## EVISION NOTICE TABLE

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## PROCESSING NOTES

Cruise: 2024-069

Agency: OSD

Location: BC Coast

Project: IOS Moorings

Chief Scientist: Spear D.

Platform: John P. Tully

Date: June 11, 2024 – June 30, 2024

Processed by: Germaine Gatien

Final Processing: 15 April 2025 – 22 May 2025

Number of HEX files: 135 Number of CTD files processed: 135

Number of rosette files: 37 (+1 test) Number of CHE files processed: 36

# INSTRUMENT SUMMARY

CTD #0443 was mounted in a rosette and attached were 2 Wetlabs CSTAR transmissometers (1185DR and 1883DG), a SBE 43 DO sensor on the primary pump (#4372), SeaPoint Fluorometer (#4186) with 3X gain on the secondary pump, WetLabs ECO fluorometer (#2216), a PAR sensor (#70613) and an altimeter (#76341).

No changes were made to equipment during the cruise.

Seasave version 7.26.7.121was used for acquisition.

The data logging Computer was a Lenovo ThinkCentre.

The deck unit was a Seabird model 11+ #508.

A Guildline model 8400B Autosal serial # 73274 was used to analyze salinity samples.

An IOS rosette with 24 10L bottles was used.

A thermosalinograph (SeaBird 21 S/N 3411) was believed to be in use, but data were missing at time of initial processing..

# SUMMARY OF QUALITY AND CONCERNS

The Daily Science Log Book was in good order with many comments on problems or conditions experienced. There was a complete list of CTD equipment. There were no changes during the cruise. There were notes by many log entries to indicate that there was a surface soak rather than a 10m soak, and it is assumed this was true for all casts. This was a deliberate choice in order to sample undisturbed surface water.

This was the 4th cruise studied in a comparison of Seapoint and ECO fluorometers to see if future use of ECO sensors will provide data consistent with older data. The comparisons confirm that the ECO compares well with Seapoint. Both sensors read low at high CHL values, with the ECO tends to be a little closer to CHL The comparison reports are available in the DOC folder.

Bottle sampling from this cruise is not as reliable for calibrating sensors as samples gathered further offshore; this is due to poor flushing of Niskin bottles in inlets and many samples coming from the bottom of casts. Fortunately, the same sensors were used during Line P cruise 2024-006 and the comparisons are close enough to justify applying the 2024-006 results to the 2024-069 data. The comparison of dissolved oxygen sensor data with DO samples has an unusual character, but similar results were found for that sensor during 2024-001 and 2024-006.

Primary channels were selected for most casts, but for event #132 data from the primary channels were bad due to jellyfish. The secondary channels were ok for most of the downcast, so they were selected for archival, though data below 117db were removed.

Similarly, for cast #160, upcast data above 210db had bad primary salinity and dissolved oxygen channels, so secondary channels were chosen for that cast and dissolved oxygen was padded above 210db.

The SBE DO sensor has a fairly long response time so data accuracy is not as high when it is in motion as it is during stops for bottles. This will be especially true when vertical DO gradients are large. To get an estimate of the accuracy of the SBE DO data during downcasts (after recalibration) a rough comparison was made between downcast SBE DO and upcast titrated samples. Some of the difference will be due to problems with flushing of Niskin bottles and/or analysis errors, so the following statement likely underestimates SBE DO accuracy.

Downcast (CTD files) Oxygen:Dissolved:SBE data for this cruise are considered, very roughly, to be:

 ±0.10 mL/L from 0-100db

 ±0.05 mL/L from 100db to 300db

 ±0.03 mL/L below 300db.

For details see files 2024-069-dox-comp3.xls

There were some loop samples taken but no corresponding TSG data were found. The loop data may be found in file 2024-069-surface.loop. If the TSG data are later found, they can be processed and added to the archive.

# PROCESSING SUMMARY

##### Seasave

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

##### Preliminary Steps

* The configuration files used at sea were checked. No errors were found nor changes during the cruise.
* The file was saved as 2024-069-ctd.xmlcon.
* The Log Book and rosette log sheets were obtained. They were in good order.
* Dissolved oxygen, extracted CHL, nutrient and salinity data were obtained in QF spreadsheet format from the analysts.
* The cruise summary sheet was completed.
* The history of the T, C and P sensors was checked and noted in section 14.

