## REVISION NOTICE TABLE

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| DATE | DESCRIPTION OF REVISION |
|  |  |

## PROCESSING NOTES

Cruise: 2021-076

Agency: OSD

Location: Quatsino Sound

Project: Quatsino Sound

Chief Scientist: Clarke C.

Platform: John P. Tully

Date: 11 October 2021 – 15 October 2021

Processed by: Germaine Gatien

Date of Processing: 18 January 2022 – 2 February 2022

Number of original HEX files: 17 Number of processed CTD files: 17

# INSTRUMENT SUMMARY

CTD #0443 was mounted in a rosette and attached were 2 Wetlabs CSTAR transmissometers (1185DR & #1883DG), a SBE 43 DO sensor on the primary pump (#3791), SeaPoint Fluorometer on the secondary pump (#3950), a Biospherical Licor PAR (#4565), a Reference PAR (#20518) and an altimeter (#76341).

Seasave version 7.26.7.121 was used for acquisition.

The data logging computer WP #102.

The deck unit was a Seabird model 11+ #425.

# SUMMARY OF QUALITY AND CONCERNS

The Daily Science Log Book was in excellent order with comments about problems encountered and a detailed list of equipment.

There were 2 WetLabs CStar transmissometers in use during this cruise:

 Channel Transmissometer refers to sensor #1185DR (650nm - red)

 Channel Transmissometer:Green refers to sensor #1883DG (530nm - green)

For comparison with other Institute of Ocean Sciences cruises, note that the transmissometer wavelength is 650nm unless otherwise stated.

The primary conductivity and salinity were very noisy so secondary channels were selected for archiving. The secondary salinity was lower than bottles by about 0.0032psu, but when likely errors due to delayed sample analysis and flushing errors are considered, estimates were that it was likely reading high by about 0.002psu. No recalibration was applied.

Dissolved Oxygen and Pressure were recalibrated based on results from previous cruises.

Channel PAR:Reference was removed because values were extremely low though profiles had a reasonable shape. If a correction factor is discovered in future, corrected data could be added.

# PROCESSING SUMMARY

##### Seasave

This step was completed at sea; the raw data files have extension HEX.

##### Preliminary Steps

The Log Book was obtained.

The cruise summary sheet was completed.

The histories of the pressure sensor, conductivity and dissolved oxygen sensors were checked. Most of the sensors had been used on 7 other cruises since the last factory recalibrations, but one has not yet been processed. See section 13 for details.

The SPAR, pH and PAR sensors were not used on the earlier cruises.

The configuration file was checked. Errors in the parameters for SPAR and PAR were corrected and the file was saved as 2021-076-ctd.xmlcon.

##### Conversion of Full Files from Raw Data

File 2021-076-ctd.xmlcon was used to convert all files.

The file names do not match the log entries. The file names are in order of acquisition and had to be renamed to match the log entries.

The Tau function and the hysteresis function were not selected since there was no deep sampling. Depth was included in the conversion.

A few casts were examined and all expected channels are present. All channels look normal except SPAR, which had values much too low, <0.5uE/m^2/sec, even when PAR is quite high.

##### WILDEDIT

Program WILDEDIT was run to remove spikes from the pressure, depth, conductivity & temperature only in the full cast files (\*.CNV).

Parameters used were: Pass 1 Std Dev = 2 Pass 2 Std Dev = 5 Points per block = 50

The parameter “Keep data within this distance of the mean” was set to 0 so all spikes would be removed.

##### ALIGN DO

A few casts were examined; both temperature channels were noisy during upcasts so the tests were not easy to interpret, but using +2.5s certainly improves the alignment and overall looks like a good choice for both sensors.

ALIGNCTD was run on all casts using +2.5s.

##### CELLTM

The noise in the upcast data makes tests for the best parameters for this routine very difficult to interpret. In the past when upcast data were not so noisy, the default setting of (α = 0.0245, β=9.5) was generally found to be the best choice. A few casts were checked for this cruise and the default setting does improve the data. CELLTM was run using (α = 0.0245, β=9.5) for both the primary and secondary conductivity.

