## REVISION NOTICE TABLE

|  |  |
| --- | --- |
| DATE | DESCRIPTION OF REVISION |
|  |  |
|  |  |

## PROCESSING NOTES

Cruise: 2022-028

Agency: IOS, Ocean Sciences Division, Sidney BC

Chief Scientist: Young K. Platform: Neocaligus

Location: Strait of Georgia Project: Strait of Georgia Zooplankton

Date: 19 May 2022 –23 May 2022

Processed by: Germaine Gatien

Date of Processing: 9 August 2022 – 12 August 2022

Number of original HEX files: 33 (including a lab test and data from Chito casts)

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

##### INSTRUMENT SUMMARY

A SeaBird Model SBE-25 CTD (s/n 0404) was used with temperature sensor #5724, conductivity sensor #1763, Wetlabs ECO Fluorometer #2215, dissolved oxygen sensor #47 and pressure sensor #0464.

# SUMMARY OF QUALITY AND CONCERNS

There was a digital log book 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.

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 about 3m above the CTD to collect near-bottom samples. In the BOT files all sample data are identified by the event number of the corresponding CTD cast. Records below 205db were removed from file 2022-028-0025.ctd due to an apparent flow problem.

Searchable bottle files were prepared by combining bottle sample data with CTD data from as close to the sample depths as possible. A BOT files was prepared for 1 cast that had only HPLC sampling; no HPLC data were available at the time of processing, but they can be added later.

Bottle samples were available for comparison with CTD salinity and fluorescence. The CTD salinity was reading within ±0.005psu of samples taken near the bottom. All extracted chlorophyll samples came from the surface, so there is insufficient evidence to judge how well the CTD fluorometer performed overall, but the relationship between CHL and fluorescence looked typical of this type of fluorometer.

A +0.5db offset was applied to pressure in the configuration file, based on results of a trial conversion with 0 offset and from a study done during processing of cruise 2022-004 which had the same sensor.

# 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.

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. Log notes mentioned occasions when casts started a little before or after the 2-minute mark.

BOTTLES:

1. For casts with bottom sampling a 1.7L Niskin bottle was mounted ~3m above the CTD.

2. Surface sampling was done for each cast after the CTD was taken out of the water and turned off. A 5L Niskin bottle was attached to the wire, sent to the surface and triggered. A separate event number is given for the surface samples.

##### 3. Conversion of Raw Data

The configuration file used at sea was correct. It was saved as 2022-028-ctd.xmlcon and used to convert all HEX files.

During the last use of this sensor the pressure was believed to be reading low by about 0.5db. So plots were examined to see if that was the case for this cruise as well. The surface appears to be at between 0.45db and 0.52db, a value of 0.52db looking definitely “in air”. During cast #44 the CTD was noted to have come out of the water after the initial soak. The minimum pressure recorded was -0.5db

Adding 0.5db looks like a good choice and so this was done to the configuration stage rather than adding it later. File 2022-028-ctd.xmlcon was adjusted by adding 0.5db to the offset.

Conversion was rerun.

Plots were made of a few casts and all expected variables were present and produced reasonable values.

Fluorescence dark value is ~0.1ug/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 and a few reversals.

##### 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.

##### 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 one 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.

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

Surface Check was run and the average was +0.125db with a range from -0.02 to +0.2db.

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 +0.3 records was used during 2022-004, but +0.7 records looks better for these data. That setting 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 22 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 those areas 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 3m above the CTD to collect near-bottom samples.

There were other casts with Chito sampling but no BOT file is being prepared for those casts.

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 2022-028-bot-hdr.txt which will be updated as needed during processing.

* Chlorophyll analysis was obtained in spreadsheet QF 2022-028\_CHL\*.xlsx.
* Salinity analysis was obtained in spreadsheet QF 2022-028\_SAL\*.xlsx.
* Nutrient analysis was obtained in spreadsheet QF2022-028\_NUTS..xlsx.

Note that only HPLC sampling was done at 1 site. At the time of processing HPLC data were not yet available, but BOT files were prepared so that those data can be added later.

