

CTD Data RV Heincke HE602

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 HE602.

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.

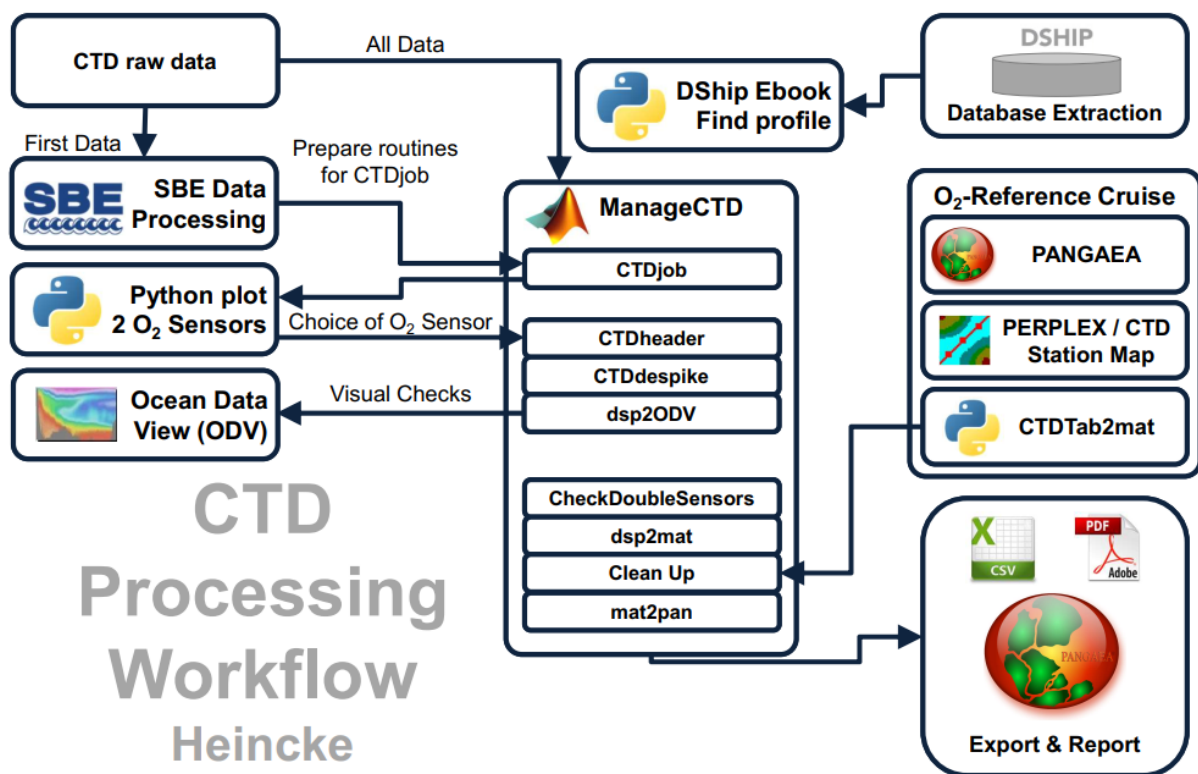


Figure 1: CTD data Processing Workflow

3 Expedition details

Vessel name	RV Heincke
Expedition number	HE602
Expedition leader	Rohde, Sven
Expedition start	23.06.2022 Bremerhaven
Expedition end	06.07.2022 Bremerhaven
Duration	13 days
No. of CTD casts	37 (according to station book)
BSH ID	20220162
Expedition report	https://doi.pangaea.de/10.48433/cr_he602
Expedition map	https://download.pangaea.de/reference/113265/attachments/HE602_nav.jpg
Event list	https://www.pangaea.de/expeditions/events/HE602

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](https://nbn-resolving.org/urn:nbn:de:hbz:5:1-64868-p0101-9)).

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 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](https://nbn-resolving.org/urn:nbn:de:hbz:5:1-64868-p0101-9)).

