



CTD Data RV Heincke HE582

Data Processing Report

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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 HE582.

2 Workflow

The different steps of processing and validation are visualized in Figure 1. The CTD raw data are delivered from Dr. Sandra Tippenhauer (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* \rightarrow *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* \rightarrow *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.



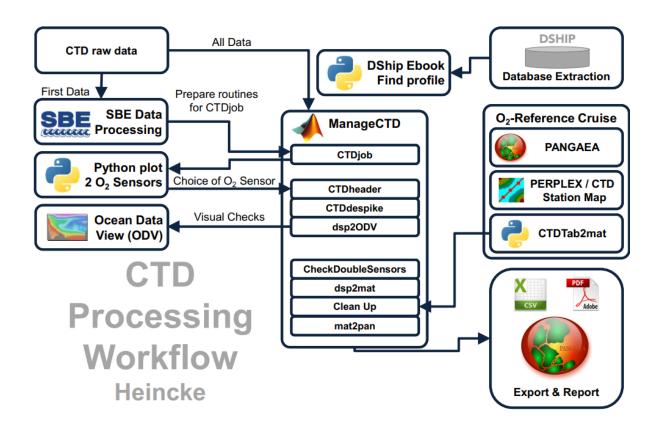


Figure 1: CTD data Processing Workflow



3 Cruise details

Vessel name RV Heincke

Cruise name HE582

Cruise start 23.08.2021 Bremerhaven Cruise end 05.09.2021 Bremerhaven

Cruise duration 13 days

No. of CTD casts 29

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 | 1373 | 11-Oct-19 |
| 3 | ConductivitySensor | 1198 | 17-Sep-19 |
| 45 | PressureSensor | 1015 | 26-Jan-17 |
| 55 | TemperatureSensor | 2929 | 13-Sep-19 |
| 3 | ConductivitySensor | 1199 | 17-Sep-19 |
| 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 | 26-Aug-20 |
| 38 | OxygenSensor | 3654 | 13-Feb-20 |

5 Processing

Details of processing procedures and processing parameters are described in *CTD Processing Log-book 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

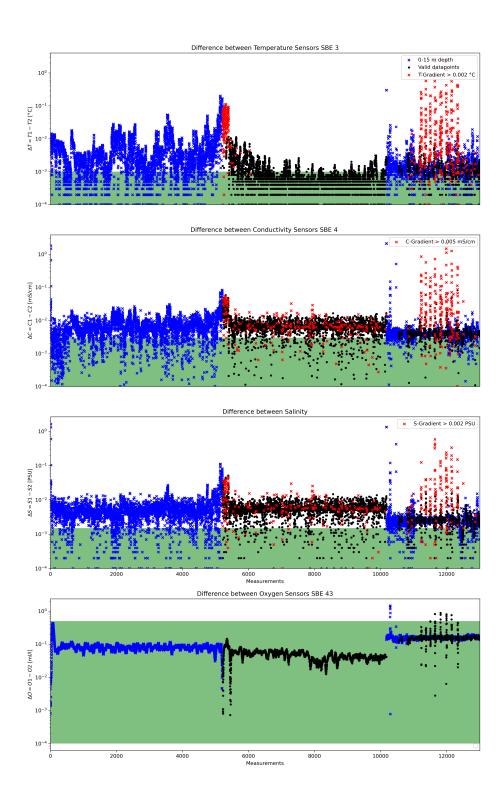


Figure 2: Data accuracy of sensor pairs HE582



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 sensor pairs 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 | Measurements | Remaining |
|--------------|------------------------------|-------------------|-----------------|
| | | removed | measurements |
| | given by manufacturer | Surface 0-15m | within accuracy |
| | | + gradient filter | specifications |
| Temperature | ±0.001 °C | 55.97% | 70.49% |
| Conductivity | $\pm 0.003~mS/cm$ | 55.69% | 8.54% |
| Salinity | $\pm 0.0015~PSU$ | 54.79% | 5.15% |
| Oxygen | $\pm 2.0 \% \ of saturation$ | 52.20% | 100.00% |

