# CTD Data RV Heincke HE600
## 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 HE600.

# 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. 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.
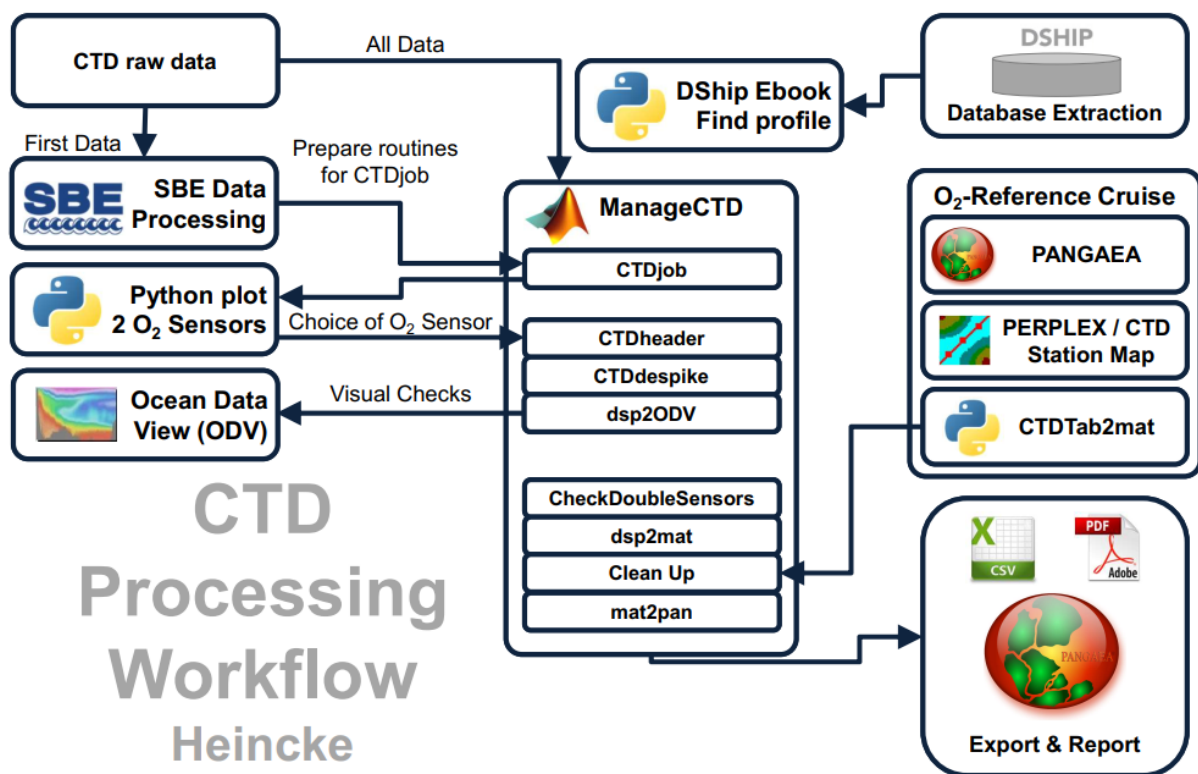
Figure 1: CTD data Processing Workflow

# 3 Expedition details

| | |
|---|---|
| Vessel name | RV Heincke |
| Expedition number | HE600 |
| Expedition leader | Floeter, Jens |
| Expedition start | 31.05.2022 Bremerhaven |
| Expedition end | 10.06.2022 Bremerhaven |
| Duration | 10 days |
| No. of CTD casts | 20 |
| BSH ID | 20220160 |
| Expedition report | https://doi.pangaea.de/10.48433/cr_he600 |
| Expedition map | https://download.pangaea.de/reference/113265/attachments/HE600_nav.jpg |
| Event list | https://www.pangaea.de/expeditions/events/HE600 |

