ALFRED-WEGENER-INSTITUT
HELMHOLTZ-ZENTRUM FÜR POLAR- UND MEERESFORSCHUNG

FIELAX

CTD Data RV Heincke HE471

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 HE471.

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.

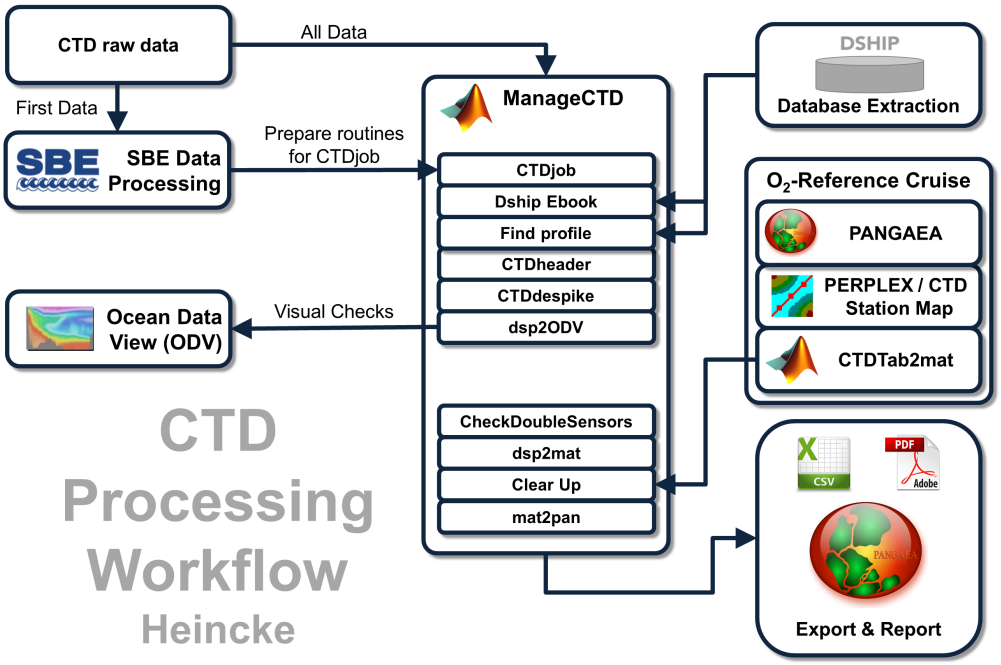

Figure 1: CTD data Processing Workflow

3 Cruise details

Vessel name	RV Heincke
Cruise name	HE471
Cruise start	06.09.2016 Bremerhaven
Cruise end	21.09.2016 Bremerhaven
Cruise duration	16 days
No. of CTD casts	27

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	19-Jan-16
3	ConductivitySensor	3810	08-Dec-15
45	PressureSensor	1015	05-Oct-10
55	TemperatureSensor	5375	19-Jan-16
3	ConductivitySensor	2470	08-Dec-15
0	AltimeterSensor	46466	23-Mar-09
71	WET_LabsCStar	1348DR	28-Jan-2016
20	FluoroWetlabECO_AFL_FL_Sensor	1365	15-Jan-2016
38	OxygenSensor	1597	25-May-16

