

CTD Data RV Heincke HE443

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 HE443.

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.

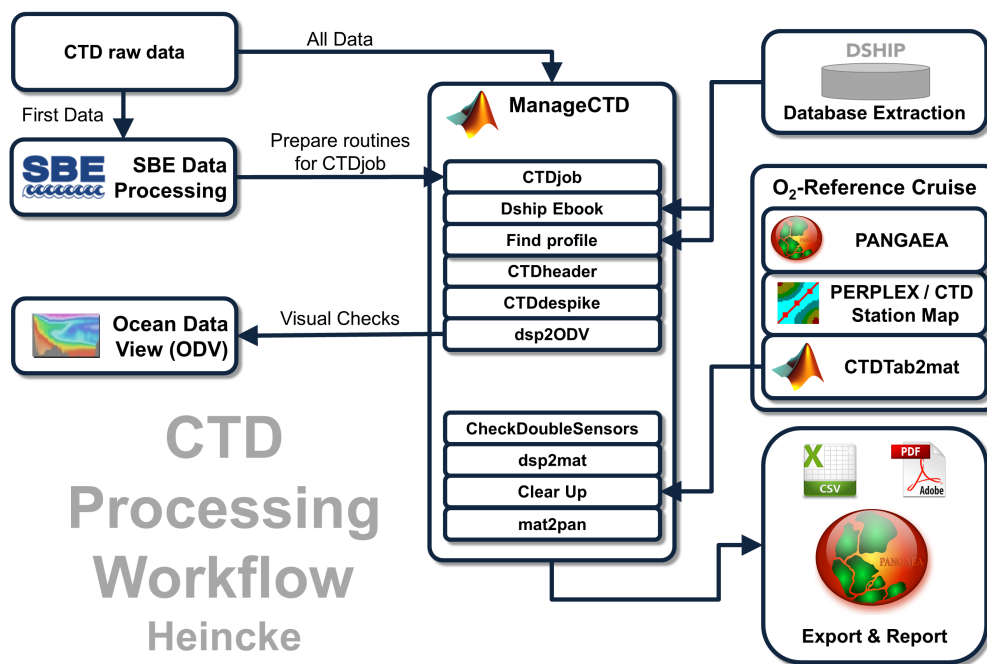


Figure 1: CTD data Processing Workflow

3 Cruise details

Vessel name RV Heincke
 Cruise name HE443
 Cruise start 28.04.2015 Bremerhaven
 Cruise end 09.05.2015 Bremerhaven
 Cruise duration 12 days
 No. of CTD casts 61

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 | 21-Jan-12 |
| 3 | ConductivitySensor | 2470 | 15-Nov-13 |
| 45 | PressureSensor | 1015 | 05-Oct-10 |
| 55 | TemperatureSensor | 5375 | 21-Jan-12 |
| 3 | ConductivitySensor | 3810 | 08-Feb-12 |
| 0 | AltimeterSensor | 46466 | 23-Mar-09 |
| 71 | WET_LabsCStar | 1348DR | 13-Oct-2010 |
| 20 | FluoroWetlabECO_AFL_FL_Sensor | 1346 | 26-Feb-2009 |
| 38 | OxygenSensor | 1597 | 19-Jun-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