##### BOTTLE FILE PREPARATION

The ROS files were created using file 2024-069-ctd.xmlcon.

The ROS files were converted to IOS Header format with extension \*.BOT.

The IOS files were put through CLEAN to create BOT files.

Temperature and salinity were plotted for all BOT files to check for outliers. No editing was found necessary. Near the surface there were larger differences, but no clear spikes. Cast #160 has huge salinity differences from 1 to 210db but this is a malfunction, not something that can be fixed by editing.

The BOT files were bin-averaged on bottle number.

The output was used to create file ADDSAMP.csv. First, the file was sorted on event number and Bottle Position order. Then sample numbers were added based on the rosette logs.

The ADDSAMP file was sorted on sample numbers.

There was no sampling from bottles fired during event #1

The ADDSAMP file was used to add sample numbers to the BOT files – output \*.SAM.

The SAM files were bin-averaged on bottle # and called SAMAVG.

The addsamp.csv file was converted to CST files, which will form the framework for the bottle files.

Next, 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 2024-069-bot-hdr.txt which will be updated as needed during processing. All loop samples were copied to file 2024-069-loops.xlsx and are not included in the following individual csv files.

DISSOLVED OXGYEN

Dissolved oxygen data were provided in spreadsheet QF2024-069\_OXY\*.xlsx which includes flags, comments and a precision study. Draw temperatures are available. The spreadsheet page with the final data was simplified and saved as 2024-069oxy.csv. That file was converted into individual \*.OXY files.

There were 2 samples (82 and 416) in the DO file that had comments starting with “ALL:” and NUTS were drawn from those bottles, so the same flags were added to the NUTS files. CHL and Salinity samples were not drawn from those 2 bottles.

EXTRACTED CHLOROPHYLL

Extracted chlorophyll and phaeo-pigment data were obtained in file QF2024-069\_CHL QF\*.xlsx. The file included comments, flags and a precision study. A simplified version of the spreadsheet (without loop samples) was prepared and saved as 2024-069chl.csv.

The csv file was then converted to individual CHL files.

Loop samples were copied to a separate loop spreadsheet.

NUTRIENTS

The nutrient data were obtained in spreadsheet QF2024-069\_NUTS\*.xlsx. This includes a precision study. The file was simplified, saved as 2024-069nuts.csv. The file was converted to individual NUT files.

SALINITY

Salinity analysis was obtained in file QF2024-069\_SAL.xlsx; there were no duplicates taken. The analyses were carried out at IOS 10-15 days after collection. The files were simplified and saved as 2024-069sal.csv. That file was then converted to individual SAL files. There were no duplicates.

The SAL, CHL, OXY and NUTS data files were merged with CST files in 4 steps.

The files were then put through CLEAN to reduce the headers to File and Comment sections only.

These files are ordered on sample number, but the SAMAVG files are ordered on bottle number, so the MRGCLN1 files were reordered on Bottle\_Number and saved as \*. MRGCLN1s.

The MRGCLN1s files were then merged with SAMAVG files using merge channel Bottle\_Number.

There was no sampling from file #1, so it was dropped from the file list.

The output of the MRG files were exported to a spreadsheet. Flags were missing for nutrient samples #536 which had pad values and comment. The analyst was contacted and provided the missing flags.

The following corrections were later made to the MRG, SAM, SAMAVG and MRGCLN2 files:

* Event 40 – station H1 changed to HG1
* Events 87 – station DO09 changed to DO9

A header check and cross-reference listing were produced. Station names were corrected for casts #123 and 129.

##### Compare

Salinity

Compare was run with pressure as reference channel.

The fit of differences between CTD and bottle salinity were extremely noisy. This is not unexpected with much shallow sampling and the deepest bottles coming from the bottom of casts. The extreme outliers all disappear if cases with standard deviation in the CTD salinity >0.001psu are removed. So either noisy CTD salinity or very high local gradients account for those outliers. This leaves only 36 records from the original 73 records, and many of those are also outliers, albeit less extreme. Many of these are from bottles fired at the bottom, which introduces some bias towards the CTD appearing to read higher than bottles due to incomplete flushing of Niskins.

