REVISION NOTICE TABLE

DATE	DESCRIPTION OF REVISION
26–Aug-2014	Corrections to 2 loop CHL samples in spreadsheets QFCHL2013-01.xlsx, 2013-01loops.xlsx and 2013-01-loops-TSG-rosette-loop.xlsx; no change to conclusions reported in this document. G.G.
15-Dec-2013	Added units to Temperature:Draw channel in the rosette files. J.L.

PROCESSING NOTES

Cruise: 2013-01
Agency: OSD
Location: North-East Pacific
Project: Line P
Party Chief: Robert M.
Platform: John P. Tully
Date: February 5, 2013 – February 19, 2013

Processed by: Germaine Gatien
Date of Processing: 25 April 2013 – 1 August 2013
Number of original HEX files: 39
Number of CTD files: 39
Number of bottle casts: 39
Number of original TSG files: 4 (1 had only 2 records, so only 3 processed)

INSTRUMENT SUMMARY

A SeaBird Model SBE 911+ CTDs (#0585) were used for this cruise. They were both mounted in a rosette and attached were a Wetlabs CSTAR transmissometer (#1396DR), an SBE 43 DO sensor (#1438), a SeaPoint Fluorometer (#2228) with a 30X cable, a Biospherical QSP-200L4S PAR sensor (#4601) and an altimeter (#1204).

A thermosalinograph (SeaBird 21 S/N 3363) was mounted with a Wetlab/Wetstar fluorometer (WS3S-713P), a remote SBE38 temperature sensor and a flow meter.

The deck unit was a Seabird model 11, serial number 0471.
The SeaSave version was V7 22.4.
All casts were run with the LARS mid-ship station.
The oxygen kit was #2 (IOS Dosimat Model 865 and 665)
The salinometer used at IOS was a Guildline model 8400B Autosal, serial # 68572.
An IOS rosette with 24 10L GO bottles was used.

SUMMARY OF QUALITY AND CONCERNS

The CTD log had an equipment list. While there was 1 fluorometer listed in the log, there were 2 sensors identified as fluorometers in the configuration file, both having signals that looked reasonable. One was in use as part of an experiment and was removed from the data to be placed in the OSD archive. Details about the rosette and oxygen sampling kit were included. The serial number of the TSG was provided but there was entry for the fluorometer. The sampling logs and dissolved oxygen analysis logs were generally in good order, though there were a few problems. In one case the profile type was not recorded in either log. In 2 cases notations were entered in the Firing # Column that actually referred to something else.

This was confusing. The Chief Scientist provided sampling notes with a good description of problems relevant to processing and a Hydro spreadsheet that cleared up some confusing points.

Salinity samples were analyzed within 4 to 19 days of collection. The comparison between CTD salinity and bottles showed both salinity channels to be within 0.001 of the bottles. The CTD looks lower than the bottles by about 0.003 at the surface despite being in a well-mixed layer where poor flushing of bottles should not be an issue. While this is a small difference, the salinity is not very low either, so this may suggest some non-linearity in the salinometer.

The Oxygen:Dissolved:SBE data are considered, roughly, to be:

±0.1mL/L from 0 to500db
±0.06mL/L from 500 to1500db
±0.04mL/L below 1500db

The CTD fluorescence values are close to extracted chlorophyll for CHL <1ug/L, but values rarely read more than 1ug/L whereas chlorophyll reaches a peak of 3.3ug/L. The profiles look smoother than expected for the gain of 30X that was entered in the log book and configuration file. If we assume the gain is wrong and should be 10X, the fit against CHL is better at high values but worse at low values. The data are provided with the assumption of 30X gain, but as always, should be considered nominal.

Problems continue to plague the thermosalinograph system on the Tully. There are no notes in the log about problems, but the flow rate was unsteady, frequently low and occasionally there was no flow at all. TSG salinity was very noisy for the first 5 days of the cruise; no explanation for this was found. No intake temperature was available. There were a selection of loop samples that include cases of the ship moving and on station. The calibration of the fluorometer was based on a comparison run during 2012-013.

The TSG fluorescence compares well with extracted chlorophyll from the loop in underway samples, but it reads about 50% higher while stopped. The loop CHL agrees well with the loop CHL while stopped. The TSG fluorometer also reads about 40% higher than the CTD fluorometer while stopped, suggesting that something happens in the loop that affects fluorescence, but not CHL. Since most TSG data are taken while moving, it is most important to do underway sampling of CHL to monitor fluorometer performance. There is some suggestion that salinity may have a similar change, but the data are too noisy to assess that.

The lack of an intake temperature sensor for the TSG combined with a variable flow rate means there are no reliable intake temperature data for the latter half of this cruise. A proxy for intake temperature can usually be derived from lab temperature based on a comparison with CTD temperatures, but the fits were not good enough to justify this method when the flow rate was <0.6.

PROCESSING SUMMARY

1 Seasave

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

2 Preliminary Steps

The Log Book and rosette log sheets were obtained as well as sampling notes summarizing problems and points of interest with reference to processing.

Extracted chlorophyll, nutrients, dissolved oxygen, DMS and salinity data were obtained in spreadsheet format from the analysts.