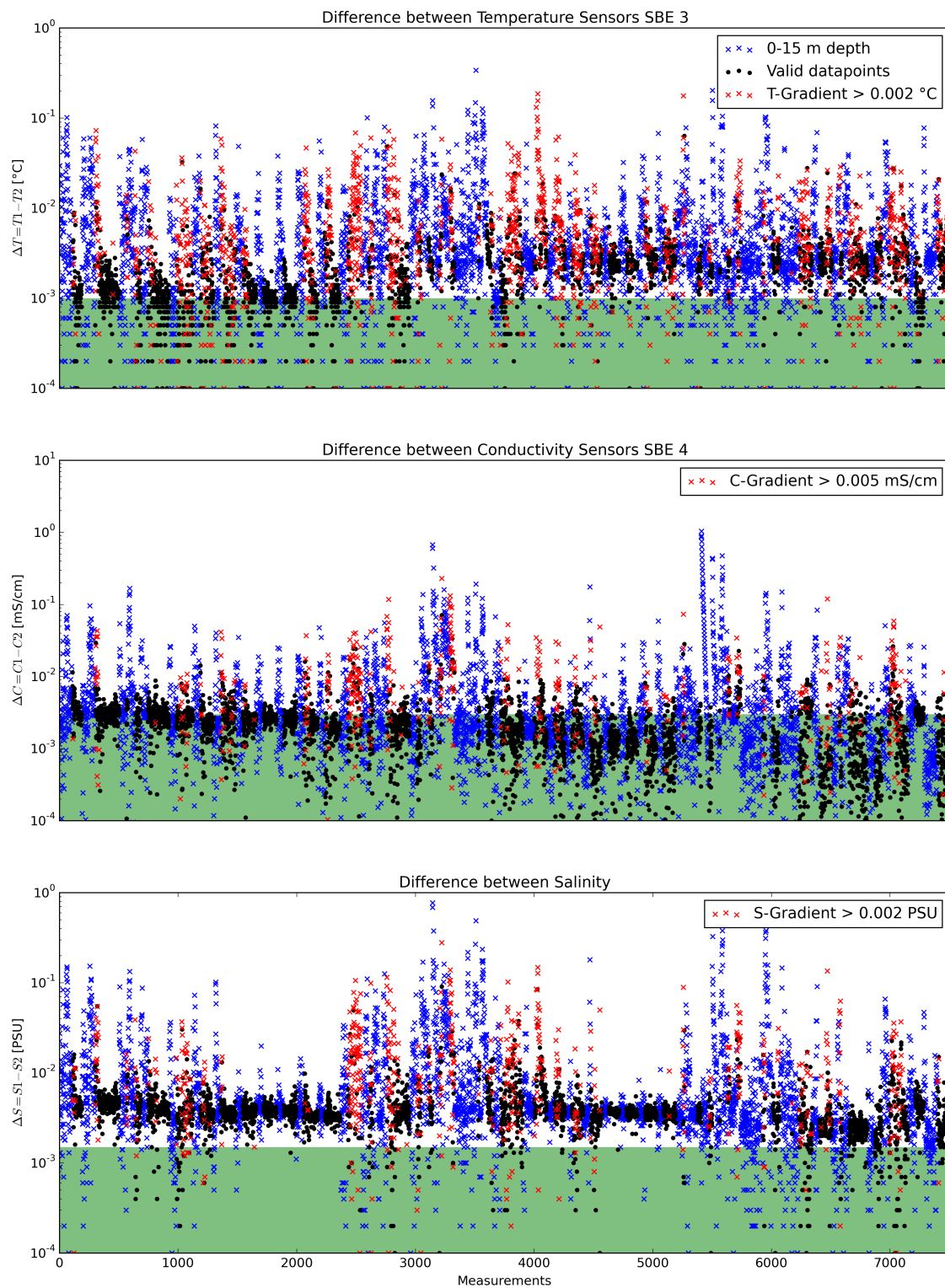


Figure 2: Data accuracy of sensor pairs HE443

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 | $\pm 0.001^{\circ}C$ | 63.92% | 24.67% |
| Conductivity | $\pm 0.003mS/cm$ | 52.95% | 77.06% |
| Salinity | $\pm 0.0015PSU$ | 55.02% | 5.42% |

Comments

- 61 CTD/RO "on ground" entries in DShip station book
- 61 CTD raw data sets delivered
- 1 DShip station book entry without raw data (12-1)
- 1 delivered CTD raw data set without DShip station book entry (65-2)
- 1 CTD data set is a failed cast (65-1; data deleted)
- 60 CTD casts processed and uploaded
- of these 60 processed CTD casts:
 - 13 oxygen profiles deleted (spiky and not matching to reference casts)
 - 344 data points interpolated
 - 51 data points erased

Result files

Text File (HE443_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-HE443-report.pdf):

This PDF document.