Sensor Differences

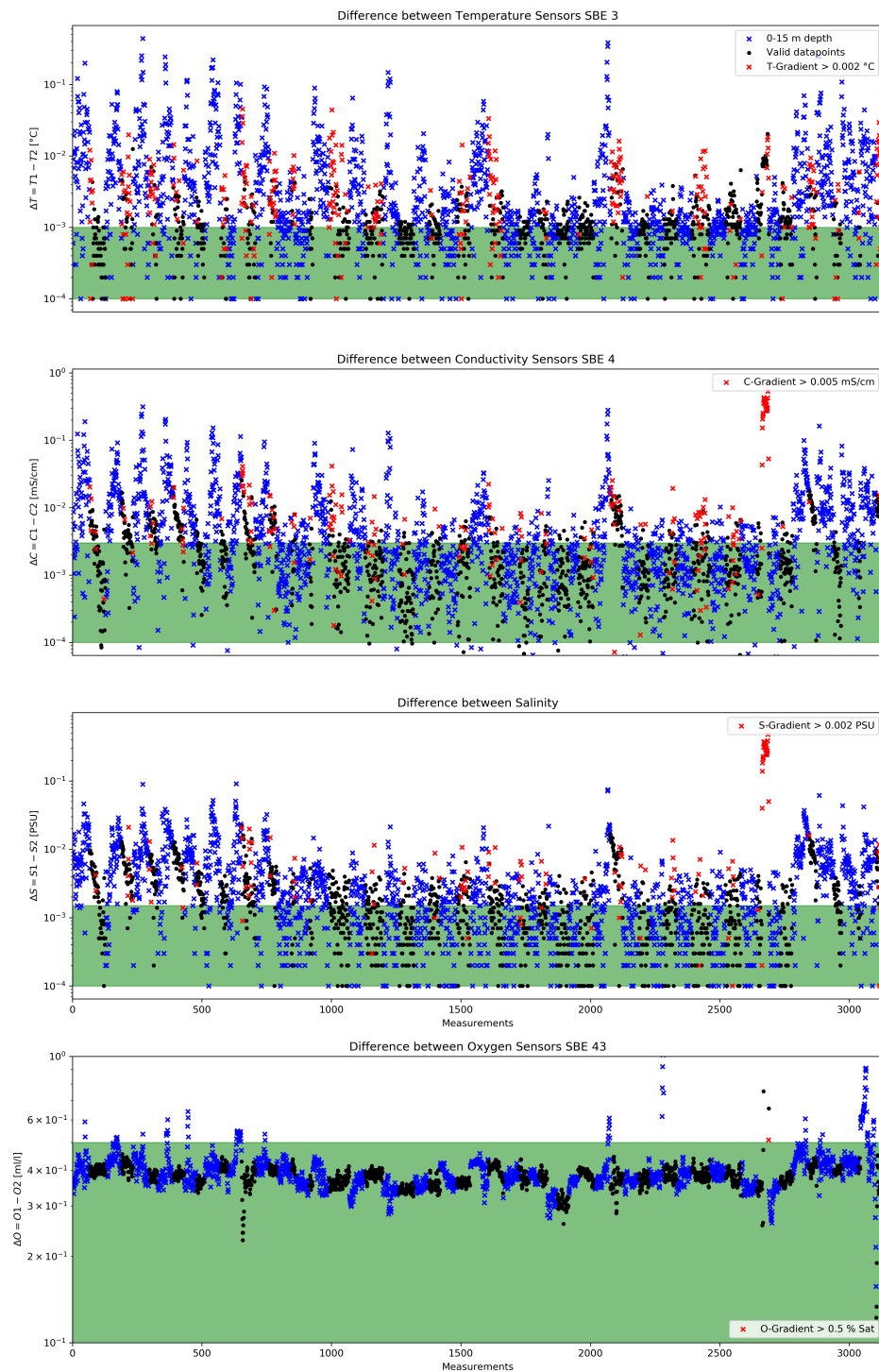


Figure 2: Data accuracy of sensor pairs HE602

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	$\pm 0.001^{\circ}C$	68.71%	54.90%
Conductivity	$\pm 0.003mS/cm$	64.24%	71.96%
Salinity	$\pm 0.0015PSU$	62.01%	51.01%