The cruise summary sheet was completed.
The history of the pressure, conductivity and DO sensors were obtained.

Next the calibration constants were checked for all instruments. The parameters were all correct but since the DO sensor has not been used for sampling below 1500m no tests have been done on factor E. This will be checked during the COMPARE step.

There are 2 fluorometer channels while only 1 is mentioned in the log book.

The PAR sensor was not always mounted but is included in the configuration file. At the REMOVE stage that channel should be removed for files with no PAR.
Files that include PAR are: 1, 6, 7, 8, 23, 28, 41, 61, 75, 78
Files with out of order bottle closing: 6, 13, 22, 23, 28, 34, 41, 58, 61, 66, 74, 75

3 BOTTLE FILE PREPARATION
Hysteresis tests have not yet been run for the DO sensor as this is the first cruise since the last factory service with deeps dissolved oxygen sampling.

The ROS files were converted using file 2013-01-ctd.xmlcon using the default value of E (0.036). Tests will be done later to see if that was the best choice.

Those files were put through CLEAN to add event numbers (*.BOT).
Cast #63 was renamed as #66 and the event number fixed in the header of the BOT file.
Header Check was run on the BOT files and no problems were found.

Temperature and salinity were plotted for all BOT files. No significant outliers were found.

The BOT files were then averaged to enable an ADDSAMP file to be prepared. Sample numbers were added to the ADDSAMP file based on rosette log records. A few problems were noted in this process:

- Event #1 – test cast – all bottles were fired but samples taken from only first 7; rest were removed from the addsamp file.
- Event #6 – Niskin #13 did not close, removed from ADDSAMP file.
- Event #13 – Niskin #13 did not close, removed from ADDSAMP file.
- Event #22 – Niskin #1 was fired twice; the 2nd firing was removed from the ADDSAMP list. Niskin #13 did not close, so that was removed and the sample # intended for Niskin #13 was used for Niskin #24 which was fired at the same depth.
- Event #23 – Two Niskins were not fired at the intended depth so the cast had to modified and sample numbers are not in Niskin # order. See Rosette Sampling log for details. This one will need special checking!
- Event #41 – The Sampling Log has a few annotations about firing # that don't agree with the rosette file; this will need checking to make sure samples for 5m, 20m and 50m stops (2 for each depth) go with the right CTD data, if there is any notable difference between the 2. There are notes in the Firing # column that do not really refer to firing order; they refer to the Niskin # for the other bottle fired at the same depth. This was confusing.
- Event #51 – There is no indication in the Daily Science Log or the Sampling Log about what kind of cast this was, but it was assumed to NOT be a ROS cast since there are no data and there

was iron sampling. But there was nutrient and salinity data, so this is not obvious. The Chief Scientist's hydro file did make it clear that this was a Go-Flo.

- Event #61 – Like event #61, the entries in the Firing # column are confusing.
- Event #66 – Remove Niskins 3-24 which were fired but not sampled.
- Event #74 – Niskins 17 and 24 were fired at the same level – the sampling log shows 24 fired first, but the rosette file shows 17 fired first. The bottle sampled was #17 according to the sample #, so this is ok.

SAM files were created using the Add Sample Number routine and those files were then bin-averaged. Bin-average was then run using bottle numbers for bins to produce SAMAVG files.

The addsamp.csv file was sorted on Event_Number and Sample_Number and then converted to CST files. The CST files will form the framework for the bottle files.

Next, each of the analysis spreadsheets were examined to see what comments the analyst wanted included in the header file. These were used to create file 2013-01-bot-hdr.txt; it may need further editing to reflect problems found during processing. The * in the spreadsheet file names that follow stands for the date the file was created. These names are updated as corrections are made.

EXTRACTED CHLOROPHYLL

Extracted chlorophyll and phaeo-pigment data were obtained in file QF2013-01chl*.xls. The file included comments and flags and an event-number column. A simplified version of the spreadsheet was prepared in which some columns were removed and the file was saved as 2013-01chl.csv which was then converted to individual CHL files. Loop data were moved to file 2013-01loops.csv.

DISSOLVED OXGYEN

Dissolved oxygen data were provided in spreadsheet QF2013-01oxy*.xls which includes flags, comments and a precision study. Draw temperatures are available. The spreadsheet page with the final data was simplified by removing a few unnecessary columns and the file was then saved as 2013-01oxy.csv. That file was converted into individual *.OXY files. There were no loop data. A few problems were found later in the event numbers; these were corrected.

SALINITY

Salinity analysis was provided in spreadsheet QF2013-01SAL*.xls. The file was simplified and saved as 2013-01sal.csv. Loop data were moved to file 2013-01loops.csv. The salinity data were analyzed within 4 to 19 days of collection. The simplified spreadsheet was converted to individual SAL files.

NUTRIENTS

The nutrient data were obtained in spreadsheet QF2013-01nuts*.xls which included a report on precisions. The file was simplified, reordered on sample numbers and saved as 2013-01-nuts.csv. The file was converted to individual NUT files. Loop data were moved to file 2013-01loops.csv.