##### DERIVE and Channel Comparisons

Program DERIVE was run on all casts to calculate primary and secondary salinity and dissolved oxygen concentration.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Cast # | Press | T1-T0  | C1-C0 | S1-S0 | Descent Rate |
| 2021-020-0037 | 320 | -0.0002 | ~ | +0.0002 | High, F.Steady |
| 2021-020-0082 | 350 | +0.0001 | +0.00017 | +0.0015 |  |
| 2021-020-0117 | 375 | +0.0004 | +0.00022 | +0.0021 | High, Noisy |
| 2021-006-0020 | 375 | +0.0004 | +0.00044 | +0.0043 | High, Noisy |
|  | 1200 | +0.0002 | +0.00042 | +0.0050 | “ |
| 2021-006-0039 | 1200 | 0 | +0.00042 | +0.0049 | High, XNoisy |
| “ | 2000 | -0.0002 | +0.00044 | +0.0055 | “ |
| “ | 3000 | -0.0003 | +0.00044 | +0.0057 | “ |
| 2021-005-0099 | 1000 | -0.0002 | +0.00050 | +0.0058 | High, Noisy |
|  | 1900 | -0.0004 | +0.00050 | +0.0064 | High, V. Noisy |
| 2021-005-0140 | 1000 | -0.0002 | +0.00055 | +0.0065 | High, Noisy |
|  | 1900 | -0.0005 | +0.00055 | +0.0072 | F. High, NOisy |
| 2021-069-0009 | 500 | +0.0002 | +0.00040 | +0.0044 | High, Noisy |
|  | 900 | -0.0001 | +0.00040 | +0.0048 | “ |
|  | 1850 | -0.0004 | +0.00041 | +0.0054 | “ |
| 2021-008-0046 | 1000 | 0 | +0.00051 | +0.0060 | High, Noisy |
|  | 2000 | -0.0004 | +.000051 | +0.0067 | “ |
|  | 3000 | -0.0005 | +0.00053 | +0.0069 | “ |
| 2021-008-0063 | 1000 | -0.0004 | +0.00046 | +0.0059 | High, Moderate |
|  | 2000 | -0.0006 | +0.00048 | +0.0063 | “ |
|  | 3000 | -0.0007 | +0.00049 | +0.0068 | “ |
| 2021-008-0077 | 1000 | -0.0003 | +0.00043 | +0.0055 | High, Noisy |
|  | 2000 | -0.0007 | +0.00043 | +0.0060 | “ |
|  | 3000 | -0.0008 | +0.00045 | +0.0063 | “ |
|  | 4000 | -0.0009 | +0.00047 | +0.0065 | “ |
| 2021-012-0046 | 1000 | -0.0004 | +0.00035 | +0.0044 | High, Moderate |
|  | 1800 | -0.0003 | +0.00035 | +0.0048 | “ |
| 2021-012-0127 | 1000 | -0.0003 | +0.00033 | +0.0042 | High, Moderate |
|  | 2000 | -0.0006 | +0.00034 | +0.0048 | “ |
| 2021-012-0156 | 1000 | -0.0004 | +0.00032 | +0.0042 | High, V.Noisy |
|  | 2000 | -0.0007 | +0.00032 | +0.0047 | “ |
| 2021-073-0018 | 180 | -0.0006 | +0.00035 | +0.0042 | High, Steady |

There were no deep casts, but differences from about 180db were in line with other recent observations.

##### Conversion to IOS Header Format

The IOSSHELL routine was used to convert SEA-Bird 911+ CNV files to IOS Headers.

CLEAN was run to add event numbers and to replace pad values in the pressure channel with interpolated values based on record number.

##### Checking Headers

* The cross-reference check and header check were run. The second instance of station IVI05 (noted in the log as not being in the same place as the first) was changed to IVI01.
* The station names as used at sea have been used somewhat randomly in the past. However, this visit is part of a new program involving many repeat visits, so new channels names were chosen by L. Bianucci and the headers were changed later in processing.
* Surface check was run and the average surface value was 3.2db. This is a little high and during 2021-069 it was found that pressure was high by ~0.8db. A correction will be applied later to subtract 0.8db, so the average will be +2.4db.
* Cruise tracks were plotted and added to the end of this report.
* The altimeter and water depth readings from the headers of the CLN files were exported to a spreadsheet. A check value was calculated by subtracting water depth from maximum depth sampled plus altimetry header.) The value was reduced by 2 to allow for the fact that depths are believed to be too high by 0.8db and that altimetry is averaged over the bottom 2m so are likely too high by an average of 1m. There were 3 casts where that number was <-5m. When water depths were checked against log records those 3 were significantly different. Most likely the depth was recorded before the beginning of the cast and possibly before the ship had fully stopped and/or there was significant variability in the bottom depths during the cast. The header files were adjusted to match the log entries. Another cast had a 2m difference between log and header so it was adjusted as well even though the Check Value was low either way. After those corrections all Check Values were ≤3m.