Comments

- 35 CTD "max depth/on ground" entries in DShip station book
- 31 CTD raw data sets delivered
- There are no CTD casts for following station book entries: 2-2, 5-1, 5-3, 12-1, 48-1, 48-1
- 1 CTD cast (he60220-1.hex) does not have a matching station book entry. Station number HE602_20-1-1 was derived for this cast because of the closeness in time and distance to station number HE602_20-1.
- 31 CTD casts processed and uploaded
- of these 31 processed CTD casts:
 - 0 oxygen profiles deleted (spiky and not matching to reference casts)
 - 65 data points interpolated
 - 17 data points erased

Result files

Text File (HE602_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-HE602-report.pdf):

This PDF document.

Station HE602_ Abbr.	Date	Time	Position Latitude	Position Longitude	Depth [m]	File Name	Sensor pair	Temp		Sal		Trans		Fluor		Oxy		Complete		2 Oxy Sensors		Oxygen reference		Comments			
								interp	erased	interp	erased	interp	erased	interp	erased	interp	erased	interp	erased	Sensor	Offset	cruise/ss-cc	dist. (km)		Offset		
1-1	23.06.2022	11:05	54° 04' 00.6" N	008° 00' 34.1" E	23	he602_station01	1														1597	0.47	HE329/920-1	2.5	2.0	no cast for this station book entry	
2-2	23.06.2022	15:49	54° 14' 08.0" N	008° 00' 19.0" E	14																1597	0.40	HE329/920-1	2.2	1.5	no cast for this station book entry	
3-1	24.06.2022	06:05	54° 04' 08.5" N	008° 00' 67.3" E	26	he602_3-1	1																			no cast for this station book entry	
5-1	24.06.2022	15:25	54° 38' 25.9" N	007° 12' 9.3" E	27																						no cast for this station book entry
5-3	25.06.2022	04:47	54° 40' 04.3" N	007° 14' 20.6" E	24																						no cast for this station book entry
6-1	25.06.2022	06:00	54° 41' 58.8" N	007° 14' 9.1" E	0	he602_6-1	1			1									1		1597	0.38	HE329/861-1	16.2	0.2		
7-1	25.06.2022	09:35	54° 40' 09.8" N	007° 15' 97.3" E	21	he602_7-1	1														1597	0.44	HE329/848-1	20.2	0.5		
8-1	25.06.2022	10:45	54° 50' 00.6" N	007° 23' 92.4" E	22	he602_8-1	2														1597	0.42	HE329/863-1	25.1	0.8		
9-1	25.06.2022	12:00	54° 42' 03.7" N	007° 34' 87.9" E	17	he602_9-1	1														1597	0.42	HE329/862-1	6.6	1.0		
12-1	25.06.2022	17:25	54° 40' 34.8" N	007° 13' 56.4" E	24																						no cast for this station book entry
13-1	26.06.2022	06:11	54° 40' 92.4" N	007° 16' 31.9" E	24	he602_13-1	1	1		1											1597	0.43	HE329/861-1	17.6	0.3		
19-2	27.06.2022	07:51	54° 47' 01.9" N	007° 21' 9.8" E	22	he602_19-2	1	1		1											1597	0.41	HE329/862-1	23.2	0.8		
20-1	27.06.2022	13:54	54° 51' 05.1" N	006° 59' 87.7" E	23	he602_20-1	1	1		1											1597	0.39	HE329/864-1	16.3	0.8		
20-1-1	27.06.2022	14:06	54° 51' 06.8" N	006° 59' 91.3" E	23	he60220-1	1	2		2											1597	0.40	HE329/864-1	16.3	0.4	no station book entry for this cast, number derived from 20-1	