Workbook 2022-028-bottles\_plus\_CTD\_6linehdr. csv was created. Data from the QF worksheets were added to one sheet of the workbook. A 6-line header was prepared using entries from the event log relevant to Niskin sampling plus bottle data. Space was included for the addition of CTD data.

There are no CTD data right at the surface, so data from as close to the surface as possible were obtained; this varied from 1.2 to 2.1db. For the bottom samples data were found from ~3db above the maximum sampling pressure before editing. Those data were added to the 6-line header file. This file will also be used to create bottle files, but with final CTD data. (See section 22.)

File 2012-028-bottle-CTD-comparison.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 and was gathered shortly after the CTD cast.

CHL values ranged from 0.63 to 16.22g/L. The CTD fluorescence was ~55% of CHL (median value).

In the plot of ratio FL/CHL vs CHL there were 2 outliers from the usual pattern observed for this type of fluorometer. The fluorescence from event #61 looks lower than expected relative to the sample and that from event #13 looks higher relative to the sample than expected.

The time difference between the CTD reading and the surface sampling ranged from 5 to 21 minutes. A better comparison would come from looking at the CTD fluorescence at the end of the casts, but the CTD data tend to be badly corrupted at that stage, so finding suitable values cannot be automated. Plots were made of the end of casts and values were picked off that were near the surface and where CTD fluorescence appeared to have settled to steady values.

Overall the fit of FL/CHL vs CHL is similar with median ratio FL/CHL changing very little. However, it brought one very large outlier into line with expectations. Based on past experience with these sensors that result is reasonable when most CHL samples were >2ug/L.

The median FL/CHL ratio was 0.51, so not much different than when downcast values were used.

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

See 2022-028-CTD-bottle-comparison.xlsx for more detail.

Salinity Comparison

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

Of the 4 surface bottles, 3 were higher than bottles and 1 was slightly lower. The CTD salinity was higher than the bottle samples by an average of 0.77psu (range of -0.01 to +2.17psu). There is too much variability near the surface to expect good matches given the differences in depth (~1m) and time (11 to 21 minutes).

As was done for fluorescence checks were made of near-surface data from the ends of casts, but the traces were much noisier due to high near-surface salinity gradients and it is not clear when the pump turns off. These comparisons are not useful for assessing calibration.

The deeper samples are more useful due to lower vertical gradients and a certainty that the pump was operating. To see what size errors could possibly be explained by incomplete flushing, the vertical movement of the CTD during the stop at the bottom and the gradient over the 10m above the bottles were examined. During cast #1 the CTD moved upwards by 2m and down again during the stop which would likely enhance flushing. There was little motion during casts #20 and #40 and during cast #56 the CTD drifted downwards by ~1m. Cast #40 had a complex profile but no CTD salinity values were as high as the bottle sample.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Event # | Pressure | CTD Sal | BOT Sal | CTD Sal - BOT Sal | gradient (psu/m) |
| 1 | 383.9 | 30.9378 | 30.9374 | 0.0004 | -0.0007 |
| 20 | 343.0 | 30.6426 | 30.6387 | 0.0039 | 0.0025 |
| 40 | 333.0 | 30.9552 | 30.9607 | -0.0055 | \*0.0001 |
| 56 | 167.0 | 30.3915 | 30.3863 | 0.0052 | 0.0041 |
|  |  |  | median | 0.0022 |  |
|  |  |  | average | 0.0010 |  |

\*The profile was complex just above the bottle firing level.

Negative gradients imply salinity decreasing with depth.

The CTD Salinity read higher than bottles by a median of 0.002 and average of 0.001psu, with a range from reading low by 0.0055 to high by 0.0052psu. Cast #1 looks like the most reliable based on local vertical gradient and sufficient vertical motion to flush the sensor; salinity for that cast was very close to the bottle. Cast #40 looks like it should be close based on local gradient but the CTD salinity is lower by 0.0055psu. Casts #20 and #56 are expected to have CTD salinity slightly higher than bottles due to higher vertical gradients and they do. The only comparison that raises doubts about the calibration is from event #40. There was a lot of variability during that cast but choosing a value from 5m above the bottle would reduce the difference to 0.003psu. However, salinity never got as high as seen in the bottle sample.