Comments

- 29 CTD "max depth/on ground" entries in DShip station book
- 30 CTD raw data sets delivered
- 1 CTD cast was invalid or test (HE580_MGF-DOG21-21)
- on 2 stations 3 CTD casts were made (3 casts on station 5-4: Sylter_Aussenriff_15_19, Sylter_Aussenriff_15_20 and Sylter_Aussenriff_15_21; 3 casts on station 7-5: Amrumbank_7_25, Amrumbank_7_26 and Amrumbank_7_27)
- 29 CTD casts processed and uploaded
- of these 29 processed CTD casts:
 - 0 oxygen profiles deleted (spiky and not matching to reference casts)
 - 70 data points interpolated
 - 0 data points erased



Result files

Text File (HE582_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-HE582-report.pdf):

This PDF document.



| ents | | | | | | | | | | | | | | | | | | | | mber ed | umber led | ımber led | | | | ımber led | ımber ed | nmber ed | | | 7 |
|------------------|--------------------------|----------------|------------------------------|--------------------------------|------------------------------|------------------------------|------------------------------|------------------------------|--------------------------------|--------------|--------------------------------|------------------|------------------|--------------------------------|--------------------------------|--------------------------------|--------------------------------|------------------------------|--------------------------------|------------------------------|------------------------------|----------------------------|--------------------------------|--------------------------------|--------------------------------|------------------------------|----------------------------|------------------------------|------------------------------|----------------------------|---------------|
| Commonte | | | | | | | | | | | | | | | | | | | | station number extended | station number extended | station number extended | | | | station number extended | station number extended | station number extended | | | |
| • | Offset | 1.2 | 1.2 | 1.2 | 1.5 | 1.4 | - | 1 | 1.7 | 6.0 | 1 | 0.3 | 0.3 | 0.4 | 0.3 | 0.4 | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 | 0.2 | 0.1 | 0.3 | 1.3 | 0.6 | 9.0 | 9.0 | 0.7 | 9.0 | |
| Oxygen reference | dist. (km) | 30.25 | 30.27 | 30.4 | 36.06 | 30.4 | 33.5 | 33.49 | 31.42 | 50.37 | 50.38 | 23.5 | 23.54 | 23.53 | 23.52 | 23.83 | 13.32 | 13.36 | 13.36 | 30.81 | 30.91 | 30.93 | 30.97 | 30.81 | 50.45 | 47.2 | 47.21 | 47.23 | 30.3 | 12.03 | |
| Oxyger | cruise/sss-cc dist. (km) | HE516/74-2 | HE516/74-2 | HE516/74-2 | HE516/74-2 | HE516/74-2 | HE516/74-2 | HE516/74-2 | HE516/74-2 | HE516/74-2 | HE516/74-2 | HE516/70-1 | HE516/70-1 | HE516/70-1 | HE516/70-1 | HE516/70-1 | HE516/71-1 | HE516/71-1 | HE516/71-1 | HE516/73-1 | HE516/73-2 | HE516/73-3 | HE516/73-4 | HE516/73-5 | HE516/74-2 | HE516/74-2 | HE516/74-2 | HE516/74-2 | HE516/74-2 | HE516/74-2 | |
| sors | Offset cr | -0.17 F | -0.14 F | -0.14 F | -0.15 F | -0.15 F | -0.13 F | -0.16 F | -0.14 F | -0.15 F | -0.16 F | -0.17 F | -0.17 F | -0.17 F | -0.17 F | -0.15 F | -0.16 F | -0.16 F | -0.16 F | -0.15 F | -0.16 F | -0.16 F | -0.17 F | -0.16 F | -0.15 F | -0.17 F | -0.17 F | -0.34 F | -0.15 F | -0.15 F | 1 |
| 2 Oxy Sensors | Sensor (| Н | 3654 | 3654 | 3654 | 3654 | 3654 | 3654 | 3654 | 3654 | 3654 | 3654 | 3654 | 3654 | 3654 | 3654 | 3654 | 3654 | 3654 | 3654 | 3654 | 3654 | 3654 | 3654 | 3654 | 3654 | 3654 | 3654 | 3654 | 3654 | |
| | erased | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | t |
| Complete | interp | | | | | | 2 | | | 2 | | 2 | | 10 | 10 | 10 | | 2 | | | 5 | 2 | | | 2 | | | | | 2 | 02 |
| y | erased | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | Ť |
| Oxy | interp | | | | | | - | | | - | | 1 | | 2 | 2 | 2 | | 1 | | | - | - | | | 1 | | | | | - | 14 |