22-1	28.06.2022	08:10	54° 47' 00.1" N	007° 22' 13.9" E	21	he602_22-1	1														1597	0.38	HE329/862-1	23.0	0.8		
24-1	29.06.2022	06:02	54° 51' 96.7" N	007° 28' 62.9" E	20	he602_24-1	1														1597	0.41	HE329/863-1	19.0	0.8		
30-1	30.06.2022	08:16	54° 51' 90.9" N	007° 29' 90.6" E	21	he602_30-1	1														1597	0.40	HE329/863-1	18.3	0.6		
35-1	01.07.2022	05:49	54° 37' 54.5" N	007° 41' 89.1" E	18	he602_35-1	1														1597	0.40	HE329/862-1	5.1	0.4		
38-2	02.07.2022	07:05	54° 36' 86.7" N	007° 41' 20.8" E	17	he602_38-2	2	1		1											1597	0.36	HE329/862-1	6.1	0.1		
40-1	02.07.2022	17:47	54° 05' 44.3" N	007° 20' 35.1" E	31	he602_40-1	1	1		1											1597	0.37	HE329/924-1	1.1	0.4		
41-1	02.07.2022	18:36	54° 03' 51.5" N	007° 07' 88.4" E	29	he602_41-1	1	1		1											1597	0.37	HE329/856-1	10.8	0.2		
42-1	02.07.2022	19:54	54° 01' 48.8" N	006° 54' 71.6" E	27	he602_42-1	2														1597	0.34	HE329/856-1	6.2	0.4		
43-1	02.07.2022	20:58	53° 58' 83.7" N	006° 40' 44.3" E	24	he602_43-1	2														1597	0.36	HE329/932-1	21.3	0.1		
44-2	03.07.2022	05:57	53° 51' 62.5" N	006° 18' 03.1" E	26	he602_44-2	2	1	2	1	2	1	2	1	2	1	2	1	2	5	10	1597	0.37	HE329/870-1	8.8	0.6	no cast for this station book entry
48-1	04.07.2022	08:53	53° 51' 41.4" N	006° 17' 8.5" E	27																						no cast for this station book entry
48-1	04.07.2022	09:25	53° 51' 31.0" N	006° 18' 0.6" E	27																						no cast for this station book entry
50-1	04.07.2022	11:05	53° 51' 7.6" N	006° 17' 5.6" E	26	he602_50-1	1														1597	0.41	HE329/870-1	8.7	0.4		
53-1	05.07.2022	06:11	53° 54' 70.6" N	006° 20' 8.6" E	22	he602_53-1	1														1597	0.38	HE329/870-1	2.9	0.5		
56-1	05.07.2022	11:13	53° 53' 02.7" N	006° 28' 4.7" E	23	he602_56-1	1														1597	0.38	HE329/870-1	10.8	0.4		
57-1	05.07.2022	11:54	53° 51' 94.4" N	006° 22' 47.3" E	25	he602_57-1	1	3		1	3										1597	0.31	HE329/870-1	8.3	0.5		
58-1	05.07.2022	12:36	53° 51' 27.0" N	006° 16' 9.0" E	27	he602_58-1	1														1597	0.38	HE329/870-1	9.8	0.4		
60-1	05.07.2022	14:49	53° 55' 6.6" N	006° 25' 3.9" E	22	he602_60-1	1	1		1											1597	0.37	HE329/870-1	5.8	0.4		
61-1	05.07.2022	15:31	53° 54' 80.5" N	006° 19' 6.2" E	26	he602_61-1	1	1		1											1597	0.41	HE329/870-1	2.7	0.5		
62-1	05.07.2022	16:05	53° 53' 8.6" N	006° 14' 1.8" E	28	he602_62-1	1														1597	0.39	HE329/870-2	7.8	0.4		
63-1	05.07.2022	16:38	53° 56' 70.0" N	006° 11' 7.8" E	28	he602_63-1	1														1597	0.39	HE329/870-2	9.1	0.5		
64-1	05.07.2022	17:14	53° 57' 37.1" N	006° 16' 8.2" E	24	he602_64-1	2	1		1											2007	0.00	HE329/870-2	4.1	0.8		
65-1	05.07.2022	17:51	53° 58' 02.6" N	006° 21' 9.7" E	25	he602_65-1	1														1597	0.35	HE329/870-2	3.9	0.5		
								12	5	14	2	12	3	12	2	65	17										