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

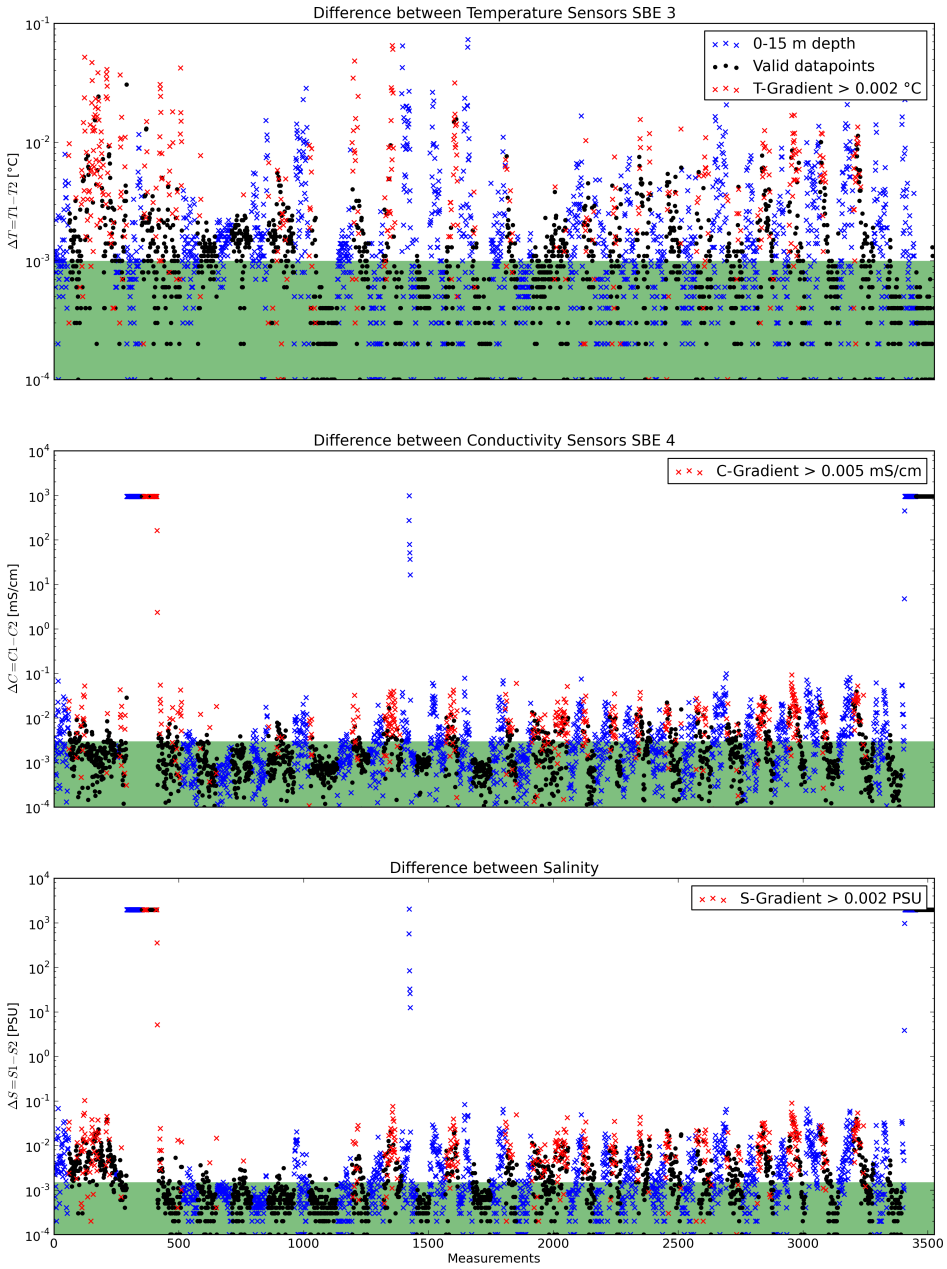

Figure 2: Data accuracy of sensor pairs HE471

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	$\pm 0.001°C$	53.97%	55.88%
Conductivity	$\pm 0.003 mS/cm$	54.11%	77.13%
Salinity	$\pm 0.0015 PSU$	53.29%	57.92%

Comments

- 27 CTD/RO "on ground" entries in DShip station book
- 26 CTD raw data sets delivered
- 0 CTD casts were invalid or tests
- 0 CTD casts were made twice on a station
- 2 files had no matching station book entries (076-2.hex, 090.hex)
- 3 station book entries had no matching CTD casts
- 24 CTD casts processed and uploaded
- of these 24 processed CTD casts:
  - 0 oxygen profiles deleted (spiky and not matching to reference casts)
  - 1 data points interpolated
  - 105 data points erased

Result files

Text File (HE471_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 [m]
Column 7	Pressure, water [dbar]
Column 8	Temperature, water [°C]
Column 9	Conductivity [mS/cm]
Column 10	Salinity [PSU]
Column 11	Temperature, water, potential [°C]
Column 12	Density, sigma-theta [kg/m^3]
Column 13	Oxygen [μmol/l]
Column 14	Oxygen, saturation [%]
Column 15	Attenuation, optical beam transmission
Column 16	Chlorophyll Fluorometer [V]
Column 17	Number of observations

Processing Report (CTD-HE471-report.pdf):
This PDF document.

