## REVISION NOTICE TABLE

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| DATE | DESCRIPTION OF REVISION |
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## PROCESSING NOTES

Cruise: 2023-023

Agency: IOS, Ocean Sciences Division, Sidney BC

Chief Scientist: Young K. Platform: Neocaligus

Location: Strait of Georgia Project: Strait of Georgia Plankton

Date: 22 July 2023 –26 July 2023

Processed by: Germaine Gatien

Date of Processing: 6 October 2023 – 8 November 2023

Number of original HEX files: 31 (including 2 empty & 3 files from Chito casts)

Number of CTD files: 26 Number of BOT files: 15

##### INSTRUMENT SUMMARY

A SeaBird Model SBE-25 CTD (s/n 1255) was used with temperature sensor #6448, conductivity sensor #6147, Wetlabs ECO Fluorometer #8046, dissolved oxygen sensor #4378, PAR/Logarithmic Satlantic sensor #2274 and pressure sensor #1255. A 1.7 L Niskin bottle was attached approximately 1m above the CTD for deep sampling at 5 sites.

# SUMMARY OF QUALITY AND CONCERNS

There was a digital log with positions and notes about sampling and a digital sampling log. Header information was entered in the raw files in a format that enabled easy conversion into IOS Header format.

CTD casts were run at 28 sites but data acquisition failed for casts #20 and 41. There were 3 sites which also had a separate CTD cast to enable Chito sampling. The Chito casts were not prepared for the archive due to frequent stops during downcasts, but salinity samples taken at the bottom of those casts are included in the bottle files for those sites. There was a regular CTD cast at each of the Chito sites.

While all activities were given separate event numbers in the log, the files prepared for the archive will contain only 1 BOT file per site with the event number matching the associated regular CTD cast.

There was a soak at 10m followed by a return to the surface before the full cast was run. Stops at the surface were quiet short; longer stops would help near-surface waters to settle. A 30s wait is recommended. Note that that the return to the surface after the soak was accidentally missed for cast #13 and data above 11m were removed from that cast due to poor quality.

Surface bottles were fired at 15 sites, near the beginning of CTD casts with chlorophyll, nutrients and HPLC sampling. During 5 CTD casts including the 3 Chito casts salinity and nutrient samples were taken at the bottom of the cast using a Niskin mounted ~1m above the CTD.

Bottle samples were available for comparison with CTD salinity and fluorescence. There were 5 deep salinity samples; the CTD salinity was higher than bottles by a median of ~0.003psu with standard deviation ~0.003psu. Deep Niskin bottles likely contained slightly fresher water due to incomplete flushing, and sampling was limited, but accuracy appears to be good, probably within ±0.005psu.

The CTD Salinity had occasional multi-record spikes in salinity, mostly in deeper water. Program WILDEDIT removed or reduced the spikes, but some remained. Since the local gradients were fairly low and the affected area <1m, the data were cleaned by interpolation.

All extracted chlorophyll samples came from the surface. The fluorescence readings are somewhat lower than usual compared to CHL. However, the pattern is typical of fluorometers in having the ratio FLUOR/CHL being highest for low CHL and gradually falling as CHL increases. This is a new fluorometer so there is no history available on its performance.

The dissolved oxygen profiles have more small-scale features than usually seen. This is a new instrument and further study of its performance is needed to determine if this is a problem or an improvement. Use on a cruise with some DO sampling is recommended.

# PROCESSING SUMMARY

##### 1. Seasave

This step was completed at sea.

##### 2. Preliminary Steps

A digital daily log was obtained as well as a sampling log.

The cruise summary sheet was completed.

The Satlantic PAR sensor is a new type with parameters presented in an easier way to enter in configuration files than with the older models.

CTD #1255 has not been used on previous cruises.

CTD Deployment method: The CTD was taken down to 10m for soak which lasted for at least 2 minutes. In most cases the CTD was then brought back to the surface and then the full cast was run. As noted in the log there was no return to the surface for cast #13.

Unfortunately the surface waits were generally very short. A wait of at least 30s is recommended so that waters can settle that may be disturbed by raising the CTD to the surface.

The Chito casts include stops for sampling during downcasts, so they will only be used to obtain CTD data to go with the samples. CTD files were prepared from regular casts at the same sites.

It is assumed that surface samples were taken while the CTD was soaking since that is the usual approach for this program.