##### Shift

Fluorescence

SHIFT was run on the SeaPoint fluorescence channel in all casts using the usual advance of +24 records. Plots show that the fluorescence offset is reasonably close to the temperature offset after this step.

pH

Tests were run on a few casts to see which setting brought pH and temperature offsets into good alignment and an advance of +30 records looked best. SHIFT was run on all casts to apply +30 records.

Dissolved Oxygen

The Dissolved Oxygen voltage channel was aligned earlier. A few casts were checked to see if the alignment looked ok, and it did. No further alignment is needed for the DO concentration channel.

Conductivity

Tests were run on a few casts to assess what settings are best to align conductivity with temperature (as judged by the effect on salinity as seen in T-S space). The settings chosen for 2021-012 were -0.5 records for the primary conductivity and -1.1 records for the secondary; those worked well for this cruise as well.

SHIFT was run twice on all SBE911 casts using -0.5 records for the primary and -1.1 for the secondary. Salinity was recalculated for both channels.

##### DELETE

The following DELETE parameters were used:

Surface Record Removal: Last Press Min

Maximum Surface Pressure (relative): 10.00

Surface Pressure Tolerance: 1.0 Pressure filtered over 15 points

Swells deleted. Warning message if pressure difference of 2.00

Drop rates < 0.30m/s (calculated over 11 points) will be deleted.

Drop rate applies in the range: 10db to 10db less than the maximum pressure

Sample interval = 0.042 seconds. (taken from header)

COMMENTS ON WARNINGS: There were no warnings.

##### Other Comparisons

Experience with these sensors since last factory service –

The pressure, temperature, and conductivity sensors were used during 5 cruises since the last factory visit:

* 2021-020 – The salinity channels started out close and gradually drifted apart. Based on information from the Line P section of cruise 2021-006 it appeared that the primary salinity did not drift much during this cruise. The drift in secondary salinity appears to have been fairly sudden and then settled down. Dissolved oxygen was recalibrated using slope/offset =1.0515/-0.0131 based on cruise 2021-006. This correction seemed high since it was first use since previous factory calibration. Pressure looked ok. No TSG.
* 2021-006 Dissolved oxygen recal slope/offset = O 1.0515/-0.0131; Primary very close to bottles selected for archive; secondary high by 0.006psu.
* 2021-005 Dissolved oxygen recal slope/offset = 1.0536/-0.0018; Primary sal high by about 0 to 0.001psu, selected for archive; secondary high by 0.005 to 0.006psu. TSG salinity low by 0.191; intake temp high by 0.02C degrees – no recal applied.
* 2021-069 Poor info for recal of DO and SAL. Used 2021-005 correction for dissolved oxygen and salinity. Primary T/S selected for archive. Pressure corrected by adding 0.8db.
* 2021-008 Salinity channels lower than bottles by 0.012psu and 0.0055psu. Estimate of errors in bottles ~0.005psu, so estimate primary low by 0.007 and secondary low by 0.0005psu. Secondary was selected for archive and was not recalibrated.
* 2021-012 - Salinity channels lower than bottles by 0.0077psu and 0.0032psu. Estimate of errors affecting the comparison are ~0.005psu so the secondary is estimated to be high by ~0.002psu. Secondary was selected for archive; it was considered to be high by ~0.002psu and was not recalibrated. Pressure was corrected by adding 0.8db. Dissolved oxygen was recalibrated: slope/offset=1.0465/0.0012.
* 2021-022 – Not yet processed.

Historic ranges – Profile plots were made with 3-standard deviation climatology ranges of T and S superimposed. Temperature and salinity data fell within the local climatology for the 1 cast for which it was available.

Post-Cruise Calibration – None available.

Repeat Casts – There were no repeat casts.

##### DETAILED EDITING

The secondary T and S were selected for archiving for cruises 2021-008 and 2021-012 because the primary salinity was noisy and the further from bottles than the secondary. The secondary look slightly better for this cruise as well so the secondary channels were selected for editing.

All DEL files were copied to \*.EDT.

CTDEDIT was used to remove records that appear to be corrupted by shed wakes. Salinity was cleaned to remove spikes that appear to be due to small misalignment or instrumental noise. All files required some editing. Notes about editing applied were added to the files.

After editing, T-S plots were examined for all casts. There are some small unstable features near the surface, but these could be real so no further editing was applied.