DMS

The nutrient data were obtained in spreadsheet DMS Summary (2013-01)*.xls which includes raw data and a precision study; details on processing were in file 2013-01 DMS report.doc. The data file was simplified and saved as 2013-01dms.csv. The file was converted to individual DMS files

The SAL, CHL, OXY, NUT and DMS files were merged with CST files in 5 steps.

After the 5th step the files were put through CLEAN to reduce the headers to File and Comment sections only.

The merged files are ordered on sample number, but the SAMAVG files are ordered on bottle number, so one or the other set needs to be reordered in order to merge them. The MRGCLN1 files were reordered on Bottle_Number, the usual method used. The output files were named MRGCLN1s.
Those files were merged with SAMAVG files choosing the Bottle_Number from the SAMAVG files.

The MRG files were exported to a spreadsheet for an initial check that all samples had been added correctly. Several errors were found and corrected:

- For casts 1, 6 and 13 and 22 this involved removing lines from the SAMAVG files for bottles that did not close.
- For cast #22 the line for the 2nd instance of bottle #1 closing was removed from the SAMAVG file.
- For cast #42, a flag 9 was added to one salinity sample that was indicated on the rosette sheet but appears to have never been gathered.
- For cast #66 there were errors in the ADDSAMP file; those were corrected, and the full MERGE process was repeated. Bottles with no sampling were removed from the SAMAVG file.
- For cast #75 there had been confusion over file names, so one sample had gone to the wrong MRG file; the process was rerun.

After corrections the final MERGE step was repeated and the files exported to spreadsheet until all problems were resolved.

4 Compare

Dissolved Oxygen

COMPARE was run with pressure as the reference channel.
When data are excluded from below 1300db as well as some outliers based on residuals, the fit is:

DO_Bottle = DOX_CTD *1.0664 + 0.0189 (1)

When data from all depths are allowed and only outliers excluded the fit is:

DO_Bottle = DOX_CTD *1.0669 + 0.0176 (2)

And when only data from below 1300db are included with outliers removed the fit is:

DO_Bottle = DOX_CTD *1.0617 + 0.0216 (3)

These fits are all reasonably close, especially given there are few data in the final group.

SeaBird recommend forcing the fit through the origin because of the unreliability of titrations below 1mL/L. But the fits done this way generally look poor, not just at the origin, but everywhere. The result using the same data as in the first group above, but with offset = 0 is:

DO_Bottle = DOX_CTD *1.07 (4)

The slope is not very different but the R^2 value is a little lower. This could just mean that we tend to have slightly high titration results at low DO. But when the same data are used as in the first group except that DO values <1mL/L are excluded from the fit, we:

DO_Bottle = DOX_CTD *1.0634 + 0.0365 (5)

So not including low DO data makes the offset larger, which seems to suggest that the accuracy of low value titrations is not worse than for higher DO. Further, the R^2 value is lower.

The same results have been seen for other cruises, fit (1) will be applied to recalibrate.

For more details see 2013-01-dox-comp1.xls.

There were no significant outliers. The larger outliers were associated with larger DO gradients where the CTD struggles to keep up, and there was one at the bottom of the deepest cast which could be due to poor flushing near the bottom or hysteresis. There is no evidence to justify changes to quality flags.

Tests for parameter E in DO configuration

There are 3 casts with sampling below 3500db and with dissolved oxygen calibration sampling. Since tests to optimize the value of E in the configuration have not been done for this sensor since it was calibrated at the factory, those tests were run. Events #30, 42 and 62 were reconverted with values of E=3.4 and E=3.8 to compare with the results of the initial E=3.6. Compare was run with the 3 versions of those 3 files.

The files were converted to IOS SHELL format, put through CLEAN, ADD SAMPLE NUMBERS, and averaged. They were then merged with the MRGCLN1s files (which needed to be copied and renamed to match the SAMAVG files) as was done for the other rosette files.

COMPARE was run using these 3 sets of files. In plots of differences against CTD DO the points below 1300db were excluded. The plots make it easy to judge if there is hysteresis since the red points (deep values) should overlie the green ones (shallow values) if there is none. The best result was with the nominal value of E=3.6. But there are too many outliers for this to be completely clear. At first sight it looks as though a slightly lower value of E might be a little better, so a run was made with E=3.55. The results were not clearly better. They look slightly better using E=3.55 for just the shallow bottles for just those 3 casts. But when the full comparison is checked, it becomes clearer that outliers are skewing the fit somewhat for the 3-cast comparison. So the default value looks best.

Plots of Titrated DO and CTD DO against CTD salinity were examined and no problems were detected.

Salinity

Compare was run with pressure as reference channel.
The cast list used for the salinity comparison had to be edited to remove casts run using a different CTD. The sample numbers do not indicate this, so the rosette logs or general log book have to be consulted for this.
There were no flagged samples except for duplicates and 2 cases with pad values.

There are 2 major outliers and 2 minor ones from both the primary and secondary comparisons:

- Event #42, 125db, sample # 261 differs from the CTD by 0.05, but the CTD data are noisy and the local gradients in T and C are extremely high. There is no justification for a flag.

