## REVISION NOTICE TABLE

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| DATE | DESCRIPTION OF REVISION |
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## PROCESSING NOTES

Cruise: 2023-002

Agency: IOS, Ocean Sciences Division, Sidney BC

Chief Scientist: Young K. Platform: Neocaligus

Location: Strait of Georgia Project: Strait of Georgia Zooplankton

Date: 16 February 2023 –21 February 2023

Processed by: Germaine Gatien

Date of Processing: 8 June 2023 – 14 June 2023

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

Number of CTD files: 28 Number of BOT files: 15

##### INSTRUMENT SUMMARY

A SeaBird Model SBE-25 CTD (s/n 0456) was used with temperature sensor #6566, conductivity sensor #5046, Wetlabs ECO Fluorometer #2216, dissolved oxygen sensor #3779, PAR sensor (4565) and pressure sensor #0464.

# 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; 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; there is a regular CTD cast at each of those sites.

Surface bottles were fired at 15 sites, sometimes right after the CTD cast and sometimes while the CTD was soaking. During 3 regular CTD casts and 1 Chito CTD cast salinity and nutrient samples were taken at the bottom of the cast using a Niskin mounted 4m above the CTD. For comparison purposes, CTD data were extracted from the Chito cast for the one case where a deep bottle was fired during a Chito cast.

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 CTD cast.

Some waits after the 10m soak period were too short to allow near-surface waters to settle. This is likely due to following the usual deployment scheme too strictly, as sometimes the CTD doesn’t get back to the surface as quickly as planned. A 30s wait is recommended; one wait was only 6s..The process of removing soak data always requires some fine-tuning, so there is no need to make the timing exact.

Bottle samples were available for comparison with CTD salinity and fluorescence. There were 4 deep salinity samples; for 3 of them the CTD salinity was lower than bottles by 0.003psu to 0.005psu, while the CTD was much higher for the 4th. This is insufficient evidence to justify recalibration, but suggests that the CTD may be reading slightly low.

All extracted chlorophyll samples came from the surface. The relationship between CHL and fluorescence looked typical of this type of fluorometer, values being close when CHL values were ~1ug/L and fluorescence reading about 50% of CHL when CHL = 5ug/L.

A +0.7db offset was applied to pressure in the configuration file, based on a trial conversion with 0 offset.

The chief scientist noted and fixed the date and time in the CTD after the first cast. Time in the first cast was corrected in processing.

# 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.

A few casts had non-standard names (missed 0s). Those names were fixed.

CTD Deployment method: Timer set to 2 minutes. CTD down to 10m for soak until 1m 30s mark, bought back to surface to sit until 2 minutes are up. Then full cast begins.

There is one flaw in this method if it is followed strictly. If for some reason the CTD is not raised until after the 90s mark, the surface wait is cut short. So operators should feel free to wait a little longer after the timer sounds. All waits at 10db were at least 60s which is good, but one wait at the surface was only 6s.

Deep samples were taken during CHITO casts; those casts will be used to obtain CTD data to go with the samples, but no CTD files are needed since there

Surface samples were taken after the CTD cast or while the CTD was soaking.

##### 3. Conversion of Raw Data

The configuration file used at sea was correct. It was saved as 2023-002-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.

Fluorescence dark value is ~0.4ug/L with no values <0; while a little high for deep water, this is not unusual in the Strait of Georgia. The pressure has steps but no reversals were noted.

##### 4. WILDEDIT

The only spikes noted in the data occurred at the beginning or end of the casts or included many points, and will be removed in the normal course of editing. So WILDEDIT was not run.

##### 5. FILTER

Normally pressure is filtered later in processing when running DELETE, but the poor resolution of this sensor means it is necessary to do this early to make sense of the other data which update more often than pressure. So program FILTER was used to apply a low-pass filter with a time constant of 0.5s to pressure and depth. The results were excellent.

Next the temperature and conductivity were examined and the usual approach of applying a cosine filter, size 8, in routine WFILTER did a good job of removing small reversals.

Running WFILTER without the previous pressure filter did not produce as good results.

##### 6. ALIGNCTD

Based on tests run for other cruises in this project using the same DO sensor, ALIGNCTD was run on all casts to advance the DO channel by 2.5s. Plots were examined after this step and the results look good, though the profiles of T and DO were extremely complex; given the slow response of the DO sensor this test is difficult to interpret.

##### 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.

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.

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

##### 10. Checking Headers

A cross-reference list was produced and the first cast did not have the hemisphere entered; that was corrected in the CNV file and reconverted and put through CLEAN; no further problems were found.

The date was also wrong in the first cast; it was corrected at sea after that cast. The file header was corrected for file #1.

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

Surface Check was run and the average was -0.066db, but PAR and fluorescence values do not look like the CTD was in water until about -0.3db to 0db. The sensors are only considered good to ±1db with resolution of 0.15db. But the readings are consistent through all casts and upcast readings are similar.

So adding 0.7db looks like a reasonable correction.

This change was made by changing the pressure offset to 0.7 in the configuration file and all steps were repeated. Surface check was rerun and the average was 0.03db.

HEADER CHECK was run. No problems were found.

##### 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 +0.4 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 5 points) was deleted from 10db to 10db above the maximum pressure.

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 23 files, mostly removal of a few records near the top and/or bottom and light editing of salinity.

Notes of editing details were made in the headers.

T-S plots were examined after this step. Some unstable features remain, mostly in the Gulf Islands area, 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 4 of those sites there was also a Niskin mounted 4m above the CTD to collect near-bottom samples. 1 of the deep samples came from a Chito cast where the CTD stopped during downcasts.