After this step station names were changed for most files based on discussions with L. Bianucci.

##### Corrections to Pressure, Salinity and Dissolved Oxygen Concentration

Pressure was found to be high by 0.8db during 2021-069 when many surface values were available.

All 2021 cruises were affected by delayed analysis of salinity samples and to a variable degree by incomplete flushing of bottles. This made estimation of errors in the salinity calibration difficult. The choices made for 2021-012 were applied to this cruise. The dissolved oxygen calibration varied little between 2021-008 and 2021-012 and the latter was selected for recalibration of the 2021-076 data.

File 2021-076-recal.ccf was prepared to subtract 0.8db from the pressure and to apply the following correction to channel Oxygen:Dissolved:

CTD DO Corrected = CTD DO \* 1.0465 + 0.0012

CALIBRATE was then run on the EDT files.

##### Fluorescence Processing

A median filter, size 11, was applied to the fluorescence channel in the COR1 files. Plots of a few casts showed that the filter was effective. (Output:\*.FIL)

##### BIN AVERAGE of CTD files

The following Bin Average values were applied to the FIL files (output AVG):

Bin channel = pressure Averaging interval = 1.000 Minimum bin value = .000

Average value will be used. Interpolated values are NOT used for empty bins.

On-screen T-S plots were examined.

Profile plots were examined. No problems were noted.

##### Final CTD File Steps (REMOVE and HEADEDIT)

A comparison of PAR:Reference versus PAR at 3m was done to confirm that the Reference PAR data were was not usable. The PAR at 3m read about 700 times the Reference PAR. We expect the Reference PAR to be higher than PAR at 3m. See file 2021-076-ReferencePAR-study.xlsx.

A second SBE DO channel (with umol/kg units) was added.

REORDER was run to get the two DO channels together.

For all casts REMOVE was run to remove the following channels:

Scan\_Number, Temperature:Primary, Conductivity:Primary, Oxygen:Voltage:SBE, Descent\_Rate, Status:Pump, Altimeter, Salinity:T0:C0 and Flag and SPAR.

(NOTE: If a correction becomes available for SPAR channel, then return to files with REO extension and apply programs CALIBRATE, REMOVE and HEADER EDIT.)

HEADER EDIT was used to fix formats and channel names and to add the comments about processing.

The Standards Check routine was run and no problems were found.

The Header Check was run; no problems were found.

Profile and T-S plots were examined. No problems were found.

The sensor history was updated.

##### Dissolved Oxygen Study

As a final check of dissolved oxygen data, % saturation was calculated and plotted. Values at 2 to 3m ranged between ~65% to 99.5%. The lowest values were in the inlets with events #8 at 99.5% and #9 at 96.5% . Low values are common in inlets. There is no evidence of a problem with the DO calibration.

PARTICULARS

19. Station not at same location as event 16 which has same station name. (Changed in processing.)

**2021-076**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **CTD#** | **Make** | **Model** | **Serial#** | **Used with Rosette?** | **CTD Calibration Sheet Competed?** |
| **1** | **SEABIRD** | **911+** | **0443** | **Yes** | **Yes** |
| **Calibration Information - 0506** |
| **Sensor** | **Pre-Cruise** | **Post Cruise** |
| **Name** | **S/N** | **Date** | **Location** | **Date** | **Location** |
| **Temperature** | **4700** | **12Dec2020** | **Factory** |  |  |
| **Conductivity** | **3531** | **06Jan2021** | **Factory** |  |  |
| **Secondary Temp.** | **4888** | **12Dec2020** | **Factory** |  |  |
| **Secondary Cond.** | **4513** | **18Dec2020** | **Factory** |  |  |
| **Transmissometer** | **1185DR** | **28Apr2021** | **Factory** |  |  |
| **Transmissometer** | **1883DG** | **28Apr2021** | **Factory** |  |  |
| **SBE 43 DO sensor** | **3791** | **22Dec2020** | **Factory** |  |  |
| **PAR sensor** | **70613** | **24Feb2021** | **Factory** |  |  |
| **SPAR** | **4565** | **24Feb2021** | **Factory** |  |  |
| **SBE pH** | **691** |  |  |  |  |
| **SeaPoint Fluor.** | **3950** |  |  |  |  |
| **Pressure Sensor** | **0443** | **07Jan2021** | **Factory** |  |  |
| **Valeport Altimeter** | **76341** | **10Feb2021** | **Factory** |  |  |