| Station HE443 | Curr. /shear | Date | Time | Position Latitude | Position Longitude | Depth [m] | File name | Sensor pair | Temp interp | Sal | Trans | Error | Chl | Complete interp | Oxygen interp | Comments |
|------------------|-----------------|------------|-------|----------------------|-----------------------|--------------|--------------|----------------|----------------|-----|-------|-------|-----|--------------------|------------------|----------------|
| 0001-1 | CTD/R60 | 28.04.2015 | 9:33 | 57° 59.64' N | 8° 15.97' E | 10.6 | 1-1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | no bit file |
| 0003-1 | CTD/R60 | 30.04.2015 | 14:04 | 54° 8.04' N | 7° 53.78' E | 51.9 | 3-1 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | oxygen deleted |
| 0004-1 | CTD/R60 | 30.04.2015 | 11:19 | 54° 8.67' N | 7° 53.76' E | 54.2 | 4-1 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | oxygen deleted |
| 0005-1 | CTD/R60 | 30.04.2015 | 11:19 | 54° 10.41' N | 7° 58.86' E | 13.6 | 5-1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | oxygen deleted |
| 0006-1 | CTD/R60 | 30.04.2015 | 7:07 | 54° 13.15' N | 7° 48.85' E | 30.0 | 6-1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | oxygen deleted |
| 0008-1 | CTD/R60 | 30.04.2015 | 9:27 | 54° 5.17' N | 7° 53.19' E | 30.1 | 8-1 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | oxygen deleted |
| 0011-1 | CTD/R60 | 30.04.2015 | 11:43 | 54° 13.19' N | 7° 54.70' E | 9.7 | 11-1 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | oxygen deleted |
| 0012-1 | CTD/R60 | 30.04.2015 | 13:56 | 54° 8.23' N | 7° 53.25' E | 53.8 | 12-1 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | oxygen deleted |
| 0013-3 | CTD/R60 | 01.05.2015 | 7:04 | 54° 14.07' N | 7° 55.47' E | 12.4 | 13-1 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | oxygen deleted |
| 0014-1 | CTD/R60 | 01.05.2015 | 8:18 | 54° 13.24' N | 7° 50.08' E | 22.1 | 14-1 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | oxygen deleted |
| 0015-1 | CTD/R60 | 01.05.2015 | 13:25 | 54° 8.83' N | 7° 52.91' E | 50.4 | 15-1 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | oxygen deleted |
| 0016-1 | CTD/R60 | 01.05.2015 | 6:33 | 54° 10.90' N | 7° 47.74' E | 41.3 | 17-1 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | oxygen deleted |
| 0018-1 | CTD/R60 | 01.05.2015 | 7:47 | 54° 8.97' N | 7° 44.17' E | 35.8 | 18-1 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | oxygen deleted |
| 0019-1 | CTD/R60 | 01.05.2015 | 9:01 | 54° 14.85' N | 7° 47.70' E | 32.3 | 19-1 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | oxygen deleted |
| 0020-1 | CTD/R60 | 01.05.2015 | 10:11 | 54° 16.21' N | 7° 44.00' E | 36.1 | 20-1 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | oxygen deleted |
| 0021-1 | CTD/R60 | 01.05.2015 | 11:39 | 54° 23.84' N | 6° 53.61' E | 34.1 | 21-1 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | oxygen deleted |
| 0022-1 | CTD/R60 | 01.05.2015 | 13:34 | 54° 31.07' N | 6° 31.52' E | 34.3 | 22-1 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | oxygen deleted |
| 0024-1 | CTD/R60 | 01.05.2015 | 16:07 | 54° 39.64' N | 6° 7.90' E | 37.4 | 23-1 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | oxygen deleted |
| 0025-1 | CTD/R60 | 01.05.2015 | 18:19 | 54° 46.78' N | 6° 49.74' E | 37.1 | 25-1 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | oxygen deleted |
| 0027-1 | CTD/R60 | 03.05.2015 | 6:13 | 54° 9.13' N | 7° 52.85' E | 36.6 | 27-1 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | oxygen deleted |
| 0028-1 | CTD/R60 | 03.05.2015 | 7:27 | 54° 3.77' N | 8° 4.77' E | 19.7 | 28-1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | oxygen deleted |