When matches with pressure <55db, standard deviations in CTD>0.001psu and salinity differences >0.005psu are removed from the fit, there is a flat fit for the primary salinity with the CTD salinity looking high by 0.0025psu (std dev 0.0009psu). There are only 14 points of comparison. The difference at 2000db is about 0.0022psu and a rough estimate of possible error due to incomplete flushing is on the order of 0.0015psu. So the salinity appears to be well within expected accuracy.

For the secondary salinity there are fewer outliers but a little more pressure dependence. The bottles are higher by 0.0017psu (std dev 0.0015psu). There are more bottles in the fit; when the same bottles are picked as for the primary salinity the average difference is +0.0015 (std dev 0.0015psu).

All outliers come from bottoms of casts or areas with high vertical gradient. No quality flag additions are recommended.

The CTD data for Primary Salinity and SBE Dissolved Oxygen for cast #160 above 210db are bad and were padded in the SAMAVG file.

The problem with the primary conductivity sensor only occurs in the upcast of event #160 and the general fit is flatter, so is likely to be the better choice for archiving unless other problems are discovered in processing of the downcasts. This will be clearer after the graphical editing stage.

The bottles fired at 50m were well above bottom; the primary CTD salinity was lower than those bottles by an average of 0.009psu when 2 large outliers were excluded (one high, one low). This is presumed to be due primarily to incomplete flushing of Niskin bottles at a level where local gradients are usually high.

For full details for the COMPARE run see file 2024-069-sal-comp1.xls.

Dissolved Oxygen

COMPARE was run with pressure as the reference channel.

Recent cruises using this CTD including DO sensor #4372 have had anomalous comparisons between CTD and titrated samples with the CTD values reading higher than samples instead of the usual pattern of mostly reading lower.

Some differences are anticipated in inland cruises with poor flushing of Niskin bottles but similar results were found during the spring Line P cruise (2024-006) when flushing is usually good.

Runs were made using pre-cruise and post-cruise calibrations for the dissolved oxygen sensor.

When the pre-cruise calibration was used, the CTD DO generally read higher than bottles by roughly 2% with a fit that is roughly linear.

When the post-cruise calibration was used the results are similar to our expectations of values reading high by about 5%. However, that calibration was run long after this cruise with 4 major cruises between this cruise and the factory visit. This cruise also does not include many casts in waters where flushing is good, so a 5% error seems large, since any flushing errors lead to the CTD DO appearing to read higher than they really are. There is no obvious reason to use the post-cruise calibration at this point, but it should be revisited when processing autumn 2024 cruises using this equipment.

To establish an offset, cases with very low SBE DO values were examined. The minimum difference from the deep cast, #36, was ~ -0.05mL/L when SBE DO was at its minimum value. This is a little lower than found during 2024-006 when it was -0.030mL/L. The intercept is not expected to vary, but given limitations in fits from both cruises, this is reasonably close. The fit for cast #36 when 2 obvious outliers were excluded was:

SBE DO Corrected = 0.980\*SBE DO original + 0.05

A fit was then done using all casts, setting the intercept to -0.05mL/L, and outliers were removed based on high standard deviations in the SBE DO data and then others removed based on residuals. The fit was:

SBE DO Corrected = 0.979\*SBE DO original + 0.05

This is close to the 2024-006 result:

SBE DO Corrected = 0.987\*SBE DO original + 0.03

We expect the 2024-069 to have poorer flushing, so using the 2024-006 result looks like a good choice as there was more deep sampling and open water sampling where Niskin flushing is likely better. Poor flushing would generally lead to the SBE DO looking lower than it really is.

A plot of differences versus file pair number shows considerable variation, with cast #160 looking much lower than the others. The DO trace looks bad above 210db of the upcast of #160; those bottles had been removed as outliers in the fit above. The primary salinity is also bad in that range, but the secondary salinity and both temperature traces look ok.

For full details for the COMPARE run see file 2024-069-dox-comp1.xls.

Outliers in the fits are all associated with large vertical gradients and/or high standard deviations in SBE DO.

Plots of Titrated DO and CTD DO against CTD salinity were examined. The only outliers found were in high vertical gradients, so no quality flags are recommended as the samples are likely fine.

Fluorescence

COMPARE was run with pressure as the reference channel.

Uranine tests in February 2024 found a voltage threshold of 0.001 for the SeaPoint Fluorometer and 0.058 for the ECO.

Tests were done to see how well the ECO and Seapoint fluorometers compared and differences were found to be slight.

First, the dark values were found by examining plots below 300db.