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

The event numbers will be those of the CTD cast at the site.

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.

File 2023-002-bottles\_plus\_CTD\_6linehdr. csv was created. A 6-line header was added and analysis data from the QF worksheets were added. Space was included for the addition of CTD data.

CTD data were bin-averaged in 0.5m bins. Data were then extracted from 1db or the shallowest data available below 1db. Another run was made to capture deep data from 4m above the maximum sampling level for the 4 casts with deep bottles. These exports included start time which was divided into Date and Time columns.

Workbook 2012-002-bottle-CTD-comp.xlsx was prepared to do a comparison of CTD and bottle data for salinity and fluorescence.

##### 16. Compare

Fluorescence

The only extracted chlorophyll sampling was at the surface. The comparison of the CTD fluorescence and extracted chlorophyll samples had a ratio FL/CHL which drops quite steadily as CHL decreases, with FL/CHL ~2.2 when CHL ~0.5ug/L and ~0.4 for CHL ~5ug/L. Only 1 CHL sample was >1.3ug/L, but this relationship looks typical for fluorometers.

These comparisons suggest that the CTD fluorometer was performing in the expected manner.

See 2023-002-CTD-bottle-comparison.xlsx for more detail.

Salinity Comparison

There were 8 bottle samples, 4 from the surface and 4 near the bottom.

The surface samples were all higher than the CTD except for cast #36 when the sample was much lower. There was a lot of time between the bottle sampling and surface CTD data. Upcast CTD data would be better for the comparison except those data are very noisy.

For comparison of the deep samples salinity values were found in CTD files about 4db above the maximum pressure sampled. The CTD read lower than 3 of the deep samples by 0.003, 0.005 and 0.003psu. In each of those casts the CTD dropped by at least a metre during the stop at the bottom so the bottle may have water from a little deeper than the level from which the comparison CTD salinity data were taken. This could partly account for the CTD reading lower than bottles. We often see CTD salinity reading higher than bottom samples due to poor flushing of bottles or lower due to evaporation of samples. With the motion observed at the bottom the flushing may have been better than usual and little evaporation is expected since the sample analysis was prompt, so those errors are likely small.

The sample from event #36 shows the CTD reading higher than the CTD by 0.03psu. The profile shows that the CTD rose during the stop at the bottom and salinity was very noisy, so this would account for the CTD reading higher than the bottle.

There are too few bottles to determine if there was calibration drift, but it does look like the bottles and CTD are in reasonable agreement, though the CTD may be reading a little low.

##### 17. Other calibration checks

Sensor History – The pressure sensor had not been used since it was last serviced. The temperature, conductivity and dissolved oxygen sensors have not been used before.

Historic Ranges – All salinity data were within the historic ranges. Temperature was either lower than the climatology minimum or showed a local minimum temperature between about 100 and 250m at casts north of GEO1 except on the western side of Texada Island. Station 51 had temperature below the historic minimum near the bottom, but if compared with the Gulf Islands climatology rather than Southern Strait of Georgia, it falls well within the climatology. This has been noted before for this site. These excursions from the climatology look more like real conditions rather than the result of calibration drift.

Post-cruise calibrations – None were available.

##### 18 CALIBRATE

Pressure was adjusted at the conversion stage.

Recalibration will not be applied to salinity as there are too few samples and 3 of 4 suggest salinity is within ±0.005psu.

There was no dissolved oxygen calibration sampling.

No calibration was applied.

##### 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. Plots of near-surface saturation show a range of 74% to 90%, The only areas with values <80% were Station IS-2 and those in the Gulf Island region. These values are low, but all casts are well-mixed in temperature, fluorescence and dissolved oxygen. There was no dissolved oxygen sampling. It is likely that the DO values are a little low but not by 10 to 25%.

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; there are instabilities in the casts at stations 59 and SC-04, but these are areas of active mixing where such features are common. No other problems were found.

##### 2. Final BOT file preparation

Workbook 2023-002-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.

The date and time were corrected in file 2023-002-0001.ios for both records. There was a problem with the clock that was corrected at sea after this cast.

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 no salinity values <25, so silicate values do not require correction.

Change Units was run to get the dissolved oxygen data in mass units.

REORDER was run to get the 2 DO channels 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

1. Niskin 4m above CTD – 3min soak. CTD time off

2. Fixed CTD date/time.

21. Chito cast, but also deep sal sample for BOT file.

40. Surface bottle closed during CTD soak.

**CRUISE SUMMARY**

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| --- | --- | --- | --- | --- | --- |
| Cruise ID#: 2023-002 | | | | | |
| Dates: Start: 16 February 2023 End: 21 February 2023 | | | | | |
| Location: Strait of Georgia Zooplankton | | | | | |
| Chief Scientist: Young K. | | | | | |
| **CTD#** | **Make** | **Model** | **Serial#** | **Used with Rosette?** | **CTD Calibration Sheet Competed?** | |
| 1 | SEABIRD | 25 | 456 | 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** | **6566** | **30Mar2021** | **Factory** |  |  |
| **Conductivity** | **5046** | **30Mar2021** | **Factory** |  |  |
| **ECO Fluorometer** | **2216** | **8Mar2017** | **Factory** |  |  |
| **SBE43 Oxygen** | **3779** | **15Oct2021** | **Factory** |  |  |
| **QSP BiosphericalPAR** | **4565** | **24Feb2021** | **Factory** |  |  |
| **Pressure**    **D:\Te****lewo****rk\2022-0** **28\Process****ing\ios\** | **573** | **4Feb****2022** | **Factory** |  |  |

**Cross-Reference List**