Station HE471/	Gear Abbr.	Date	Time	Position Latitude	Position Longitude	Depth [m]	File HE471_	Sensor pair	Temp		Sal		Trans		Chlorophyll		Oxy		complete		Oxygen reference			Comments
									interp	erased	interp	erased	interp	erased	interp	erased	interp	erased	interp	erased	cruise/sss-cc	dist. (km)	Offset	
									0	**21**	**0**	**21**	**1**	**66**	**0**	**21**	**0**	**21**	**1**	**150**				
0003-1	CTD-R	07.09.2016	6:20	55° 15.50' N	004° 44.98' E	44.1	003	1						45					0	45	HE453/41-1	10.04	0.8	all transmission data deleted
0010-1	CTD/RO	08.09.2016	6:00	55° 15.58' N	004° 44.90' E	44.3	001	1											0	0	HE453/41-1	9.95	0.8	several salinity data of sensor 2 deleted
0012-1	CTD/RO	08.09.2016	23:54	53° 59.03' N	006° 11.09' E	27.6													**0**	**0**				no data available
0014-1	CTD-R	09.09.2016	6:16	53° 59.38' N	006° 13.88' E	27.2	014	1					1						1	0	HE453/13-1	39.99	0.9	
0023-1	CTD/RO	10.09.2016	5:50	53° 59.42' N	006° 13.78' E	27.2	023	1		1		1		1		1			0	5	HE453/13-1	40.01	0.9	
0032-1	CTD/RO	10.09.2016	6:04	54° 05.41' N	007° 21.44' E	32.7																		no data available
0032-1	CTD/RO	12.09.2016	6:19	54° 05.40' N	007° 21.44' E	32.9	032	1		2		2		2		2		2	0	10	HE453/30-1	20.76	1.0	
0041-1	CTD/RO	13.09.2016	5:55	54° 05.52' N	007° 21.53' E	33.3	041	1		2		2		2		2		2	0	10	HE453/30-1	20.52	0.9	
0043-1	CTD/RO/MIC	13.09.2016	11:22	54° 27.37' N	007° 22.74' E	25.3													**0**	**0**				no data available
0048-1	CTD/RO	14.09.2016	6:11	54° 26.37' N	007° 25.57' E	24.7	048	1		2		2		2		2		2	0	10	HE470/091-1	0.39	0.3	
0061-1	CTD/RO	15.09.2016	6:05	54° 28.47' N	007° 21.13' E	26.4	061	1		2		2		2		2		2	0	10	HE470/118-1	2.97	0.4	
0076-1	CTD/RO	16.09.2016	11:37	54° 10.32' N	007° 57.69' E	21.4	076												0	0	HE453/78-1	4.94	0.5	
							076_2												**0**	**0**				no DSHIP entry
0082-1	CTD/RO	17.09.2016	6:09	54° 10.88' N	007° 57.70' E	21.5	082	1		1		1		1		1		1	0	5	HE453/78-1	5.64	0.3	
0086-1	CTD/RO	17.09.2016	10:11	54° 03.76' N	008° 01.12' E	25.8	086	1		3		3		3		3		3	0	15	HE452/37-1	4.41	0.8	
0088-1	CTD/RO	18.09.2016	6:06	54° 04.03' N	008° 01.54' E	21.8	088	1											0	0	HE452/14-1	4.16	0.8	
							090												**0**	**0**				no DSHIP entry, no btl-file
0095-1	CTD/RO	19.09.2016	6:26	54° 03.09' N	007° 57.99' E	23.3	095	1											0	0	HE452/37-1	1.16	0.7	no btl-file
0097-1	CTD/RO	19.09.2016	6:42	54° 03.05' N	007° 58.17' E	23.6	097	1											0	0	HE452/37-1	1.36	0.7	no btl-file
0099-1	CTD/RO	19.09.2016	7:00	54° 03.03' N	007° 58.34' E	25.8	099	1											0	0	HE452/37-1	1.54	0.7	no btl-file
0101-1	CTD/RO	19.09.2016	7:14	54° 03.00' N	007° 58.52' E	26.4	101	1		4		4		4		4		4	0	20	HE452/37-1	1.74	0.7	no btl-file
0103-1	CTD/RO	19.09.2016	7:27	54° 02.97' N	007° 58.68' E	26.6	103	1											0	0	HE452/37-1	1.92	0.7	no btl-file
0105-1	CTD/RO	19.09.2016	7:41	54° 02.95' N	007° 58.85' E	26.5	105	1		1		1		1		1		1	0	5	HE452/37-1	2.10	0.7	no btl-file
0107-1	CTD/RO	19.09.2016	8:42	54° 02.94' N	007° 59.03' E	27.4	107	1											0	0	HE452/37-1	2.28	0.7	no btl-file
0109-1	CTD/RO	19.09.2016	9:01	54° 02.91' N	007° 59.21' E	27.3	109	1											0	0	HE452/37-1	2.49	0.7	no btl-file
0111-1	CTD/RO	19.09.2016	10:06	54° 02.87' N	007° 59.38' E	27.9	111	1		2		2		2		2		2	0	10	HE452/37-1	2.69	0.7	
0117-1	CTD/RO	20.09.2016	6:03	54° 03.09' N	007° 58.48' E	27	117	1		1		1		1		1		1	0	5	HE452/37-1	1.63	0.7	
0120-1	CTD/RO	21.09.2016	1:55	54° 03.89' N	008° 01.11' E	25.3	120	1											0	0	HE452/37-1	4.43	0.7	
0122-1	CTD/RO	21.09.2016	2:32	54° 03.04' N	007° 58.55' E	29	122	1											0	0	HE452/37-1	1.73	0.7	several salinity data of sensor 2 deleted