Dark Values: SeaPoint 4186 +0.012ug/L

ECO 2216 +0.03ug/L (rough value)

Making corrections by subtracting those values made little difference in the comparisons. The ECO is closer to CHL samples though still significantly lower than CHL.

No corrections will be applied to either fluorescence channel.

For more details see document 2024-069-fl-chl-comp1.xls.

A report on the comparison between ECO and SEAPOINT fluorometers was prepared based on data from 4 cruises using several sensors of each type. The ECO sensor generally compared well with the Seapoint sensors. Uranine tests are now done regularly which are important for good calibration of the ECO sensors.

At this point the bad primary salinity and SBE dissolved oxygen data were replaced with pad values in file 2024-069-0160.samavg and the merge of samavg and mrgcln1s files was rerun for that cast.

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

All files were converted using 2024-069-ctd.xmlcon.

The Tau function and the hysteresis function were selected since there was at least 1 deep cast. Depth was included in the conversion.

A few casts were examined.

The primary conductivity and dissolved oxygen traces look bad in parts of parts of casts 28, 132 and 160 – mostly in upcasts but for #132 it is both downcast and upcast that are affected. Just a few casts were checked based on notes in the log and observations in bottle comparisons.

There is no SeaPoint fluorometer data in events 1-16 due to a cable not being connected. Data was acquired but all values are 0.

The T and C pairs were close during downcasts but, as usual, further apart during upcasts.

The transmissivity, DO and fluorescence profiles look normal. Altimetry looks good although there are a few spikes at the bottom.

##### 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.

A few spikes noted in conductivity were successfully removed by this step.

##### 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. That setting has worked well for many SBE DO sensors in recent years. 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.

Tests were run to see if the previous steps performed as expected:

* Some spikes noted in conductivity profiles were removed by WILDEDIT.
* The dissolved oxygen upcasts are quite noisy so hard to assess, but the alignment is definitely improved and downcast features are in good agreement with temperature traces, so ALIGNCTD appears to have worked well.
* CELLTM worked as expected, lowering salinity where temperature is decreasing (cell warms water raising conductivity but temperature sensor reading is correct, so salinity is overestimated). Conversely, it raises salinity where temperature is increasing (conductivity too low). This brings downcast and upcast traces closer together, so T-S downcast and upcast plots are in better agreement after this step.

DERIVE was run a second time on a few of the deeper casts to find the differences between the pairs of temperature, conductivity and salinity channels.

The sensors were used during cruise 2024-001 and 2024-006. Differences were found to be small during 2024-006 but values were not available.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Cast # | Press | T1-T0  | C1-C0 | S1-S0 | Descent Rate |
| 2024-001-0030 | 550 | -0.0003 | -0.00038 | -0.0038 | High, V. Steady |
| 2024-001-0050 | 550 | -0.0004 | -0.00033 | -0.0037 | High, F. Steady |
| 2024-001-0074 | 550 | -0.0003 | -0.00032 | -0.0031 | High, F. Steady |
| 2024-069-0025 | 500 | -0.0010 | -0.00014 | -0.0008 | High, Moderate |
|  | 1000 | -0.0006 | -0.00017 | -0.0015 | “ |
|  | 1500 | -0.0003 | -0.00020 | -0.0020 | “ |
|  | 2000 | -0.0001 | -0.00021 | -0.0024 | “ |
| 2024-069-0036 | 500 | -0.0005 | -0.00014 | -0.0011 | High, Moderate |
|  | 1000 | -0.0004 | -0.00016 | -0.0016 | “ |
|  | 1500 | -0.0002 | -0.00017 | -0.0019 | ‘ |
|  | 2000 | +0.0001 | -0.00018 | -0.0023 | ‘ |
| 2024-069-0069 | 500 | -0.0006 | -0.00014 | -0.0011 | High, V. Steady |
| 2024-069-0180 | 500 | -0.0008 | -0.00024 | -0.0018 | High, V. Steady |

Temperature differences are small and decrease with depth; at 500db there is no indication of temporal drift.

Conductivity differences are small and increase with depth; at 500db there is no indication of temporal drift. The conductivity differences are smaller than during 2024-001 though not by much and may be due to different equipment set-up.

Salinity differences are small and increase with depth; at 500db there is a hint of temporal drift, but it is small and the evidence is weak. There were few casts as deep as 500db and they vary greatly in local environments.