Event #71, samples #376 and #379 from 1250 and 1000db. The differences are ~0.4 and 0.8. The local gradients are not particularly high. The bottle values do not match CTD values at another depth, so do not look like a case of sampling from the wrong bottles. The CTD data are similar to those from another cast at the same site. The pressures match the rosette sheet entries, so this is not a misfire. The bottle values are too low, so the only obvious cause is that the bottles closed on the downcast, or late on the upcast or freshwater got in the samples. They could have been mislabelled but this seems unlikely because the only missing sample would have higher salinity value. These values were replaced with pad values and flag 5 attached with comment: "Severe outlier in comparison to CTD salinity; no evidence of misfire or miss-sample."

- Event #71, Sample #385 at ~10db. The difference is ~0.02 with the bottle reading lower than the CTD. The difference looks unbelievably high since the local gradients are low and the CTD data show a small standard deviation. Poor flushing and evaporation would produce errors of the opposite sign. No upcast CTD data were found with salinity this low for this cast. Flag 4 was

applied with comment "Outlier in comparison to CTD salinity." Even a misfire or premature closing does not explain this difference. The samples analyzed immediately after these seem fine, so Autosal problems don't seem likely. Bottle closing during the surface soak or freshwater getting in the sample seems like the only explanation.

- The only other sample from event 371, sample #382, is very slightly out of line, but local gradients likely explain that.
- Nutrient samples 376 and 379 were also flagged 2 with the comment: "Nutrient values appear to be good, but 2 salinity samples had clearly bad values with no explanation, so caution is advised about all samples from those bottles."

When only bottles below 500m are included and the outliers noted above are excluded both the primary and secondary salinity channels are found to be high by an average of 0.0005 with standard deviations of 0.001. Excluding data between 500 and 1200 has little effect on the average difference and choosing 300db also makes little difference. Neither sensor shows much pressure dependence but the primary is slightly less than the secondary. Excluding a few more outliers to try to flatten the fit against pressure also reduces the average difference. Salinity does not need recalibration.

A plot of salinity differences against salinity shows a slight tendency towards the CTD reading lower than bottles at lower salinity for both channels, but by no more than 0.003. Where surface salinity gradients are very large the CTD tends to be higher than bottle salinity because the CTD is lower than the bottles. If bottles don't flush well, then the CTD will tend to read lower than the bottles. But for this cruise the surface gradients are low in the top 50m for most casts, so the gradient would not seem to explain the fact that the bottles above 50m look higher than the bottles. This would seem to leave non-linearity in the salinometer as an explanation since the salinity values are relatively low in the top 50m. The difference is not very large, but does add to evidence that there may be a problem that would be more significant in inshore waters where salinity can be much lower.
In a plot of differences against file pair number, the secondary is slightly flatter than the primary, but there is a lot of scatter in the data, so there is no evidence of significant drift in either channel.

The 22 bottles fired at 2000m during cast #39 were studied next. The usual way of creating rosette files includes data for 10s for each bottle, but when bottles are fired rapidly at one depth, that leads to the CTD data being the same for every bottle. So a special rosette file was created with a 0.4s window which gave independent data for each firing. The standard deviations were 0.0017 for the bottle values and 0.0002 for the CTD salinity. The CTD salinity varied from being lower than bottles by about 0.001 for both sensors to being higher by 0.007 for the primary and 0.006 for the secondary. Plots of salinity versus depth show a general tendency of higher salinity coinciding with deeper samples. This is clearest for the CTD salinity, which can respond quickly to change. The rosette salinity is noisier which will be mainly because of the limits of the analysis, but there may be some effect from the vertical motion and wakes associated with that. For the first 4 bottles when there was very little vertical motion, the two CTD salinity channels are within 0.0001 of the bottles. A detailed examination of CTD salinity shows some lower salinity values than are captured in the rosette file, which may explain some outliers. The results show reasonable repeatability.

For full details for the COMPARE run see file 2013-01-sal-comp1.xlsx.

Fluorescence

COMPARE was run using the SeaPoint fluorescence and the Extracted Chlorophyll from bottles.

For extracted CHL values <0.2ug/L the CTD fluorometer reads too high by up to 8 times when CHL is near zero, but for 0.2ug/L<CHL<0.8ug/L the ratio of SeaPoint Fluorescence to CHL is close to 1. For higher CHL values the fluorescence does not increase much with maximum values of ~0.9ug/L whereas CHL reaches values up to 3.3ug/L. The ratio gradually decreases reaching ~0.3 at 3.3ug/L. The high CHL values are found from stations P1 to P4. While the SeaPoint Fluorescence often flattens out at high CHL values, it seems to do so much at lower values than usual for these data.

For more details see file 2013-01-fl-chl-comp1.xlsx.

5 Conversion of Full Files from Raw Data
All files were converted using 2013-01-ctd.xmlcon.
File #2013-01-0063 was renamed 2013-01-0066.

A few casts were examined and all expected channels are present. A local temperature minimum was found at ~100m with a local maximum at ~150m which could prove challenging for the dissolved oxygen sensor.

