0	0	0	0	0	0	0	0	2	0	2007	~0.12	HE448/07-1	139	~0.8	
4-4	CTD	11.07.2017	08:26	60° 50.116' N	003° 54.873' E	326.2	04-4_.*	2	13	0	0	0	13	0	13	0	13	0	65	0	2007	~0.11	HE448/33-1	35	~0.1	
4-6	CTD	11.07.2017	13:12	60° 51.829' N	003° 59.491' E	327.1	04-6_.*	2	14	0	0	0	14	0	14	0	14	0	71	0	2007	~0.11	HE448/33-1	30	~0.5	
5-4	CTD	12.07.2017	08:12	61° 21.772' N	007° 21.781' E	365.6	05-4_.*	2	17	90	0	90	17	0	17	0	17	0	85	180	2007	~0.05	HE448/24-1	6	~1.0	High T/S differences between two sensor pairs in mixed surface layer => upper 90 data points deleted
5-5	CTD	12.07.2017	12:47	61° 21.681' N	007° 22.722' E	373.8	05-5_.*	2	19	0	0	0	17	0	17	0	17	0	87	0	2007	~0.06	HE448/24-1	5	~1.0	
6-4	CTD	13.07.2017	08:26	61° 05.624' N	007° 00.910' E	934.4	06-4_.*	2	21	0	0	0	20	0	20	0	20	0	102	0	2007	~0.08	HE448/21-6	5	~1.0	
6-5	CTD	13.07.2017	13:09	61° 07.480' N	007° 06.576' E	930.3	06-5_.*	2	15	0	0	0	15	0	15	0	15	0	75	0	2007	~0.07	HE448/21-1	2	~0.3	
7-4	CTD	15.07.2017	08:35	61° 01.514' N	004° 47.826' E	401.1	07-4_.*	2	23	0	0	0	22	0	22	0	22	0	111	0	2007	~0.10	HE448/32-5	7	~0.3	
8-3	CTD	16.07.2017	08:59	61° 10.893' N	006° 33.705' E	656.3	08-3_.*	2	20	0	0	0	20	0	20	0	20	0	100	0	2007	~0.07	HE448/20-1	3	~0.5	
9-5	CTD	17.07.2017	08:50	61° 22.419' N	007° 23.214' E	375.8	09-5_.*	2	17	0	0	0	17	0	17	0	17	0	85	0	2007	~0.06	HE448/24-1	4	~0.6	
9-8	CTD	17.07.2017	12:51	61° 24.763' N	007° 27.507' E	333.9	09-8_.*	2	10	0	0	0	10	0	10	0	10	0	50	0	2007	~0.06	HE448/24-1	2	~0.7	no btl files
9-9	CTD	17.07.2017	21:05	61° 08.389' N	005° 54.882' E	1246.4	09-9_.*	2	1	0	0	0	0	0	0	0	0	0	2	0	2007	~0.09	HE448/30-5	1	~0.9	
9-10	CTD	17.07.2017	22:51	61° 03.686' N	005° 28.400' E	1242.0	09-10_.*	2	3	0	0	0	2	0	2	0	2	0	12	0	2007	~0.09	HE448/31-4	3	~0.8	
10-4	CTD	19.07.2017	08:16	62° 36.143' N	004° 24.391' E	198.2	10-4_.*	2	8	0	0	0	8	0	8	0	8	0	42	0	2007	~0.10	HE448/39-1	57	~0.4	
10-6	CTD	19.07.2017	12:34	62° 35.818' N	004° 25.333' E	197.3	10-6_.*	2	8	0	0	0	5	0	5	0	5	0	32	0	2007	~0.11	HE448/39-1	56	~0.4	
11-1	CTD	20.07.2017	08:07	62° 23.434' N	005° 35.158' E	51.4	11-1_.*	2	1	0	0	0	1	0	1	0	1	0	5	0	2007	~0.10	HE448/40-1	1	~0.8	
11-5	CTD	20.07.2017	12:44	62° 23.147' N	005° 33.170' E	113.1	11-5_.*	2	4	0	0	0	3	0	3	0	3	0	17	0	2007	~0.08	HE448/40-1	1	~0.8	
12-4	CTD	22.07.2017	08:38	63° 54.917' N	007° 03.632' E	259.5	12-4_.*	2	7	0	0	0	7	0	7	0	7	0	36	0	2007	~0.07	HE448/50-5	60	~0.5	
12-6	CTD	22.07.2017	12:46	63° 54.665' N	007° 06.343' E	248.3	12-6_.*	2	9	0	0	0	7	0	7	0	7	0	38	0	2007	~0.05	HE448/50-5	58	~0.5	no btl files
12-7	CTD	22.07.2017	17:05	63° 53.130' N	007° 10.531' E	234.7	12-7_.*	2	6	0	0	0	1	0	1	0	1	0	19	0	2007	~0.08	HE448/50-5	54	~0.5	no btl files
13-1	CTD	23.07.2017	06:31	63° 39.408' N	008° 10.666' E	241.5	13-1_.*	2	2	0	0	0	2	0	2	0	2	0	10	0	2007	~0.07	HE448/49-1	13	~0.3	
13-5	CTD	23.07.2017	07:40	63° 38.737' N	008° 09.210' E	194.4	13-5_.*	2	4	0	0	0	4	0	4	0	4	0	22	0	2007	~0.07	HE448/49-1	12	~0.3	
13-6	CTD	23.07.2017	08:35	63° 38.049' N	008° 08.062' E	216.2	13-6_.*	2	8	0	0	0	8	0	8	0	8	0	40	0	2007	~0.06	HE448/49-1	10	~0.3	
13-8	CTD	23.07.2017	11:31	63° 35.993' N	008° 03.391' E	198.2	13-8_.*	2	6	0	0	0	6	0	6	0	6	0	30	0	2007	~0.07	HE448/49-4	5	~0.3	
14-4	CTD	24.07.2017	08:27	63° 47.497' N	011° 14.560' E	412.9	14-4_.*	2	16	0	0	0	16	0	16	0	16	0	80	0	2007	~0.06	HE448/67-1	7	~0.5	
14-6	CTD	24.07.2017	12:45	63° 47.205' N	011° 10.250' E	76.3	14-6_.*	2	1	0	0	0	1	0	1	0	1	0	5	0	2007	~0.06	HE448/67-1	4	~0.5	no btl files
15-4	CTD	25.07.2017	08:34	63° 31.552' N	010° 24.266' E	246.8	15-4_.*	2	7	2	0	2	7	0	7	0	7	0	35	4	2007	~0.06	HE448/63-5	5	~0.4	
15-6	CTD	25.07.2017	12:41	63° 31.102' N	010° 27.245' E	40.4	15-6_.*	2	1	0	0	0	1	0	1	0	1	0	5	0	2007	~0.06	HE448/63-5	5	~0.4	no btl files
15-7	CTD	25.07.2017	16:40	63° 30.692' N	010° 24.090' E	70.9	15-7_.*	2	2	0	0	0	2	0	2	0	2	0	10	0	2007	~0.06	HE448/63-5	7	~0.4	no btl files
									271	92	0	92	247	0	247	0	247	15	1287	199						

Figure 4: ODV Screenshot of HE491 CTD data