The pressure dependence in the salinity differences together with the pressure dependence in the secondary salinity comparison with bottles, suggests that the primary channels are more dependable. Unfortunately, the primary is a little spikier. Most casts are shallow where differences are only about 0.001psu.

##### 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.

There are some negative values in the ECO fluorescence channel; they are very small coming from a jitter in the signal when it is very low. Most will be removed by CLIP, DELETE or BIN AVERAGE. Any that remain will be removed later.

A cross-reference list was produced; station names were compared to those in the log; log entries were substituted where there were differences:

* Event 3 station name changed from E01-63 to E01.
* Event 21 station name missing - added P1
* Event 39 – station MS11B changed to MT11B
* Event 40 – station H1 changed to HG1
* Events 87, 88, 89 – stations DO09, DO08 and DO07 changed to DO9, DO8, DO9.
* Event 157 – station BL5 changed to BL4

The changes for events #40 and 87 were also applied to the SAM, SAMAVG and MRG files

There was no 10m soak. There was generally a wait at about 3m lasting from 1 to 3 minutes, though the pumps were not always on during the whole soak time. In some cases there was a long wait at 1m followed by a short wait at 3m.

This makes choosing an ideal starting point for each cast difficult. Going through so many files to pick the ideal number of scans to remove for each is very time consuming.

A text file was prepared, Clip.csv, with an estimated # of records to remove. This is rough and probably remove too much from some files and not enough from others.

Plots were made to identify cases of too much removed and the CLIP file was adjusted and CLIP rerun.

Editing will have to suffice for cases with too little removed.

##### Pressure, Water Depth and Position checks

* Surface check was run and found an average of 1.4db for downcasts and 2.3 for upcasts.
* A header check was run after CLIP. No problems were noted.
* Deck pressures recorded in the log on 5 occasions ranged from 1db to 1.2db. Those measurements are not always found to be reliable but in this case they match observations in CTD cast #1 in Saanich Inlet and near-surface data in a few other casts.
	+ - At the beginning of cast #1 the transmissivity (red) is consistently 64.2%/m until pressure reaches >1.1db; it then drops to <10%/m then rises to ~15%/m at 2db. Temperatures drop as well around 1.2db. The pumps are off at this point so conductivity does not help. There is no Seapoint fluorometry for this cast. The ECO fluorometry is mostly negative until the pressure reaches ~1.2db. PAR starts dropping at about 1.4db, but given the variability in PAR this is not reliable evidence.
		- At the end of cast #1 the transmissivity drops very suddenly at about 1.2db, has a 0 value at 1.1db then rises to values of ~65% for pressures <1.1db. ECO fluorescence looks normal to about 1.1db after which it bounces between negative numbers and very high values. PAR rises sharply starting at about 2.5db.
		- The very low transmissivity may be associated with a surface slick.
		- During cast #193 transmissivity (red) was about 71%/m until ~1.05db and dropped to 0 at 1.1db. At ~1.3db values look normal for near-surface water.
		- During cast #76 upcast transmissivity went from about 23%/m at 1.1db to near 0 at 0.9db and then rose to values >66%/m above 0.9db.
* Cruise tracks were plotted, looked reasonable and were added to the end of this report.
* Header values for altimetry and water depth were exported to file 2024-069-altimeter-ctd.xlsx. The water depth when the CTD is at the bottom of casts is of more interest than when it is at the surface, especially if there is bottle sampling.

A “check value” was calculated as follows:

Check Value = Absolute Values {(Altimetry header + Max. depth sampled - Water depth in Header}

This value is expected to be close to 0, but in an area with narrow channels and steep slopes larger check values are common. All cases with that value >5m were checked. There were 12 such casts. For 2 casts the CTD did not get within 15m of bottom, so no check is possible. First water depth entries were checked against the log entry for depth; where available, log entries were chosen from the BOT log reading to match the time when the altimetry was measured. For 9 casts, using the log entry produced smaller check values, but for 4 of those the difference was slight, so header depths were left as is. For 5 casts the log entry produced much better results – in one case the header entry was obviously a typo and for another it likely had the entry from the previous cast.