# 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 | 4918 | 05-Mar-21 |
| 3 | ConductivitySensor | 3810 | 09-Feb-21 |
| 45 | PressureSensor | 1015 | 26-Jan-17 |
| 55 | TemperatureSensor | 5110 | 05-Mar-21 |
| 3 | ConductivitySensor | 3827 | 02-Feb-12 |
| 0 | AltimeterSensor | Valeport | None |
| 71 | WET_LabsCStar | 435 | None |
| 20 | FluoroWetlabECO_AFL_FL_Sensor | 1365 | 7.1.2022 |

# 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).
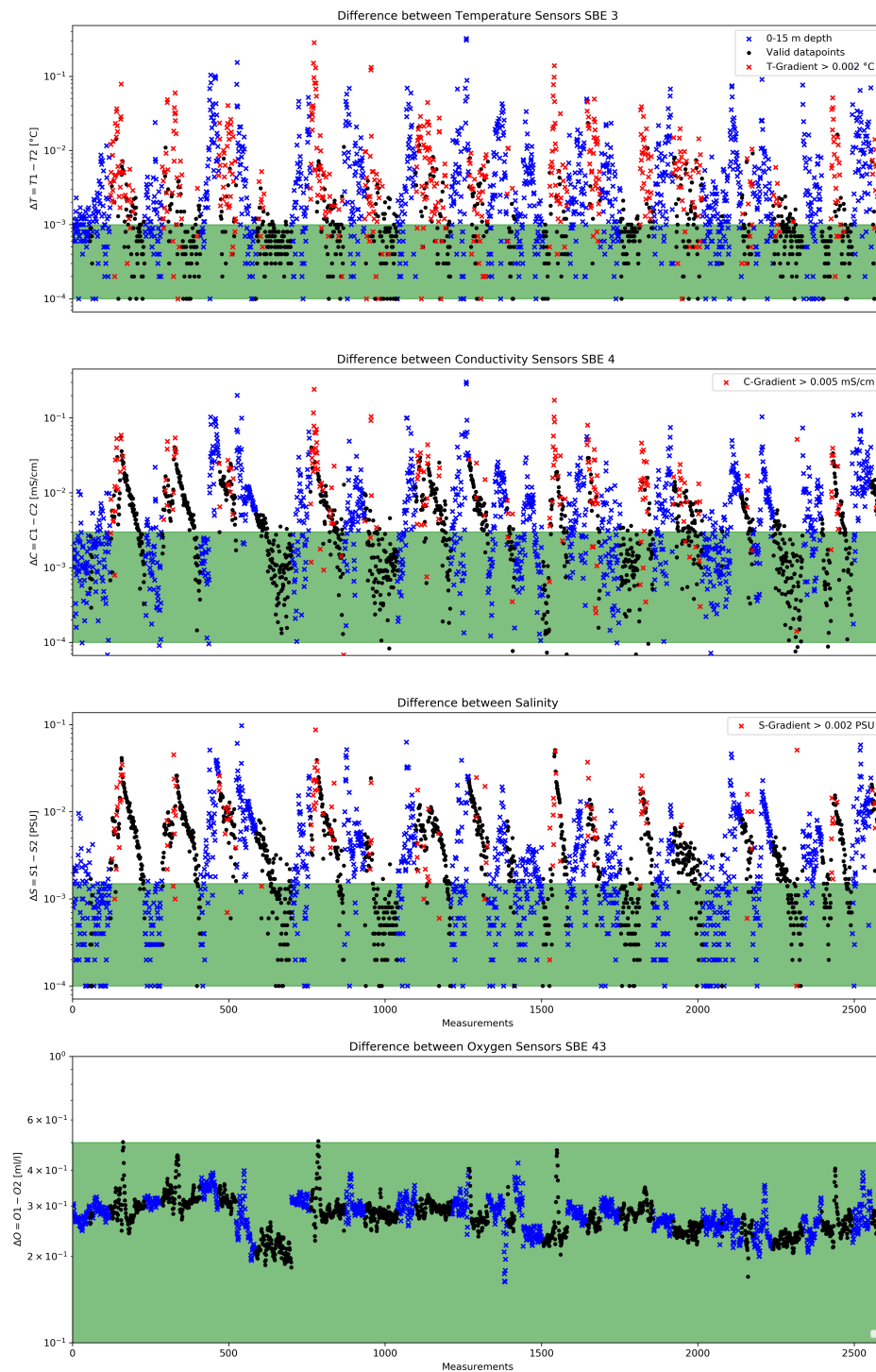
# Sensor Differences



Figure 2: Data accuracy of sensor pairs HE600

# 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 | $\pm0.001^{\circ}C$ | 65.87% | 69.27% |
| Conductivity | $\pm0.003mS/cm$ | 54.30% | 48.10% |
| Salinity | $\pm0.0015PSU$ | 51.25% | 29.98% |

**Comments**

- 20 CTD "max depth/on ground" entries in DShip station book

- 20 CTD raw data sets delivered

- 20 CTD casts processed and uploaded

- of these 20 processed CTD casts:
    - 98 data points interpolated
    - 2 data points erased

**Result files**

Text File (HE600_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-HE600-report.pdf):

This PDF document.

Table (rotated 90°):