Times are wrong in the CTD files by about 9 hours. Internal clock times for 7 files were compared with log entries. The differences vary from 9 hours 2 minutes to 9 hours 14 minutes, with most towards the lower end of that range. The variations show no trend with event #, so are likely due to small variations in time differences between log time recording and CTD starting. Adding the median difference, 9.07 hours, is a reasonable estimate.

##### 3. Conversion of Raw Data

The configuration file used at sea was correct. It was saved as 2023-023-ctd.xmlcon and used to convert all HEX files.

Plots were made of a few casts and all expected variables were present and produced reasonable values, but there were spikes in conductivity for a few casts.

Fluorescence dark value is ~0.035ug/L with no values <0.

No steps or reversals were seen in the pressure.

The PAR values look reasonable.

Cast #41 did not convert due to an unexpected end of file. The XML file was examined and it contained no data. This problem was mentioned in the log.

##### 4. WILDEDIT

WILDEDIT was run and greatly reduced the largest conductivity spikes. It did leave some small ones but they may well be real as there were also some in upcasts at similar depths.

##### 5. FILTER

Program FILTER is often used for SBE25 CTDs to apply a low-pass filter with a time constant of 0.5s to pressure and depth. But for these data it did not appear necessary since pressure versus scan number is quite smooth.

Next the temperature and conductivity were examined and the usual approach of applying a cosine filter, size 16, in routine WFILTER did a good job of removing small reversals.

##### 6. ALIGNCTD

In the past it has generally been found best to run ALIGNCTD to advance the DO channel by 2.5s. Tests were run using a range of values to see if that value is best for this sensor. The results are best judged after deriving DO concentration, so tests were run after running DERIVE. Generally we look for the vertical separation between downcast and upcast DO and TEMP to see if they are similar, but the profiles were quite different. At least one cast has a bad upcast. Looking at particular features in downcasts helped somewhat, but the answer is far from clear. An advance of 2.5s looked best overall and has been used often in the past, so it was selected for these data.

ALIGNCTD was run on all casts using an advance of 2.5s.

##### 7. CELLTM

CELLTM was run on all casts using the SeaBird recommended parameters, (α, 1/β) = (0.04, 8).

##### 8. DERIVE

Program DERIVE was run to calculate salinity and dissolved oxygen concentration (tau correction included).

Plots were examined and confirmed that steps 5, 6 and 7 had improved the data, but there remain some unstable features in the T-S curves. Tests were run to see if varying the WFILTER size would remove those features, but it resulted in only small improvements. It is likely that the issue is one that will be improved by changing alignment of T and C that will addressed at the SHIFT step.

At this point the CHITO files were renamed with a leading 9 in the event number to make them easier to handle in IOS SHELL routines.

##### 9. Conversion to IOS Headers

The IOSSHELL routine was used to convert the CNV files to IOS Headers.

Plots were examined to see if there are any cases of fluorescence <0; the only cases found were at the very beginning of casts before the soak period or.in deep water where the values are low and the noise in the signal leads to some negative values.

CLEAN was run to add event numbers and replace pad values in the pressure channel with interpolated values and to replace negative values in fluorescence with pad values.

ADD TIME CHANNELS was used to add 9.07 hours to start times.

##### 10. Checking Headers

Cross-reference listing was run and time were checked against the log. Most times were within 1 minute of the log start times, with the largest difference being 4 minutes. Some variation is expected in the time recorded in the log.

Header Check was run and no negative fluorescence values remain.

Track plots looked ok so were added to the end of this report.

Surface Check was run on the IOS files to find the average pressure when data acquisition began; the average was +0.387db. Checking a few casts the fluorescence bounced between high values and near 0 at 0.4db so this likely is the surface. Upcasts show the CTD likely left the water at about 0.4db as well. So the pressure appears to be reasonably accurate, well within specifications.

##### 11. CLIP

The next step is to remove the data collected during soaks at 10m. Plots were examined to see how many records should be removed from each cast. File clip.csv was prepared with 2 columns containing event # and # of records to removed. CLIP was run and output plots examined until all looked appropriate.

##### 12. SHIFT

Conductivity

Tests were run to see what shift to conductivity made the best improvement to stability in T-S space. A shift of +2.0 records was applied to all casts.

Fluorescence

The fluorometer was not pumped, so a shift in alignment is expected to be small or unnecessary. Profile plots of temperature and fluorescence were examined and there was too little variation to judge alignment. Shift was not run on fluorescence.

Dissolved Oxygen

This channel was aligned earlier, but checks were made by examining plots of temperature and dissolved oxygen. No further adjustment was made.