* For casts 186 and 190 the altimetry is confused, the CTD depth varied a lot at the bottom and the check values are not large, so no change was made.
* For cast 160 it is likely there was significant shoaling during the cast; the check value is large, so the water depth was changed from 326m to 344m. The CTD definitely got deeper than 326m which was the header and log entry.
* Changes were made to the CLN files and CLIP was rerun for the affected files.
* The same changes were made to bottle files (SAM, SAMAVG, MRG & MRGCLN2) for casts #40 and 160.

##### 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 closer to the temperature offset after this step.

No change was made to the ECO fluorometry since it is not pumped and the alignment looks ok.

Dissolved Oxygen

The Dissolved Oxygen voltage channel was aligned earlier and the results look good. No further alignment will be applied.

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 best setting was -0.8 records for the primary and -0.25 for the secondary.

SHIFT was run twice to apply those settings on all casts. Salinity was recalculated.

##### 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 –

CTD #0443 has been used for many cruises since it was last serviced at the factory. 4 of those cruises have not yet been processed.

* No issues were noted with pressure.
* The dissolved oxygen sensor was used during 7 previous cruises, of which only 2 had dissolved oxygen sampling. For 2024-001 there was only inland sampling; the fit of differences against bottles looked much different from the normal drift, so an estimate of drift was made at that time, but later reversed due to results of 2024-006. For 2024-006 it was found the CTD DO was reading high by about 1.5%.
* The primary conductivity sensor has been used for many cruises with variable comparison but all within ±0.002psu. At the factory check in Dec. 2024 it was within 0.001psu.
* The secondary conductivity sensor has been used for 3 previous cruises with the only comparison available showing it to be within ±0.002psu and the factory check before service in Dec. 2024 suggests salinity was very slightly low.

Historic ranges –Profile plots were made with 3-standard deviation climatology ranges of T and S superimposed where local climatology was available. There were many excursions (mostly towards high temperature and low salinity) from the climatology in areas close to shore, but that is expected as those areas are likely not well represented in the climatology. In the deeper sections there were only a few minor excursions near the bottom with slightly low salinity and high temperature, as have been observed in recent years. In one case the profile went much deeper than the climatology. There is no evidence of systematic differences suggesting calibration problems.

Post-Cruise Calibration – Factory checks were available for conductivity from December 2024 and conductivity from November 2024. There were significant errors in dissolved oxygen (reading high by roughly 5%) while salinity values looked to be within 0.002psu.

##### DETAILED EDITING

The decision on which channel pair to choose for archival is not clear. There was clearly a problem for casts #103 to 105 with some contamination leading to noisy conductivity; there was a sudden change in the secondary near the bottom of #104. One cast bad primary conductivity (#132) and several others have problems in the secondary channel. The deciding factor is the pressure dependence in the secondary channel. So the primary channels were chosen for most casts, but the secondary must be chosen for cast #132.

The DEL files were zipped and submitted to the QC CTD program. Cast #90 failed to run because it contained no data. The CLIP, SHIFT and DELETE routines were rerun on that cast and it was then run through the QC CTD program again.

The DEL files were copied to \*.EDT to ensure there would be a complete set of EDT files whether they needed editing or not.

CTDEDIT was used to remove records that appear to be corrupted by shed wakes and to clean salinity where small spikes appear to be due to small misalignment or instrumental noise.

Most casts needed editing at the top and/or bottom of casts.

The following casts required no editing:98, 114, 152, 162, 174, 189, 197.

Notes about editing applied were added to the files.

The edited files were copied to \*.EDT.

After editing T-S plots were examined for all casts. Small unstable features remain in many casts which is expected with many casts being close to shore and/or in areas of tidal mixing and mixing near sills.

The output files were submitted to the QC CTD program.

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

Silicate requires recalibration since there was silicate sampling and salinity was <25psu for some samples.

File 2024-069-recal-sil.ccf was prepared and applied to the MRGCLN2 files.

Comparisons with bottles from this cruise were limited but in reasonable agreement with results from the second part of cruise 2024-006 when the same sensors were used and sampling was from offshore. Pressure, Salinity:T0:C0 and Dissolved Oxygen recalibration will be based on those applied to 2024-006 data. Since the secondary channels were selected for 1 cast, recalibration of Salinity:T1:C1 was based on that applied to Salinity:T0:C0 + 0.0008psu to bring the 2 salinity channels into agreement.