| Station HE600_ | Gear Abbr. | Date | Time | Position Latitude | Position Longitude | Depth [m] | File Name | 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 | 2 Oxy Sensors Offset | Oxygen reference cruise/sss-cc | Oxygen reference dist. (km) | Oxygen reference Offset | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1-5 | CTD | 31.05.2022 | 15:42 | 54° 05.026' N | 007° 53.841' E | 37 | he600_station1_hol1 | 1 | 2 |  | 2 |  | 2 |  | 2 |  | 2 |  | 10 |  | 1597 | 0.23 | HE329/921-1 | 4.3 | 0.61 |  |
| 4-5 | CTD | 01.06.2022 | 07:45 | 54° 17.087' N | 006° 33.513' E | 33 | he600_station4_hol2 | 2 | 1 |  | 6 |  | 1 |  | 1 |  | 1 |  | 10 |  | 1597 | 0.24 | HE329/942-1 | 8.7 | 0.74 |  |
| 6-4 | CTD | 01.06.2022 | 11:35 | 54° 29.999' N | 006° 59.950' E | 35 | he600_station6_hol3 | 1 | 3 |  | 3 |  | 3 |  | 3 |  | 3 |  | 15 |  | 1597 | 0.26 | HE329/860-1 | 0.0 | 0.35 |  |
| 8-3 | CTD | 01.06.2022 | 14:52 | 54° 41.606' N | 007° 12.181' E | 23 | he600_station8_hol4 | 1 | 1 |  | 1 |  | 1 |  | 1 |  | 1 |  | 5 |  | 1597 | 0.27 | HE329/861-1 | 13.4 | 0.42 |  |
| 12-4 | CTD | 02.06.2022 | 06:36 | 54° 39.550' N | 007° 41.080' E | 18 | he600_station12_hol5 | 1 |  |  |  |  |  |  |  |  |  |  |  |  | 1597 | 0.27 | HE329/862-1 | 1.5 | 1.13 |  |
| 14-1 | CTD | 02.06.2022 | 11:27 | 54° 21.176' N | 007° 15.621' E | 40 | he600_station14_hol6 | 1 | 1 |  | 1 |  | 1 |  | 1 |  | 1 |  | 5 |  | 1597 | 0.30 | HE329/849-1 | 5.0 | 0.55 |  |
| 14-4 | CTD | 02.06.2022 | 12:16 | 54° 21.087' N | 007° 14.707' E | 41 | he600_station14_hol7 | 1 | 1 |  | 1 |  | 1 |  | 1 |  | 1 |  | 5 |  | 1597 | 0.32 | HE329/849-1 | 5.9 | 0.61 |  |
| 18-4 | CTD | 04.06.2022 | 06:55 | 54° 55.894' N | 007° 08.913' E | 25 | he600_station18_hol8 | 1 |  |  |  |  |  |  |  | 1 |  |  |  | 1 | 1597 | 0.33 | HE329/864-1 | 11.9 | 0.35 |  |
| 20-2 | CTD | 04.06.2022 | 10:18 | 54° 45.094' N | 006° 47.865' E | 38 | he600_station20_hol9 | 1 | 1 |  | 1 |  | 1 |  | 1 |  | 1 |  | 5 |  | 1597 | 0.31 | HE329/940-1 | 12.0 | 1.01 |  |