| 0029-1 | CTD/R60 | 03.05.2015 | 8:20 | 54° 1.65' N | 8° 13.66' E | 11.9 | 29-1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | oxygen deleted |
| 0030-1 | CTD/R60 | 03.05.2015 | 8:55 | 54° 5.94' N | 8° 19.99' E | 13.8 | 30-1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | oxygen deleted |
| 0031-1 | CTD/R60 | 03.05.2015 | 9:21 | 54° 5.87' N | 8° 24.32' E | 20.9 | 31-1 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | oxygen deleted |
| 0032-1 | CTD/R60 | 03.05.2015 | 10:08 | 54° 5.80' N | 8° 21.82' E | 16.7 | 32-1 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | oxygen deleted |
| 0033-1 | CTD/R60 | 03.05.2015 | 11:00 | 54° 52.75' N | 8° 31.34' E | 21.7 | 33-1 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | oxygen deleted |
| 0034-1 | CTD/R60 | 03.05.2015 | 13:32 | 54° 6.66' N | 8° 18.85' E | 11.4 | 34-1 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | oxygen deleted |
| 0035-1 | CTD/R60 | 03.05.2015 | 14:29 | 54° 13.49' N | 8° 33.86' E | 9.1 | 35-1 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | oxygen deleted |
| 0036-1 | CTD/R60 | 03.05.2015 | 14:57 | 54° 13.49' N | 8° 18.17' E | 10.5 | 36-1 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | oxygen deleted |
| 0037-1 | CTD/R60 | 03.05.2015 | 15:40 | 54° 12.42' N | 8° 5.51' E | 17.0 | 37-1 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | oxygen deleted |
| 0038-1 | CTD/R60 | 03.05.2015 | 16:18 | 54° 10.41' N | 8° 3.00' E | 16.7 | 38-1 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | oxygen deleted |
| 0041-1 | CTD/R60 | 04.05.2015 | 7:27 | 54° 10.95' N | 7° 55.78' E | 30.4 | 43-1 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | oxygen deleted |
| 0042-1 | CTD/R60 | 04.05.2015 | 7:33 | 54° 10.95' N | 7° 55.78' E | 30.4 | 43-1 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | oxygen deleted |
| 0043-1 | CTD/R60 | 04.05.2015 | 7:33 | 54° 10.95' N | 7° 55.78' E | 30.4 | 43-1 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | oxygen deleted |
| 0044-1 | CTD/R60 | 04.05.2015 | 8:45 | 54° 8.82' N | 7° 24.35' E | 35.0 | 44-1 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | oxygen deleted |
| 0045-1 | CTD/R60 | 04.05.2015 | 9:58 | 54° 14.89' N | 7° 23.70' E | 36.1 | 45-1 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | oxygen deleted |
| 0046-1 | CTD/R60 | 04.05.2015 | 11:09 | 54° 14.07' N | 7° 23.70' E | 36.9 | 46-1 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | oxygen deleted |
| 0047-1 | CTD/R60 | 04.05.2015 | 12:30 | 54° 23.77' N | 6° 53.79' E | 35.8 | 49-1 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | oxygen deleted |
| 0048-1 | CTD/R60 | 04.05.2015 | 14:14 | 54° 31.71' N | 6° 53.75' E | 35.8 | 48-1 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | oxygen deleted |
| 0050-1 | CTD/R60 | 04.05.2015 | 16:13 | 54° 26.52' N | 6° 31.07' E | 37.5 | 50-1 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | oxygen deleted |
| 0051-1 | CTD/R60 | 04.05.2015 | 17:41 | 54° 48.54' N | 6° 48.07' E | 37.3 | 51-1 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | oxygen deleted |
| 0052-1 | CTD/R60 | 04.05.2015 | 19:46 | 54° 2.97' N | 8° 52.14' E | 30.8 | 51-1 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | oxygen deleted |
| 0052-1 | CTD/R60 | 04.05.2015 | 19:28 | 54° 1.84' N | 8° 53.86' E | 35.4 | 51-1 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | oxygen deleted |
| 0052-1 | CTD/R60 | 04.05.2015 | 19:28 | 54° 1.84' N | 8° 53.86' E | 35.4 | 51-1 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | oxygen deleted |
| 0052-1 | CTD/R60 | 04.05.2015 | 19:28 | 54° 1.84' N | 8° 53.86' E | 35.4 | 51-1 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | oxygen deleted |