File 2024-069-recal1.ccf was prepared to apply the following corrections:

 Pressure Corrected = Pressure -1.1

SBE DO Corrected = 0.987\*SBE DO original + 0.03

Salinity:T0:C0 Corrected = Salinity:T0:C0 – 0.0015psu

Salinity:T1:C1 Corrected = Salinity:T1:C1 – 0.0008psu

These corrections were first applied to the SAM and MRGCLN2 files.

COMPARE was rerun on salinity and dissolved oxygen and shows that the corrections were applied properly

Pressures were also found to have been corrected appropriately.

Calibrate was then run the EDT files.

*The following information was sent to Jeannette Bedard for entry in the sensor history.*

*Pressure*

*#0443 – high by ~1.1db– subtracted 1.1db.*

*Conductivity*

*#2754 – Based on COMPARE -Salinity- High by 0.0025; limited sampling and likely flushing effects; used 2024-006 result to recalibrate.*

*#1766 – Based on COMPARE -Salinity - Low by 0.0017; limited sampling and likely flushing effect; used 2024-006 result to recalibrate.*

*Oxygen-Dissolved - #4372 – COMPARE fit: DO Corrected = 0.979\*SBE DO original + 0.05; likely flushing effects and close to result of 2024-006; used 2024-006 result to recalibrate.*

##### Final Calibration of DO

The initial recalibration of dissolved oxygen corrects for sensor calibration drift. Alignctd corrects for transit time errors. Those 2 steps may partly correct for response time errors, but to see if a further correction is needed, a comparison is made of downcast CTD data to bottle data from the same pressure. Small differences are expected due to ship drift, temporal changes, incomplete flushing of Niskin bottles and delayed response and noise in CTD data.

Downcast recalibrated files (bin-averaged to 0.5m-bins) were thinned and compared to the bottle values in the MRG files. COMPARE was run to study the differences between the downcast CTD DO data and the titrated samples from upcast bottles. Outliers were removed based on residuals in a fit against DO. Plots were then made against pressure using the same data.

Downcast (CTD files) Oxygen:Dissolved:SBE data for this cruise are considered, very roughly, to be:

 ±0.10 mL/L from 0-100db

 ±0.05 mL/L from 100db to 300db

 ±0.03 mL/L below 300db.

For details see files 2024-069-dox-comp3.xls

##### 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.

Casts #25 and 26 each had a single negative value in the ECO fluorescence channel. A text editor was used to replace values -0.001 with 0.000 and the header limits were adjusted. No other negative values were found in the channel.

On-screen T-S plots were examined. There was only one significant unstable feature, but this was from a narrow channel where unstable features may be real.

Profile plots were examined to see if there any problems. None were found. PAR appeared to have no signal for a few night-time plots, but there is a small signal right at the surface that was removed earlier. So PAR is ok.

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

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

REORDER was run to get the two DO channels together.

Note that the DO data for cast #132 will be removed.

REMOVE was run to remove the following channels from all but cast #132:

Scan\_Number, Temperature:Secondary, Conductivity:Secondary, Oxygen:Voltage:SBE, Descent\_Rate, Status:Pump, Altimeter, Salinity:T1:C1 and Flag and Flag:Prediction.

REMOVE was run to remove the following channels from cast #132:

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

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.

##### Dissolved Oxygen Study

As a final check of dissolved oxygen data, % saturation was calculated and plotted. Given the wide variety of environments sampled it is not surprising that values at 2m ranged between 80% and 160%. In the most exposed sites it ranged from 100% to 115%. This study is not very useful in inshore waters.

##### Final Bottle Files

MRGSORT was run to get files in pressure order.

REMOVE was run to remove the following channels from all except cast #160:

Scan\_Number, Temperature:Secondary, Conductivity:Secondary, Oxygen:Voltage:SBE, Descent\_Rate, Status:Pump, Altimeter, Salinity:T1:C1 and Flag.

REMOVE was run to remove the following channels from cast #160:

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

A second SBE DO channel with mass units was added for both the CTD DO and titrated DO and REORDER was run to get the pairs of DO channels together.

HEAD EDIT was run to add comments to the headers.

Data were exported from the CHE files to file 2024-069-bottles-final.xlsx. The entries were compared with the compiled sampling document and no data were found to be missing.

A Header Check and Standard Check were prepared and no problems were found.

The track plot looks ok.

A cross-reference listing and header check were produced for the CHE files.