##### 13. DELETE

DELETE was run on all casts using the following parameters:

Surface Record Removal: Last Press Min. Surface Swell Pressure Tolerance: 1.0

Swells deleted. Warning message if pressure difference of 2.00

Drop rates < 0.3m/s (calculated over 8 points) was deleted from 10db to 10db above the maximum pressure.

Pressure was filtered over 7 records since it was not filtered earlier.

COMMENTS ON WARNINGS: There were no warnings.

##### 14. DETAILED EDITING

All DEL files were copied to \*.EDT so there will be a complete set of files even if some need no editing.

CTDEDIT was used to do some light editing of 21 files, mostly removal of a few records near the top and/or bottom. A few casts required some editing of salinity.

Notes of editing details were made in the headers.

T-S plots were examined after this step. Some small unstable features remain, but that is common in that area and may well be real.

##### 15. Initial Bottle Data Steps

There was no rosette available for this cruise. There were surface bottles fired at 15 sites; they were given separate event numbers from the CTD casts. At 5 of those sites there was also a Niskin mounted ~1m above the CTD to collect near-bottom samples. 3 of the deep samples came from a Chito cast where the CTD stopped during downcasts. The data from the downcasts of CHITO events are not suitable for archiving due to many stops at mid depths, but there were good wait times at the top and bottom of those casts, so those values are useful for preparing bottle files.

BOT files were prepared with the sample data plus CTD gathered at the same site.

The event numbers will be those of the regular CTD cast at the site. The deep bottles fired during CHITO casts will have the event number of the regular CTD cast at the same site.

File 2023-023-bottles\_plus\_CTD\_6linehdr. csv was created and a 6-line header was added based on such files from previous cruises from this program. Analysis data from the QF worksheets were added. Space was included for the addition of CTD data.

CTD data were prepared for addition to the 6-line header file as follows:

* The EDT files were bin-averaged in 0.5db bins.
* THIN was run on the binned files using a list of pressures needed: 1db, 2db, 5db for Chito casts and the maximum pressure sampled for each deep cast – 1db.
* Change units was run on the thinned files to get dissolved oxygen in mass units. The CTD data from those files were exported to file 2023-023-thin.csv.
* That file was edited to select the shallowest value for surface samples, plus 5db for CHITO casts and the appropriate depth for deep sampling at 5 casts (maximum pressure-1db). Many records were removed in this process including those for casts with no sampling.

The remaining data were re-ordered to match the entries in the 6-line header file; they were then copied into that file which was saved as 2023-023-bottles\_plus\_CTD\_6linehdr.csv.

Each of the analysis spreadsheets were examined to see what comments the analysts wanted included in the header file. These were used to create file 2023-002-bot-hdr.txt which will be updated as needed during processing.

Workbook 2023-023-bottle-CTD-comp.xlsx was prepared (using data from the 6-line header file) to do a comparison of CTD and bottle data for salinity and fluorescence.

##### 16. Compare

Salinity Comparison

There were 10 bottle samples, 5 from the surface and 5 near the bottom.

4 of the surface samples were lower than the CTD as expected given depth of samples is generally lower than the minimum depth of CTD data available. The 1 case where the CTD was lower than surface samples was low by only 0.0009psu. The standard deviation in the differences was 0.0865psu.

4 of the deep samples were lower than the CTD salinity and 1 was higher. The median difference was 0.0027psu and the standard deviation was 0.0027psu. Once again the samples are expected to be a little lower due to incomplete flushing of Niskin bottles, but lower vertical gradients generally mean smaller differences. So the CTD appears to be reading well within ±0.005psu.

Fluorescence

The only extracted chlorophyll sampling was at the surface.

Fluorescence values were an average of 63% of CHL values. That is somewhat lower than usually seen since most CHL values were <2ug/L.

However, the pattern was typical of fluorometers with the ratio FL/CHL dropping quite steadily as CHL increased. The ratio FL/CHL was ~0.9 when CHL<1ug/L. For CHL>2 the differences were highly variable with fluorescence ranging from 14% of CHL to 85%. For the lowest case at SC-04 the shallowest CTD data is from 2db so it is possible that the surface water was quite different. Overall, the correspondence is reasonable.

The fluorometer is a new one so we have no history of its performance.

These comparisons suggest that the CTD fluorometer was performing in the general expected manner but with values lower than usually seen.

See 2023-023-bottle-CTD\_comp.xlsx for more detail.