| 0052-1 | CTD/R60 | 04.05.2015 | 19:28 | 54° 1.84' N | 8° 53.86' E | 35.4 | 51-1 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | oxygen deleted |
| 0052-1 | CTD/R60 | 04.05.2015 | 19:28 | 54° 1.84' N | 8° 53.86' E | 35.4 | 51-1 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | oxygen deleted |
| 0052-1 | CTD/R60 | 04.05.2015 | 19:28 | 54° 1.84' N | 8° 53.86' E | 35.4 | 51-1 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | oxygen deleted |
| 0052-1 | CTD/R60 | 04.05.2015 | 19:28 | 54° 1.84' N | 8° 53.86' E | 35.4 | 51-1 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | oxygen deleted |
| 0052-1 | CTD/R60 | 04.05.2015 | 19:28 | 54° 1.84' N | 8° 53.86' E | 35.4 | 51-1 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | oxygen deleted |
| 0052-1 | CTD/R60 | 04.05.2015 | 19:28 | 54° 1.84' N | 8° 53.86' E | 35.4 | 51-1 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | oxygen deleted |
| 0052-1 | CTD/R60 | 04.05.2015 | 19:28 | 54° 1.84' N | 8° 53.86' E | 35.4 | 51-1 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | oxygen deleted |
| 0052-1 | CTD/R60 | 04.05.2015 | 19:28 | 54° 1.84' N | 8° 53.86' E | 35.4 | 51-1 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | oxygen deleted |
| 0052-1 | CTD/R60 | 04.05.2015 | 19:28 | 54° 1.84' N | 8° 53.86' E | 35.4 | 51-1 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | oxygen deleted |
| 0052-1 | CTD/R60 | 04.05.2015 | 19:28 | 54° 1.84' N | 8° 53.86' E | 35.4 | 51-1 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | oxygen deleted |
| 0052-1 | CTD/R60 | 04.05.2015 | 19:28 | 54° 1.84' N | 8° 53.86' E | 35.4 | 51-1 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | oxygen deleted |
| 0052-1 | CTD/R60 | 04.05.2015 | 19:28 | 54° 1.84' N | 8° 53.86' E | 35.4 | 51-1 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | oxygen deleted |
| 0052-1 | CTD/R60 | 04.05.2015 | 19:28 | 54° 1.84' N | 8° 53.86' E | 35.4 | 51-1 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | oxygen deleted |
| 0052-1 | CTD/R60 | 04.05.2015 | 19:28 | 54° 1.84' N | 8° 53.86' E | 35.4 | 51-1 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | oxygen deleted |
| 0052-1 | CTD/R60 | 04.05.2015 | 19:28 | 54° 1.84' N | 8° 53.86' E | 35.4 | 51-1 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | oxygen deleted |
| 0052-1 | CTD/R60 | 04.05.2015 | 19:28 | 54° 1.84' N | 8° 53.86' E | 35.4 | 51-1 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | oxygen deleted |
| 0052-1 | CTD/R60 | 04.05.2015 | 19:28 | 54° 1.84' N | 8° 53.86' E | 35.4 | 51-1 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | oxygen deleted |
| 0052-1 | CTD/R60 | 04.05.2015 | 19:28 | 54° 1.84' N | 8° 53.86' E | 35.4 | 51-1 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | oxygen deleted |
| 0052-1 | CTD/R60 | 04.05.2015 | 19:28 | 54° 1.84' N | 8° 53.86' E | 35.4 | 51-1 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | oxygen deleted |
| 0052-1 | CTD/R60 | 04.05.2015 | 19:28 | 54° 1.84' N | 8° 53.86' E | 35.4 | 51-1 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | oxygen deleted |
| 0052-1 | CTD/R60 | 04.05.2015 | 19:28 | 54° 1.84' N | 8° 53.86' E | 35.4 | 51-1 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | oxygen deleted |
| 0052-1 | CTD/R60 | 04.05.2015 | 19:28 | 54° 1.84' N | 8° 53.86' E | 35.4 | 51-1 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | oxygen deleted |
| 0052-1 | CTD/R60 | 04.05.2015 | 19:28 | 54° 1.84' N | 8° 53.86' E | 35.4 | 51-1 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | oxygen deleted |
| 0052-1 | CTD/R60 | 04.05.2015 | 19:28 | 54° 1.84' N | 8° 53.86' E | 35.4 | 51-1 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | oxygen deleted |
| 0052-1 | CTD/R60 | 04.05.2015 | 19:28 | 54° 1.84' N | 8° 53.86' E | 35.4 | 51-1 | 2 | 2 | 2 | 2</ | | | | | |