| Fluor | erased | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Ē | interp | | | | | | - | | | - | | - | | 2 | 2 | 2 | | - | | | - | - | | | - | | | | | - | 14 |
| Trans | erased | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| _ | d interp | | | | | | - | | | - | | - | | 2 | 2 | 2 | | - | | | - | - | | | 1 | | | | | - | 14 |
| Sal | o erased | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | 1 |
| | ed interp | | | | | | - | | | - | | - | | 2 | 2 | 2 | | - | | | 1 | 1 | | | 1 | | | | | - | 14 |
| Temp | rp erased | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | 1 |
| sor | r | | | | | | _ | | | | | 1 | | 2 | 2 | 2 | | 1 | | | 1 | 1 | | | 1 | | | | | - | 14 |
| Sensor | . pair | 1 | _ | 1 | - | - | - | 1 | 1 | _ | 1 | 11 1 | 12 1 | 3_13 1 | _3_14 1 | 3_15 1 | 1 1 | 1 1 | 18 1 | 19 | 20 1 | 1 1 | 1 1 | 23 1 | 24hex 1 | - | - | . 2 | 1 | - | $\frac{1}{1}$ |
| File | Name HE582_ | Eider1_1_1 | Eider1_1_2 | Eider1_1_3 | Elder1_1_4 | Eider1_1_5 | Eider1_1_6 | Eider1_1_7 | Eider1_1_8 | NOAHNORD_2_9 | NOAHNORD_2_10 | NOAH I WEST 3_11 | NOAH_I_WEST_3_12 | NOAH I WEST 3 | NOAH I WEST 3 | NOAH I WEST 3 | NOAH I EAST 4 16 | NOAH_I_EAST_4_17 | NOAH EAST 4_18 | Sylter-Außenriff_5_19 | Sylter-Außenriff_5_20 | Sylter-Außenriff_5_21 | Sylter-Außenriff_5_22 | Sylter-Außenriff_5_23 | NOAH_E_Nord_6_24 | Amrumbank_7_25 | Amrumbank_7_26 | Amrumbank_7_27 | Eider1_8_28 | NOAHE_9_29 | |
| Depth | [m] | 9.4 | 9.3 | 21.4 | 18.3 | 9.0 | 15.4 | 15.3 | 11.0 | 15.9 | | | | | 35.5 | 35.2 | 28.9 | 27.6 | 28.2 | 24.9 | 25.2 | 25.3 | 25.9 | 26.1 | 16.7 | 10.4 | 11.3 | 10.0 | 9.7 | 27.9 | 1 |
| Position | Longitude | 008° 18,088' E | 54° 16,307' N 008° 18,085' E | 54° 16,382' N 008° 18,129' E | 54° 19,570' N 008° 19,739' E | 54° 16,382' N 008° 18,124' E | 54° 21,407' N 008° 08,754' E | 54° 21,414' N 008° 08,707' E | 54° 16,793' N 008° 18,744' E | 7° 37,789' E | 54° 46,989' N 007° 37,796' E | 3° 40,494' E | 3° 40,447' E | 55° 38,684' N 003° 40,475' E | 55° 38,699' N 003° 40,463' E | 55° 38,559' N 003° 40,258' E | 55° 27,688' N 004° 32,249' E | 55° 27,727' N 004° 32,283' E | 55° 27,711' N 004° 32,239' E | 54° 53,938' N 006° 54,271' E | 54° 53,982' N 006° 54,319' E | 006° 54,344' E | 54° 53,988' N 006° 54,406' E | 54° 53,892' N 006° 54,376' E | 54° 47,058' N 007° 37,699' E | 54° 37,108' N 007° 54,210' E | 007° 54,239' E | 54° 37,092' N 007° 54,269' E | 54° 14,942' N 008° 20,417' E | 7° 17,513' E | |
| | | 89' N 00k | 07' N 008 | 85. N 009 | 70' N 00 | 82' N 00k | 02' N 008 | 14' N 00k | 93. N 009 | 89' N 00; | .00 N .68 | 38. N 00: | 02. N 00: | 84' N 00; | 36. N 00: | 29' N 00. | 88. N 00° | 27' N 00- | 11' N 00 | 38. N 00 | 82' N 00t | | 88. N 00 | 92' N 00t | 28' N 00. | .00 N .80 | _ | 92' N 00; | 42' N 00k | 54° 28,612' N 007° 17,513' | $\frac{1}{2}$ |
| | Latitude | Н | Н | | \vdash | | \vdash | | _ | | | | | | | | _ | | Н | | | 54° 53,988' N | | Н | | | 54° 37,089' N | | Н | + | |
| Į. | | Ш | 17:06 | 19:11 | 106:37 | 07:24 | 12:38 | 13:01 | 11:28 | 11:27 | 11:50 | 06:24 | 06:47 | 10:70 | 12:31 | 10:06 | 16:45 | 17:08 | 17:28 | 08:18 | 08:39 | 08:57 | 12:17 | | 07:02 | 06:04 | 06:25 | 06:44 | | 19:10 | |
| oteO | | 23.08.2021 | 23.08.2021 | 23.08.2021 | 24.08.2021 | 24.08.2021 | 25.08.2021 | 25.08.2021 | 26.08.2021 | 27.08.2021 | 27.08.2021 | 28.08.2021 | 28.08.2021 | 28.08.2021 | 28.08.2021 | 29.08.2021 | 29.08.2021 | 29.08.2021 | 29.08.2021 | 30.08.2021 | 30.08.2021 | 30.08.2021 | 30.08.2021 | 31.08.2021 | 01.09.2021 | 02.09.2021 | 02.09.2021 | 02.09.2021 | 03.09.2021 | 04.09.2021 | |
| | Abbr. | _ | CTD | CTD | | CTD | CTD | CTD | CTD | | CTD | | CTD | | CTD | CTD | CTD | CTD | CTD | СТD | СТБ | СТБ | _ | | CTD | СТD | стр | стр | CTD | CTD |] |
| Station | HE582_ | 1-6 | 1-7 | 1-21 | 1-24 | 1-25 | 1-56 | 1-57 | 1-85 | 2-6 | 2-7 | 3-2 | 3-3 | 3-4 | 3-14 | 3-16 | 4-1 | 4-2 | 4-3 | 5-4-1 | 5-4-2 | 5-4-3 | 5-17 | 5-21 | 6-5 | 7-5-1 | 7-5-2 | 7-5-3 | 8-2 | 11-2 | |