##### 17. Other calibration checks

Sensor History – All sensors were new with no history available.

Historic Ranges – Temperatures were mainly with the historic ranges but there were frequent small excursions towards values above the maximum between 10 and 15db and in deeper water at a few casts to the south including the Gulf Islands and Cowichan Bay. The excursions look real rather than systematic calibration issues. Salinity values were all within the climatology except for station 56 where it was high. It has been noted before that this site often fits the Gulf Islands climatology better than that for southern Strait of Georgia and it would not have looked out of line in that climatology range.

Post-cruise calibrations – None were available.

##### 18 CALIBRATE

No calibration was applied as none appeared necessary.

##### 19. Fluorescence Filter

The fluorescence data did not require filtering.

**20. Bin Average, Remove, Derive DO in mass units, Reorder**

The files were bin averaged using 1db bins.

REMOVE was run to remove Scan\_Number, Oxygen:Voltage, Descent Rate and Flag channels.

Dissolved Oxygen was derived in mass units and that was used to calculate DO saturation. Oxygen:Dissolved:SBE values cannot be confirmed as there was no calibration sampling

for dissolved oxygen. Surface saturation values were between 65% and 118% with all

values that were below 100% coming from the Gulf Islands area (including cast #49).

REORDER was used to get the 2 dissolved oxygen channels together.

##### 21. HEADER EDIT and final checks of CTD files.

Header Edit was used to fix headers, fix formats and to add comments about processing.

A cross-reference listing was produced.

A header check and standards check were run on the CTD files and no errors were found.

The sensor history was updated.

Plots of CTD casts were examined and no problems were found.

##### 2. Final BOT file preparation

Workbook 2023-023-bottles\_plus\_CTD\_6linehdr. csv was converted to IOS Header files.

That file was converted to IOS Header files for each cast.

The time and date are present as channels as these cannot be converted directly into header entries.

CLEAN was run to add START and END time to the headers. The END TIME is identical so the START time so it will be removed later.

CLEAN was also used to enter 0 flags where the flag channels are empty.

There are salinity values <25, so silicate values require correction.

CALIBRATE was run using file 2023-023-recal-SIL.ccf.

NO other recalibration was applied as salinity and pressure look reasonably accurate.

There was no DO calibration sampling so Change Units was not run.

REORDER is not needed as the 2 DO channels are together.

REMOVE was run to remove Date and Time channels.

Header Edit was run to add comments and to remove END TIME since it is the same as START TIME and TIME ZERO.

The final files have extensions BOT.

The standards check was run and no errors were found.

A cross-reference list and header check were run on the BOT files and no problems were found.

Plots were made of all BOT casts. With just 1 or 2 levels these were not very useful.

Finally all data from BOT files were extracted to a spreadsheet and compared to the event log; no problems were found.

PARTICULARS – notes from log

General – Clock on CTD wrong by ~9 hours

Fluorescence looks low.

3. Chito

13. Did not return to surface after 10m soak

18. Chito

20. No data

33. Bottom bottle 75in from CTD

41. No data

45. Chito

**CRUISE SUMMARY**

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| Cruise ID#: 2023-023 |
| Dates: Start: 22 July 2023 End: 26 July 2023 |
| Location: Strait of Georgia Zooplankton |
| Chief Scientist: Young K. |
| **CTD#** | **Make** | **Model** | **Serial#** | **Used with Rosette?** | **CTD Calibration Sheet Competed?** |
| 1 | SEABIRD | 25+ | 1255 | No | Yes |

**CTD CALIBRATION INFORMATION**

**Make/Model/Serial#: SEABIRD/SBE25/0456 Cruise ID#: 2022-003**

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| **Calibration Information** |
| **Sensor** | **Pre-Cruise** | **Post Cruise** |
| **Name** | **S/N** | **Date** | **Location** | **Date** | **Location** |
| **Temperature** | **6448** | **4Feb2023** | **Factory** |  |  |
| **Conductivity** | **6147** | **18Jan2023** | **Factory** |  |  |
| **ECO Fluorometer** | **8046** | **21Apr2023** | **Factory** |  |  |
| **SBE43 Oxygen** | **4378** | **28Mar2023** | **Factory** |  |  |
| **PAR/Satlantic** | **2274** | **25Jan2023** | **Factory** |  |  |
| **Pressure****D:\Te****lewo****rk\2022-0** **28\Process****ing\ios\** | **1255** | **13Feb2023** | **Factory** |  |  |

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