##### 17. Other calibration checks

Sensor History – The pressure sensor was used during 2022-004 when it appeared to read low by 0.5db. Conductivity and dissolved oxygen sensors were used on 3 other cruises since last being serviced. There was very little deep calibration sampling but CTD salinity appeared to be reading higher than bottles by 0.008psu and 0.006psu on the 2nd and 3rd of those cruises, but that was possibly the result of in complete flushing of the Niskin bottle.

Historic Ranges – Temperature and salinity data were within the historic ranges for most casts. Temperature was slightly low at station 12 in the northern Strait. Similar conditions were noted during February and March 2022 cruises for this program, but that was in the south-east in the spring. Temperature was slightly high at 2 casts near the surface in the northern Strait. Salinity was low at a few casts near the surface in the northern Strait and at one cast near the Fraser River 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

For pressure an offset was added at the conversion stage and the results look good for pressure and depth.

Salinity appears to be within +/- 0.005psu and is likely closer than that. Recalibration will not be applied.

There was no dissolved oxygen calibration sampling.

No calibration was applied.

##### 19. Fluorescence Filter

The fluorescence data was not filtered as it had little effect on the data.

**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 111%, except for Baynes Sound where it was ~133%. Most values were between 95% and 105% with lower values in the Gulf Island region and one cast north of Texada Island and higher values at some central Strait sites. This spread is typical of this region and offers no calibration guidance.

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 top 40m of cast #61, but this is an area of active mixing where such features are common. No other problems were found.

##### 2. Final BOT file preparation

To enable searching of bottle data, BOT casts were created that contain sample data and CTD data from the downcast at the same site. The file that was prepared previously to enable comparison of CTD and bottle files; it was updated by replacing CTD data with that from the final CTD files.

The event number will match the CTD cast. CTD data were extracted from the CTD files and added to spreadsheet 2022-028-bottles\_plus\_CTD\_6linehdr.csv.

The data were sorted on order of increasing pressure.

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 CALIBRATE was run to correct affected silicate values.

REMOVE was run to remove Date and Time channels.

The final CTD data include DO in mass units.

There was no DO sampling so there is no need to derive mass units for the sample data.

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. (There were messages about empty flag channels but they appear to be due to a problem with the checking routine.)

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. Log indicates samples ~390m but cast did not go that deep.

4/5. Chito sampling

20. Samples ~343db.

23/24. Chito sampling – CTD turned on but doesn’t need processing.

25. Weird upcast – pump clog – also part of downcast affected.

37. Chito sampling

40. Samples at 333m.

44. Came out of water after soak so returned and did another minute at 10m

54. Chito sampling. Did not use sample #40. CTD left on.

55. CTD still on from previous chito event.

56. Samples at ~167m.

**CRUISE SUMMARY**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Cruise ID#: 2022-028 | | | | | |
| Dates: Start: 19 May 2022 End: 23 May 2022 | | | | | |
| Location: Strait of Georgia Zooplankton | | | | | |
| Chief Scientist: Young K. | | | | | |
| **CTD#** | **Make** | **Model** | **Serial#** | **Used with Rosette?** | **CTD Calibration Sheet Competed?** | |
| 1 | SEABIRD | 25 | 404 | No | Yes | |

**CTD CALIBRATION INFORMATION**

**Make/Model/Serial#: SEABIRD/SBE25/0404 Cruise ID#: 2022-003**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Calibration Information** | | | | | |
| **Sensor** | | **Pre-Cruise** | | **Post Cruise** | |
| **Name** | **S/N** | **Date** | **Location** | **Date** | **Location** |
| **Temperature** | **5724** | **5Dec2019** | **Factory** |  |  |
| **Conductivity** | **1763** | **12Dec2019** | **Factory** |  |  |
| **ECO Fluorometer** | **2215** | **27Nov2018** | **Factory** |  |  |
| **SBE43 Oxygen** | **47** | **3Feb2021** | **Factory** |  |  |
| **Press**    **D:\Telework\2022-0** **28\Processing\ios\** | **0573** | **4Feb2022** | **Factory** |  |  |