##### LOOP File

Loop samples were taken while the ship was underway, but there TSG files were not found in OSDCommon. TSG data from the first 12 hours of the cruise were found in a file that contained 1 record from cruise 2024-041 from August 2024.

The loop sites were separated from CTD casts by too much time and/or distance to enable a reasonable comparison of surface data.

A 6-line header spreadsheet was prepared with the extracted chlorophyll and salinity data together with times and positions taken from the log.

That file was converted to IOS Header format and put through CLEAN to add start and end items and positions to the headers.

Header edit was run to add comments and fix formats. That file was saved as 2024-069-surface.loop.

Header Edit was run to add comments and fix formats.

##### TSG

Should TSG files be found, processing details should be entered here.

**Particulars - Many entries say “surface soak” but not all.**

Deck pressure readings – 1.13, 1.03, 1.2, 1.2, 1.01, 1.01

1. 24 bottles fired at bottom. No sampling.

16. Connected SeaPoint fluorometer cable after this cast.

25. PAR left on with P>2000db.

28. Offsets in DO and SAL when leaving bottom – reset at 750m.

28. Visual basic crashed when saving rosette surface soak.

36. Niskin 6 vent leak

46. Cast at SRC with LIIST powered on.

46. Sampling cast at SRC

63, 70 – lots of particles in water

70. 2 bottles fired at bottom, skipped 150m bottle to get sample numbers lined up.

71. Particles at surface. Glitch in salinity at 225m.

72. Strong surface current.

90. Differences in salinity sensors near surface – maybe tilting rosette in strong gradient.

103. Rosette “gooped” after cast.

104. Note from log: “Large differences in salinity during soak and again during cast. Maybe due to “goop”. Problem was with spikes in both conductivity channels that were mostly replaced with pad values in processing. Secondary looks best near surface but primary much better near bottom.

105. Flushed plumbing but still differences ~0.01 and single signed.

106. Salinity better.

123. Station name wrong in header – change to HEC55. Fixed in raw files.

127. Altimetry reading badly between 20 and 80m in 110m of water due to many jellies.

129. Station name should be CH14 not CHT14. Fixed in raw files.

132. Primary conductivity looks bad. Jelly stuck in primary intake. Secondary channels chosen. DO channel removed. Some corruption of secondary channels was found when the CTD reached 117.4db of the downcast.

137. Flushed primary.

154. stop at 33db to reposition and at 16db on way up.

158. Wild salinity differences in upper 40m.

160. Upcast Primary Salinity and DO bad – flushed both systems.

161. Went down to 10m to check sensor, back to surface for soak. Sal Differences large in upper 10m of downcast.

162. Sal diff ~0.002.

181. Surface soak accidentally short.

**2024-069 CRUISE SUMMARY – CTD**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **CTD#** | **Make** | **Model** | **Serial#** | **Used with Rosette?** | **CTD Calibration Sheet Competed?** |
| **1** | **SEABIRD** | **911+** | **0443** | **Yes** | **Yes** |
| **Calibration Information - 0443** |
| **Sensor** | **Pre-Cruise** | **Post Cruise** |
| **Name** | **S/N** | **Date** | **Location** | **Date** | **Location** |
| **Temperature** | **2106** | **15Feb2023** | **Factory** |  |  |
| **Conductivity** | **2754** | **14Feb2023** | **Factory** |  |  |
| **Secondary Temp.** | **5130** | **18Mar2023** | **Factory** |  |  |
| **Secondary Cond.** | **1766** | **18Jan2023** | **Factory** |  |  |
| **Transmissometer** | **1185DR** | **11Jan2024** | **IOS** |  |  |
| **Transmissometer** | **1883DG** | **11Jan2024** | **IOS** |  |  |
| **SBE 43 DO sensor** | **4372** | **27Mar2023** | **Factory** |  |  |
| **PAR** | **70613** | **24Feb2024** | **Factory** |  |  |
| **SeaPoint Fluor.\*\*** | **4186** | **Aug 2023** | **Factory** |  |  |
| **WetLabs ECO Fluor** | **2216** | **8Mar2017** | **Factory** |  |  |
| **Pressure Sensor** | **0443** | **23Mar2022** | **Factory** |  |  |
| **Valeport Altimeter** | **76341** | **10Feb2021** | **Factory** |  |  |



Cast #1 in Saanich Inlet is not shown to enable better display.