| 22-4 | CTD | 04.06.2022 | 13:48 | 54° 34.068' N | 006° 27.163' E | 37 | he600_station22_hol10 | 1 | 5 |  | 5 |  |  |  |  | 1 |  |  | 11 |  | 1597 | 0.29 | HE329/935-1 | 10.8 | 0.56 |  |
| 25-4 | CTD | 05.06.2022 | 06:47 | 54° 48.950' N | 006° 34.999' E | 37 | he600_station25_hol11 | 1 |  |  |  |  |  |  |  |  |  |  |  |  | 1597 | 0.30 | HE329/940-1 | 5.7 | 1.01 |  |
| 27-1 | CTD | 05.06.2022 | 10:03 | 54° 48.819' N | 007° 03.652' E | 28 | he600_station27_hol12 | 1 |  |  |  |  |  |  |  |  |  |  |  |  | 1597 | 0.29 | HE329/861-1 | 16.9 | 0.05 |  |
| 29-4 | CTD | 05.06.2022 | 13:44 | 54° 49.110' N | 007° 34.301' E | 19 | he600_station29_hol13 | 1 |  |  |  |  |  |  | 1 |  | 2 |  | 3 |  | 1597 | 0.28 | HE329/862-1 | 17.8 | 0.51 |  |
| 32-3 | CTD | 06.06.2022 | 07:40 | 54° 39.800' N | 007° 51.857' E | 2 | he600_station32_hol14 | 1 |  |  |  |  |  |  |  |  |  |  |  |  | 1597 | 0.33 | HE329/862-1 | 12.8 | 1.34 |  |
| 34-1 | CTD | 08.06.2022 | 15:59 | 54° 29.945' N | 007° 14.952' E | 31 | he600_station34_hol15 | 1 | 1 |  | 1 |  | 1 |  | 1 |  | 1 |  | 5 |  | 1597 | 0.25 | HE329/848-1 | 5.6 | 0.25 |  |
| 37-2 | CTD | 09.06.2022 | 06:08 | 54° 46.723' N | 007° 09.060' E | 23 | he600_station37_hol16 | 1 |  |  |  |  | 2 |  |  |  |  |  | 2 |  | 1597 | 0.27 | HE329/861-1 | 15.8 | 0.05 |  |
| 39-1 | CTD | 09.06.2022 | 09:50 | 54° 36.361' N | 007° 00.114' E | 36 | he600_station39_hol17 | 1 | 3 |  | 3 |  | 3 |  | 3 |  | 3 |  | 15 |  | 1597 | 0.29 | HE329/861-1 | 6.7 | 0.03 |  |
| 41-1 | CTD | 09.06.2022 | 13:53 | 54° 26.462' N | 007° 00.324' E | 33 | he600_station41_hol18 | 1 | 1 |  | 1 |  | 1 |  | 3 |  | 1 |  | 7 |  | 1597 | 0.25 | HE329/860-1 | 6.5 | 0.12 |  |
| 44-1 | CTD | 10.06.2022 | 06:16 | 54° 15.332' N | 008° 03.107' E | 15 | he600_station44_hol19 | 1 |  |  |  |  |  |  |  |  |  |  |  |  | 1597 | 0.26 | HE329/947-1 | 3.0 | 0.45 |  |
| 46-1 | CTD | 10.06.2022 | 07:43 | 54° 06.497' N | 008° 03.058' E | 22 | he600_station46_hol20 | 1 |  |  |  |  |  |  |  |  |  |  |  |  | 1597 | 0.25 | HE329/920-1 | 4.4 | 0.25 |  |
| **Totals** |  |  |  |  |  |  |  |  | 20 | 0 | 25 | 0 | 17 | 0 | 19 | 2 | 17 | 0 | 98 | 2 |  |  |  |  |  |  |