There are 2 fluorometers listed, but one was from a different agency and not intended for the usual purposes. Plots make it clear that Fluorometer2 is the one to be archived. The other channel should be removed later.

The descent rate is generally extremely noisy. Even though it was kept high on average it is so noisy that there are some complete reversals of direction during the descent and obvious shed wake corruption.
Dissolved Oxygen looks normal with some hysteresis.
The pairs of temperature and conductivity channels are in good correspondence during downcasts, but the upcasts are noisy, as usual.
PAR, transmissivity and fluorescence look normal.
Altimetry looks useful when the CTD got near the bottom.

6 WILDEDIT
Program WILDEDIT was run to remove spikes from the pressure, conductivity & temperature only.
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.

7 ALIGN DO
Tests were done on 3 casts applying a variety of settings to make the offset between the upcast and downcast DO channel close to that for the temperature. It is very hard to judge because the temperature is so noisy on the upcast, the descent rate was noisy and only casts with few stops for bottles are appropriate. Further there was a complex temperature and DO structure. An advance of 4.5s appears to have a good effect overall though 4s and 5s look better for some features. For cruise 2011-44 a setting of +4.2s was used.
ALIGNCTD was used to advance the DO Voltage by 4.5s relative to the pressure.

8 CELLTM
The upcast data are extremely noisy making the usual tests for CELLTM settings hard to interpret, especially for the secondary sensors. For both sensors there was little difference among the tested parameters, but overall the primary sensors were probably better with ($\alpha = 0.02$, $\beta=9$) and the secondary with ($\alpha = 0.03$, $\beta=9$).
CELLTM was run using ($\alpha = 0.02$, $\beta=9$) for the primary and ($\alpha = 0.03$, $\beta=9$) for the secondary conductivity channels.

9 DERIVE

Program DERIVE was run twice:

on all casts to calculate primary and secondary salinity and dissolved oxygen concentration.

on a few casts to calculate the differences between primary and secondary channels for temperature, conductivity and salinity. These were placed in a test directory and will not be archived.

10 Test Plots and Channel Check

A sample of casts was plotted to check for agreement between the pairs of T and C sensors. The differences are extremely noisy so these are very rough estimates; if there was a spike at the given depth, nearby values were chosen.

Cast #	Press	T1-T0	C1-C0	S1-S0	Descent Rate
2013-01-0017	500	-0.0004	-0.00003	~0	XNoisy, high
"	1000	-0.0004	-0.00005	+0.0001	"
"	1900	-0.0003	-0.00001	+0.0001	
2013-01-0042	500	-0.0002	-0.00005	-0.0003	XNoisy, high
"	1000	-0.0003	-0.00003	-0.0001	"
"	1900	-0.0001	-0.00001	~0	"
"	3500	~0	~0	-0.0001	"
2013-01-0062	500	-0.0002	-0.00005	-0.0004	XNoisy, high
"	1000	-0.0002	-0.00003	~0	
"	1900	-0.0001	-0.00002	-0.0001	"
"	3500	~0	-0.00002	-0.0002	"

There was no significant pressure dependence or variation with time, but the noise level in the differences was very high.

11 Conversion to IOS Headers

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.

12 Checking Headers

The header check was run. No obvious problems were found.

Surface Check was run and shows an average surface pressure for the cruise was 4.2db which looks a little high for the Tully, but conditions were very rough, so it is not unreasonable. In Saanich Inlet in calm conditions the surface was at 2.0db. There were a few values between 5 and 10db that skew the average; the median was 3.9db. During cast #58 the CTD got really close to the surface while archiving data and the salinity becomes very low when pressure is about 0.2db and the pumps were still on. So pressure looks fine.

The cross-reference check was compared with the log book and the only problem found was ana error in station name for casts #54 and 56. This was changed from P26 to PA-006 for both bottle and profile files.

The cruise track was plotted and added to the end of this report. No problems were found.

The altimeter readings from the headers of the CLN and SAMAVG files were exported to a spreadsheet. Most casts did not get within 15m of the bottom so there are no header entries. Problems were found for

casts #30, 42, 61 and 75 for the CLN files and #10, 30, 42 and 62 for the bottle files with spikes in altimetry misinterpreted whereas the CTD did not get within 15m of the bottom. The altimetry entry was removed from the headers for those files.

Water depths were checked and there were 3 discrepancies – for 1 the value had not been updated from the previous statement and the other two look like typos. Those were corrected in both CLN and SAMAVG and MRG files.

13 Shift

Fluorescence

Tests were run on two casts to see what SHIFT value should be used to make the offset between the downcast and upcast fluorescence trace look like that of the temperature trace. This task was complicated by noisy upcast temperature data but the usual value of +24 records looks appropriate.
SHIFT was run on all casts to advance the SeaPoint fluorescence by +24 records.
After this step a few plots were made to see if the results are satisfactory While it is very hard to judge whether it is ideal, the alignment is certainly improved.

Conductivity

Tests were run on 4 casts to determine how to align the conductivity channels relative to temperature, so as to minimize noise in the salinity channels.
A shift to the primary conductivity of -0.5records looked best overall and for the secondary values a shift between +1.4 and +1.6 looked best. The traces are noisy with no one setting producing very satisfactory results.
SHIFT was run on all casts using -0.5 records for the primary conductivity and +1.5 records for the secondary conductivity.