Figure 3: CTD data Processing Summary HE582 Page 7 of 8



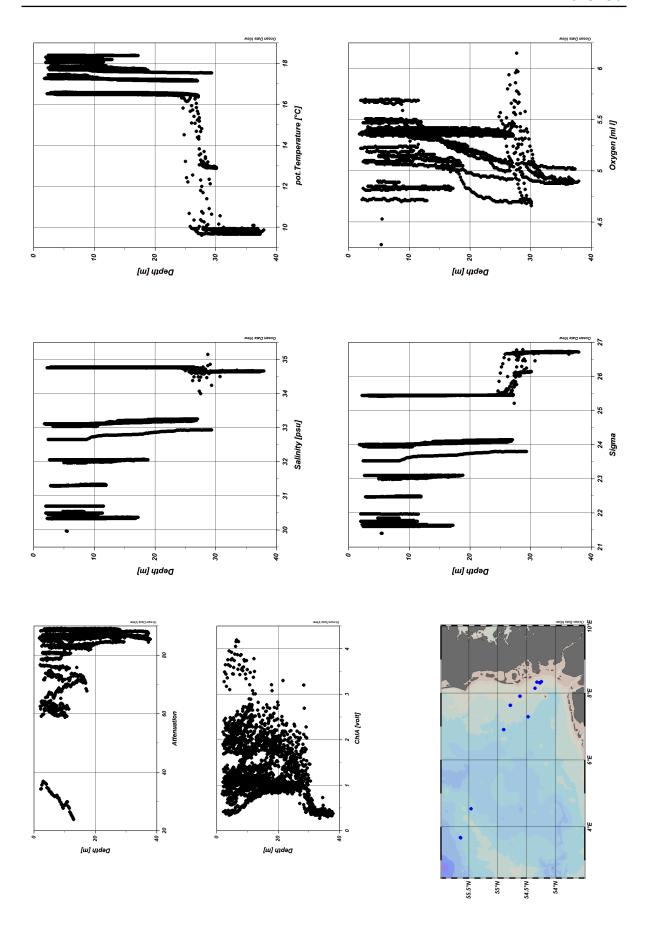


Figure 4: ODV Screenshot of HE582 CTD data Page 8 of 8