Figure 3: CTD data Processing Summary HE602
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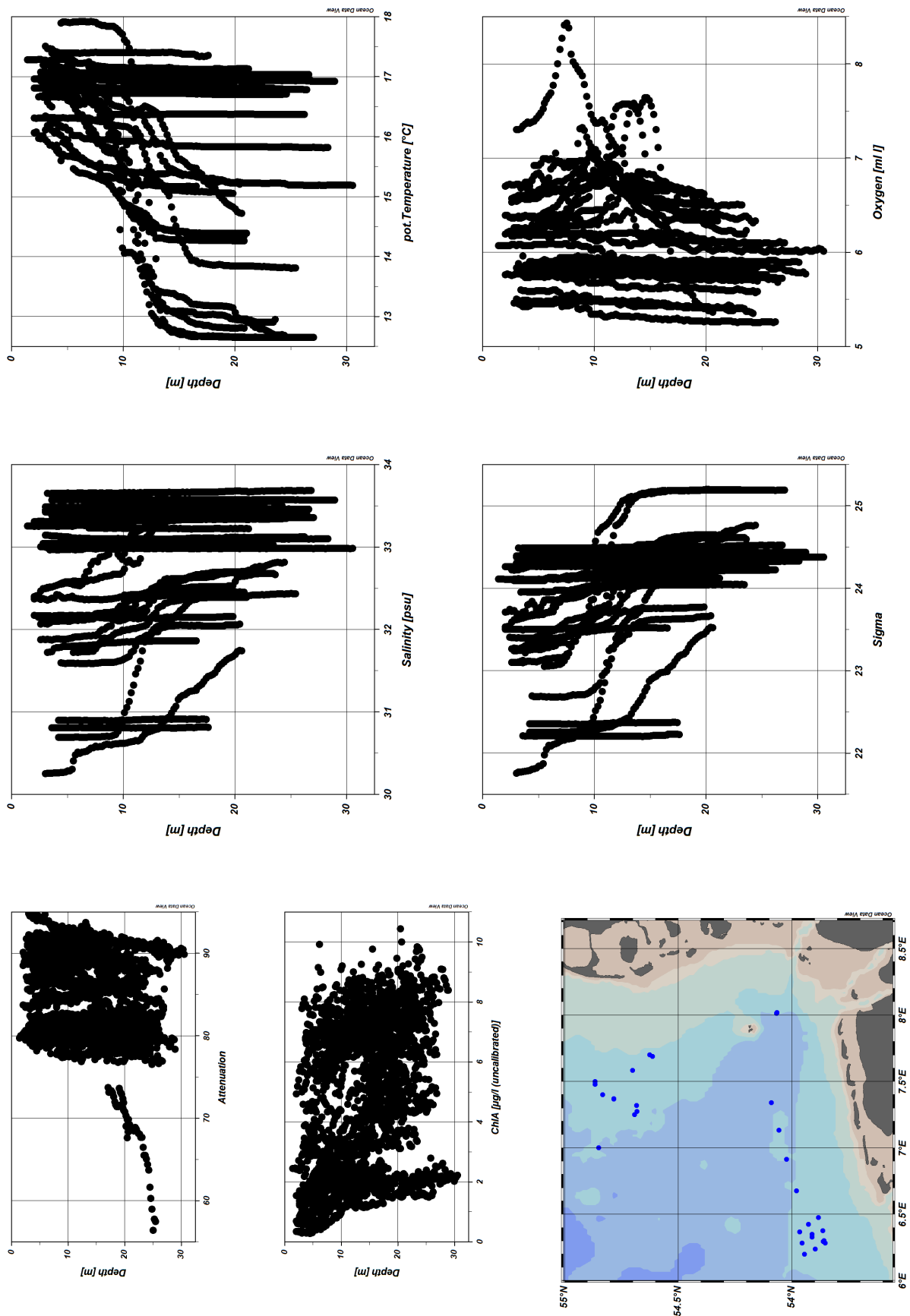


Figure 4: ODV Screenshot of HE602 CTD data
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