Dissolved Oxygen

The Dissolved Oxygen voltage channel was aligned earlier. A few casts were checked to see if further alignment is needed for the DO concentration channel, but as far as can be judged by such noisy, data further alignment does not appear necessary.

14 DELETE

For a few files data from the initial soak period were included and had to be removed to make DELETE work properly. A text editor was used to do this for files: 56, 59, 62.
DELETE was run on all files.
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:
The DEL files were copied to EDT files in case some do not need editing.

15 DETAILED EDITING

At this stage it must be decided whether primary or secondary channels will be edited, and hence archived. The bottle comparison shows that both salinity channels are close to the bottles. Both T/S

channel pairs are very noisy, but overall the primary T/S looks somewhat smoother, so the better choice for editing.

The descent rate of the CTD was extremely noisy for almost all casts.
CTDEDIT was used to remove large spikes, smaller spikes that appear to be due to instrumental problems (chiefly miss-alignment of T and C) and likely to affect the bin-averaged values and many records corrupted by shed wakes including some surface records.

For most casts the descent rate of the CTD was extremely noisy with many complete reversals of direction.
Editing was required for all casts.

16 Other Comparisons

Previous experience with these sensors –

1. Salinity:
   The temperature and conductivity sensors were used for only 1 cruise before this one. There was no salinity calibration sampling and these sensors were not selected for archiving.
2. Dissolved Oxygen
   The DO sensor was used during 2011-44 with another sensor. Both data sets were found to be reasonably close to bottles but the other sensor was archived since it had a quicker response.
3. Pressure
   The sensor on CTD #0585 has been used only once since it was recalibrated in April 2011 and the factory calibration was found appropriate.

Historic ranges – Profile plots were made with 3-standard deviation climatology ranges of T and S superimposed. The only excursions in salinity was around 75m at P8 where the salinity was higher than usual. This looks like a case of the mixed layer being shallower than usual. The temperature was a little low between 100 and 200m at P21 probably for the same reason. Most data are well within the climatology.

Repeat Casts –
There were many repeat casts. An examination of the casts at or near P26 turned up one outlier, which led to the discovery that the station name was wrong in the log book and the header. It should be P24.

At P26 there were 2 casts within 10 hours of each other and the differences were <0.0015°C and <0.0002psu at 1100db. This is excellent repeatability.

Post-Cruise Calibration
There were no post-cruise calibrations available.

17 Initial Recalibration

No recalibration was considered necessary for pressure and salinity.
Dissolved oxygen was using the results of the comparison described in section 4:

DO Corrected = 1.0664 * CTD DO (original) + 0.0189

CALIBRATE was run using file 2013-01-recal1.ccf to apply that correction to the dissolved oxygen channel in the SAM and MRGCLN2 files. COMPARE was rerun to check that the salinity was recalibrated appropriately and it was. The calibration was then applied to the EDT files.
(See file 2013-01-dox-comp2.xls.)

18 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 a further correction is sometimes found appropriate to correct for errors found by comparing downcast CTD data to bottle data from the same pressure.

Downcast files were bin-averaged to 0.5m bins for the casts with DO bottle samples. Those files were then thinned to the usual levels for bottles and compared to the bottle values in the MRG files. COMPARE was used to study the differences between the downcast CTD DO data and the upcast bottles. The fit looks excellent at the high end of the scale, while the low values are high by ~0.008. But there is a lot of scatter and if more outliers are removed, the fit becomes much flatter with values high by an average of 0.002. Since the standard deviation in that fit is ~0.02 and the method used for this comparison is very rough, there is no justification for a further recalibration.

Based on the final comparison a very rough estimate was made of the accuracy of the downcast Oxygen:Dissolved:SBE data:

±0.1 mL/L from 0 to 500db
±0.035 mL/L from 500 to 2500db
±0.015 mL/L below 2500db

(See 2013-01-dox-comp3.xls.)

19 Special Fluorometer Processing

There were no off-scale fluorescence data.

Special files were prepared for Dr. Peña by clipping the COR1 files to 150db. The clipped files were bin-averaged (0.25db bins), put through REMOVE and HEADEDIT and named as *.FCTD1 and saved. A second set, *.FCTD2, were created by filtering before bin-averaging. The SAM files were put through REMOVE and named *.BOF and saved. A readme.doc file was prepared with some notes on the preparation of those files.

A median filter, fixed size=11, was applied to the fluorescence channels in the COR1 files to reduce spikiness. Before and after plots of a few casts showed that the filter was effective.

20 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.
After averaging, page plots were examined on screen and no further editing appeared to be necessary.

21 Final CTD File Steps (REMOVE and HEADEDIT)

REMOVE was run on all casts with a PAR sensor mounted to remove the following channels:

Scan_Number, Temperature:Secondary, Salinity:T1:C1, Conductivity:Primary, Conductivity:Secondary, Oxygen:Voltage:SBE, Fluorescence:Seapoint:2, Altimeter, Status:Pump, Descent_Rate and Flag.
(Note: there were 2 fluorometry channels - Fluorescence:Seapoint is the channel kept.)