Figure 3: CTD data Processing Summary HE471

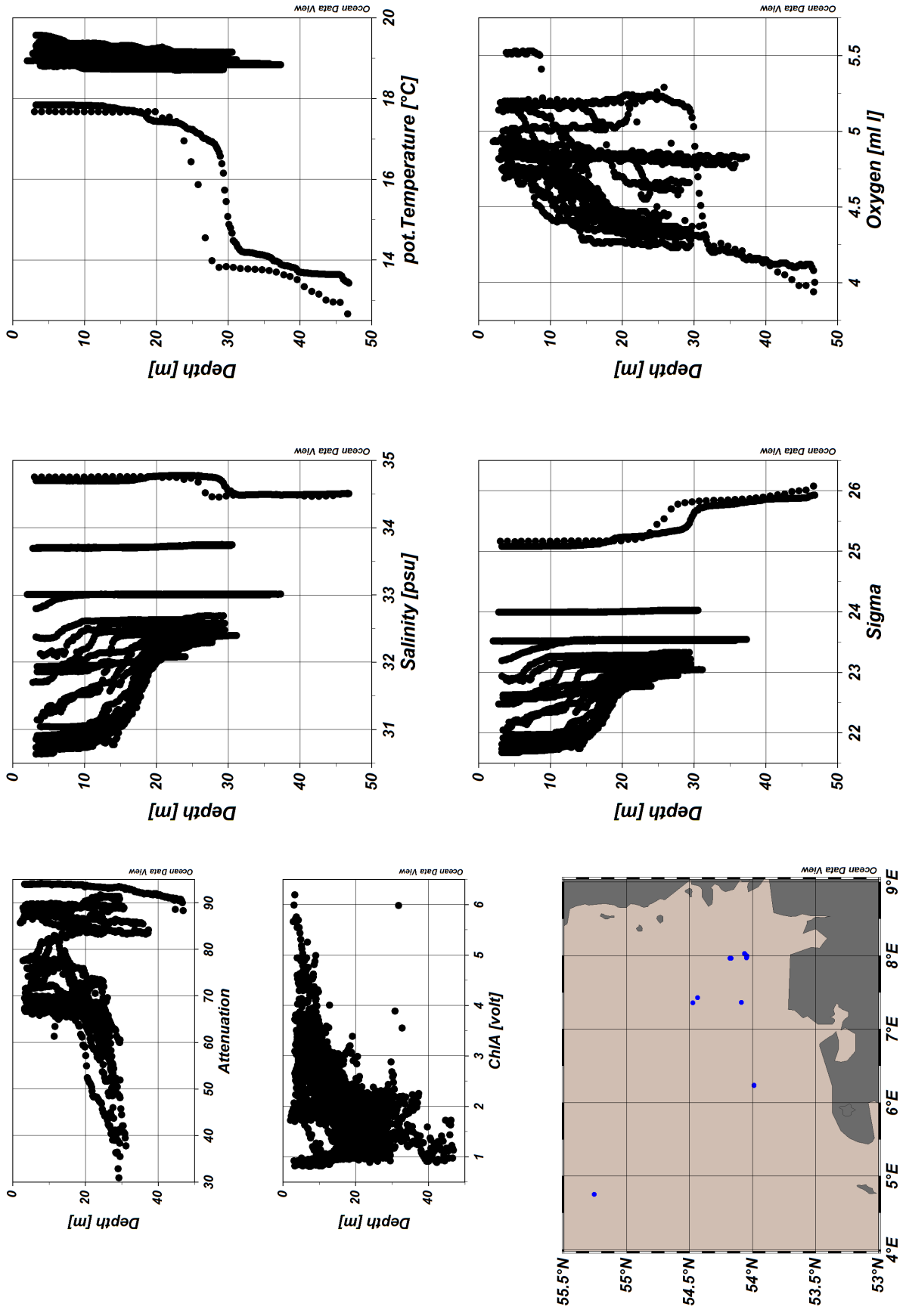

Figure 4: ODV Screenshot of HE471 CTD data