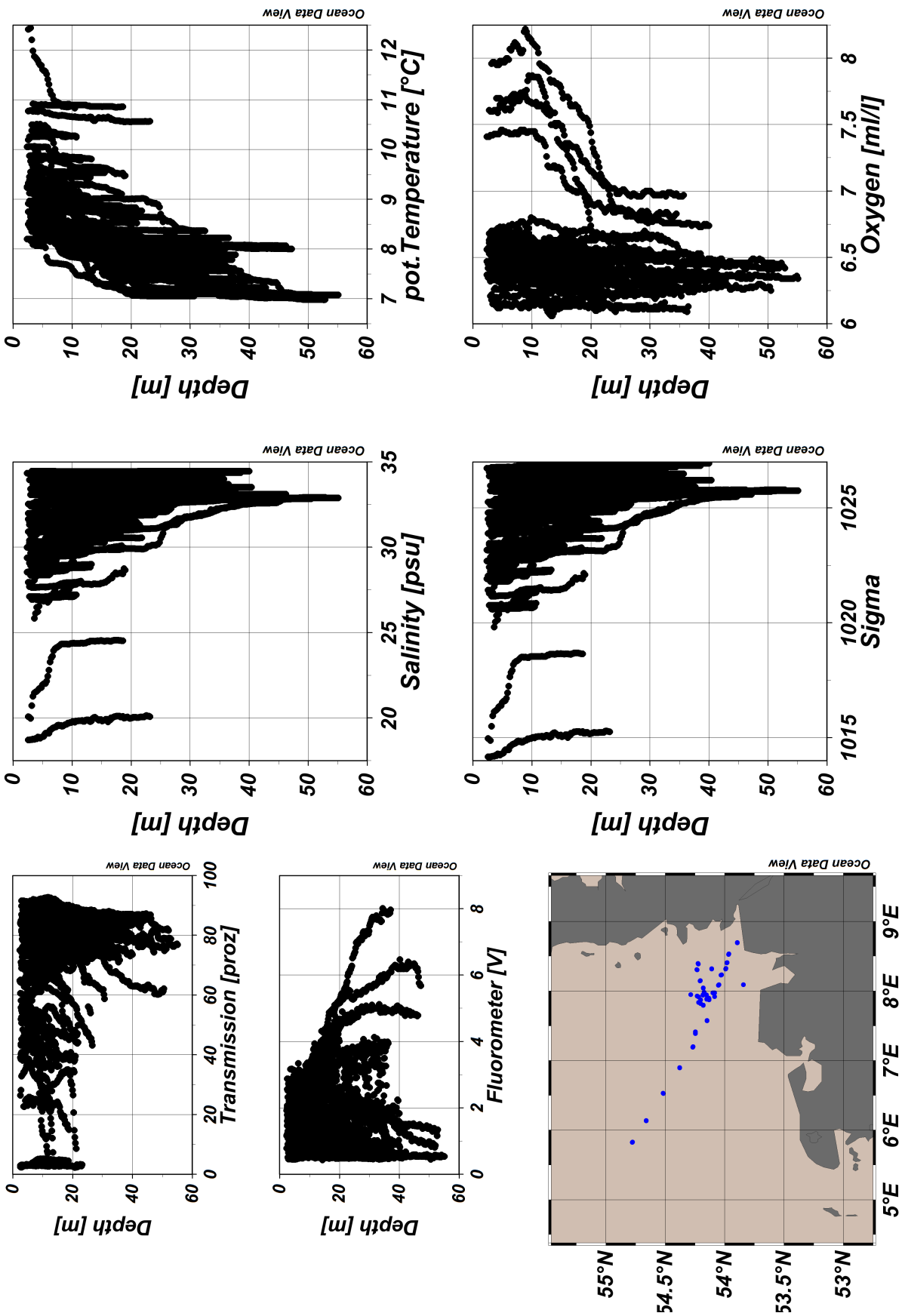


Figure 4: ODV Screenshot of HE443 CTD data
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