REMOVE was on casts with no PAR sensor to remove the following channels:

Scan_Number, Temperature:Secondary, Salinity:T1:C1, Conductivity:Primary, Conductivity:Secondary, Oxygen:Voltage:SBE, Fluorescence:Seapoint:2, PAR, Altimeter, Status:Pump, Descent_Rate and Flag.

(Note: there were 2 fluorometry channels - Fluorescence:Seapoint is the channel kept.)
A second SBE DO channel (with umol/kg units) was added.
REORDER was run to get the two DO channels together.

HEADER EDIT was used to fix formats and channel names, to add "Mid-ship" to the instrument location section and to add the following comments:

Data Processing Notes:
*---------- *

Transmissivity, PAR and Fluorescence data are nominal and unedited except that some records were removed in editing temperature and salinity.

For details on how the transmissivity calibration parameters were calculated see the document in folder "\cruise_data\documents\transmissivity".

Based on the recommendation from SeaBird, the method for calibration of Dissolved Oxygen concentration was changed from that used for 2011 and some 2012 cruises. SBE DO calibration was done using the method described in the SeaBird Application NOte #64-2 with a modification allowing a small offset.

The Oxygen:Dissolved:SBE data are considered, very roughly, to be:
±0.1 mL/L from 0 to 500db
±0.035 mL/L from 500 to 2500db
±0.015 mL/L below 2500db

For details on the processing see processing report: 2013-01-proc.doc.

The cross-reference list was produced no errors were found.
The Standards Check routine was run and no problems were found.
The Header Check was run and no problems were found.
The final files were named CTD.

Profile plots were made and look ok.
The track plot looks ok.
The sensor history files were updated.

22 Dissolved Oxygen Study
As a final check of dissolved oxygen data, % saturation was calculated and plotted. The near-surface values in Saanich Inlet were ~70%. Off shore the values were between 90% and 100% at P1, P2 and P3. West of P3 all values were between 100% and 103%, with the highest values at P4.

23 Final Bottle Files
The MRGCOR1 files were put through SORT to order on increasing pressure.

REMOVE was run on casts with a PAR sensor mounted to remove the following channels:
Scan_Number, Temperature:Secondary, Salinity:T1:C1, Conductivity:Primary, Conductivity:Secondary, Oxygen:Voltage:SBE, Fluorescence:Seapoint:2, Altimeter, Status:Pump, Descent_Rate and Flag. (Note Fluorescence:Seapoint is the channel kept.)
REMOVE was run on casts with no PAR sensor to remove the following channels:

Scan_Number, Temperature:Secondary, Salinity:T1:C1, Conductivity:Primary, Conductivity:Secondary, Fluorescence:Seapoint:2, Oxygen:Voltage:SBE, Altimeter, Status:Pump, PAR, Descent_Rate and Flag. (Note Fluorescence:Seapoint is the channel kept.)

A second SBE DO channel was added with different units and REORDER to get the 2 SBE DO channels together.

HEADER EDIT was run to fix formats and units, fix a few headers, change the channel name Bottle_Number to Bottle:Firing_Sequence and the name Bottle:Position to Bottle_Number and to add a comment about quality flags and analysis methods and a few notes about the CTD data.

A header check was run on the final files and no problems were found.
For a final check the CHE bottle data were exported to a spreadsheet and compared with the rosette log sheets and no errors were found.

Plots were made of CTD Salinity versus SBE Dissolved Oxygen and bottle DO and no further outliers were identified.

Standards check was run on all files and no problems were.
A cross-reference list turned up no further errors.
The track plot was produced on screen and no further errors were found.

The question arose at the end of processing as to whether there was an error in the fluorescence processing. There were 2 fluorometers. One had a 1X gain and produces values closer to CHL at the high end at P2, but not at P4; but it has odd high deep values that don't look realistic. This is believed to be the fluorometer being used as part of another program. The other fluorometer is said to have a 30X gain and has profiles that seem too smooth and values that are too low when CHL>3ug/L. Tests were done to see if the fluorescence gain could be wrong. Tests were run to see if more realistic values are achieved with a gain of 3X, but while that made values at the high end closer to CHL values, the dark values are much too high and low values tend to be significantly higher than CHL.

24 Thermosalinograph Data –
Data were provided in 4 hex files.

Loop data were combined in file 2013-01loops.csv. Salinity, extracted chlorophyll and nutrient data were available. Time and date were added to the file to enable addition of the TSG data later.

Some of the loop samples coincide with rosette casts; others were taken while underway.

a.) <u>Checking calibrations</u>
The calibrations were checked and no problems were found. The fluorometer parameters are those found for 2012-13 when there was an inter-comparison with the CTD fluorometer.
The CON file was saved as 2013-01-tsg.xmlcon.
There were only 4 hex files provided, one of which was only a test with few records. The Chief Scientist noted that there should be 5 files, but that there was a computer crash before files #4 and #5 were backed up. File #4 was found on the hard drive, but not File #5. The missing file would have covered the return trip after the final cast at P1, so TSG data is available for most of the cruise.

b.) The 4 files were converted to CNV files using the configuration files mentioned above.
No external temperature data were available for this cruise.