Figure 3: CTD data Processing Summary HE600
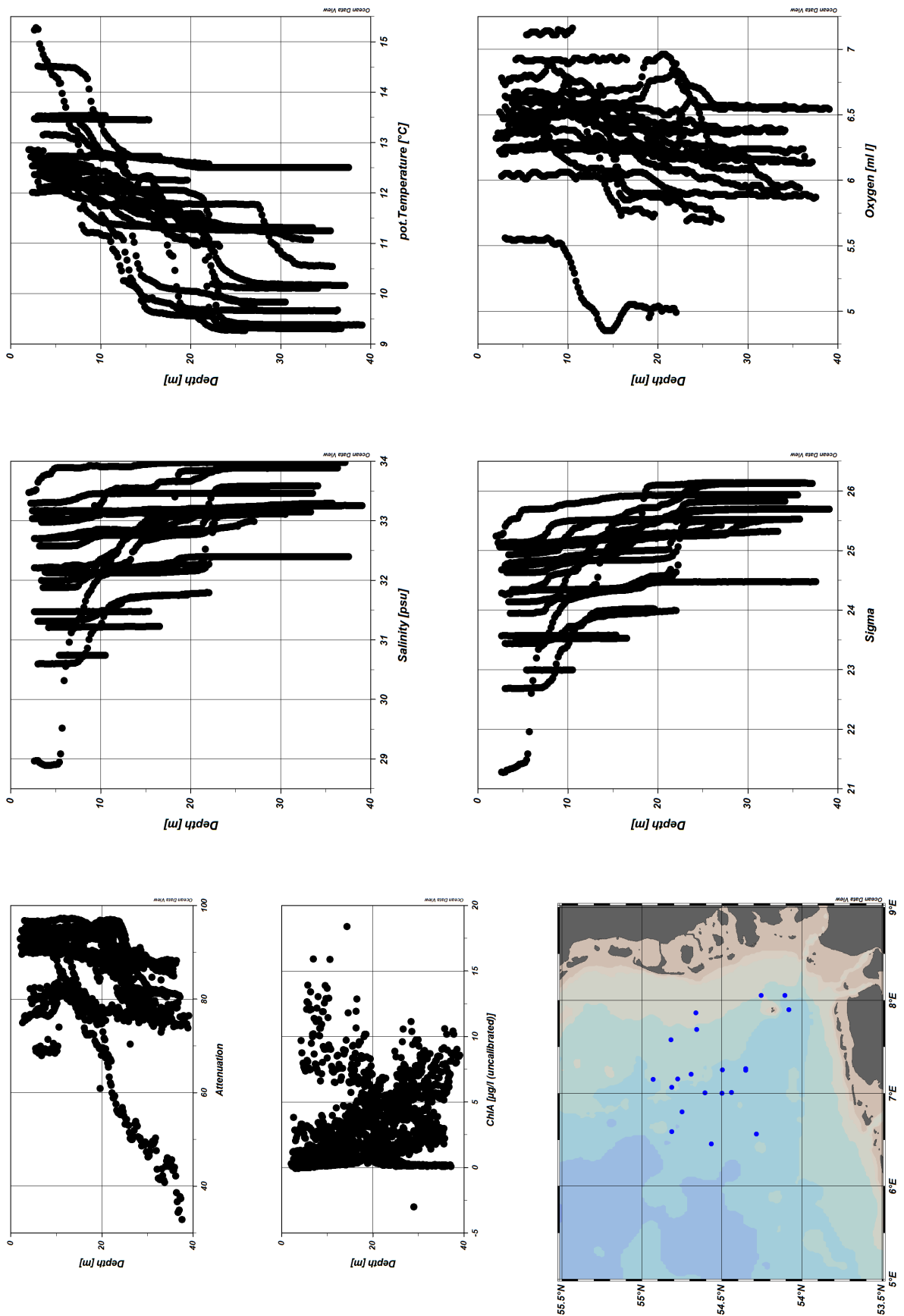
Figure 4: ODV Screenshot of HE600 CTD data