The files were then converted to IOS HEADER format.

CLEAN was run to add End times and Longitude and Latitude minima and maxima to the headers. ADD TIME CHANNEL was used to add Time and Date channels based on the Julian time.

Time-series plots were produced:

- The flow rate starts out ok, but reduces gradually through file #2. For file #3 it gets much worse and is zero for a few hours and low after that. For file #4 the flow is generally low with 0 values for a few hours.
- The salinity is very noisy between the mouth of Juan de Fuca and P16 though the data are somewhat quieter between P6 & P8. The noise is one-sided with bad values being lower by up to 1.5psu and typical spikes being low by ~0.4. This is most obvious in file #3 where there was a sudden change to a smoother profile at about 22:00 on February 9th. After that there are occasional spikes, but the trace is generally much quieter. This change is not associated with a better sea state, judging from the CTD descent rate, and the ship heading did not change at that time. The lower salinity could be due to shallower water being entrained, but bubbles or fresh water contamination in the loop seem more likely explanations because the surface waters were well mixed.

c.) Checking Time Channel

The CTD data were thinned to reduce the files to a single point from the downcast at or within 0.5db of 4db. There were 20 casts with no data available near 4db, so the window was increased to include 2 to 6db which will probably be ok especially well offshore since these waters were well-mixed at the surface. The data from the thinned files were exported to a spreadsheet which was saved as 2013-01-ctd-tsg-comp.xls. The data were reduced to just one 1 reading per cast, as close to 4db as is available. This produced 34 casts available for comparison with the TSG data. The only 2 with CTD data from 6db were from well offshore.

Normally data would be extracted from the TSG files at this stage for comparison with the CTD and loop data, but the salinity is poor for most of file #2 and the beginning of file #3. Tests were run to see if anything can be done to improve these data.

- First filtering salinity was tests. A box filter gave poor results with salinity looking too low. The best results were with median filters which preferentially removed low salinity, but even with a setting of 21 records (10 minutes) the data are still quite noisy, and real changes are going to be masked.
- Tests were then run to see if editing the salinity at this stage would help. First cast #3 was edited since the section of bad data is fairly short, from about records #1 to #600. The results looked smoother, but there is still a step upwards at the point where the original salinity trace changed from noisy to smooth.
- To check how big an error remains in the salinity channel even after editing, data were found in the TSG record to compare with casts #27 and 30 which occur before and after the shift to smoother salinity.

Event #27	P15	CTD Sal at 4db	32.5675
		TSG min over 2 minutes	32.5350
		TSG max over 2 minutes	32.5492
Event #30	P16	CTD Sal at 4db	32.5675
		TSG min over 2 minutes	32.5686
		TSG max over 2 minutes	32.5696

So the noisy salinity is reading low even after editing by about 0.02 to 0.03. Even more rigorous editing would leave the TSG salinity low by ~0.01. In the smooth area the variation over 2 minutes is only 0.001 and the TSG salinity is higher than the CTD by 0.002. Given the inexactness of the comparison between TSG and CTD (depth of sampling, time uncertain) the comparison in the smooth section looks very good.

The question remains as to whether the noisy salinity is worth keeping in the file or not. Editing file #2 with its 10,000 scans would be extremely time-consuming. If that produced excellent results it might be worth doing, but it does not. Applying a median filter will produce data that is still low by up to ~0.05 for much of the underway section when the noise is generally even worse than during stops. We can apply the filter to only the sections that have the noise, but there are many single-point spikes in the rest of the record, so it is best to apply the filter to the whole record. A median filter size 5 does as well as wider filters (9 and 21 were tested). The question is whether it is deceiving to users or helpful to have the data. There will still be noise in the trace to alert the users to the problem areas, so this is probably worth doing..

File #1 does not contain enough data to be worth processing. The ATC files #2, #3 and #4 were opened in EXCEL, median and standard deviations (over 5 records) were calculated for intake temperature, lab temperature, salinity and fluorescence, and the files were reduced to the times of CTD files. Those data were added to 2013-01-ctd-tsg-comp.xls. There were 34 matches.

To check for problems in the TSG clock or bad matches of TSG and CTD data, the differences between latitudes and longitudes were found. The differences in latitude were ≤0.0002° and in longitude were ≤0.0005° and the median differences were 0° for both, so there is no systematic error. This shows both the times and positions are reliable for both systems.

TSG values were also found for times of underway loop sampling and added to the loop file which was then saved as 2013-01-loop-tsg-rosette-comp.xls. The nutrient data were moved to a separate page in the spreadsheet. Near-surface rosette data (both CTD and samples) were found for the cases where loops were taken during CTD casts and added to the files.

These spreadsheets will be used in step (d) to compare temperature, salinity, fluorescence/chlorophyll and nutrients.

d.) Comparison of T, S and Fl from Loop and Rosette samples and TSG and CTD data

- T1 vs T2 The intake thermistor was not available.

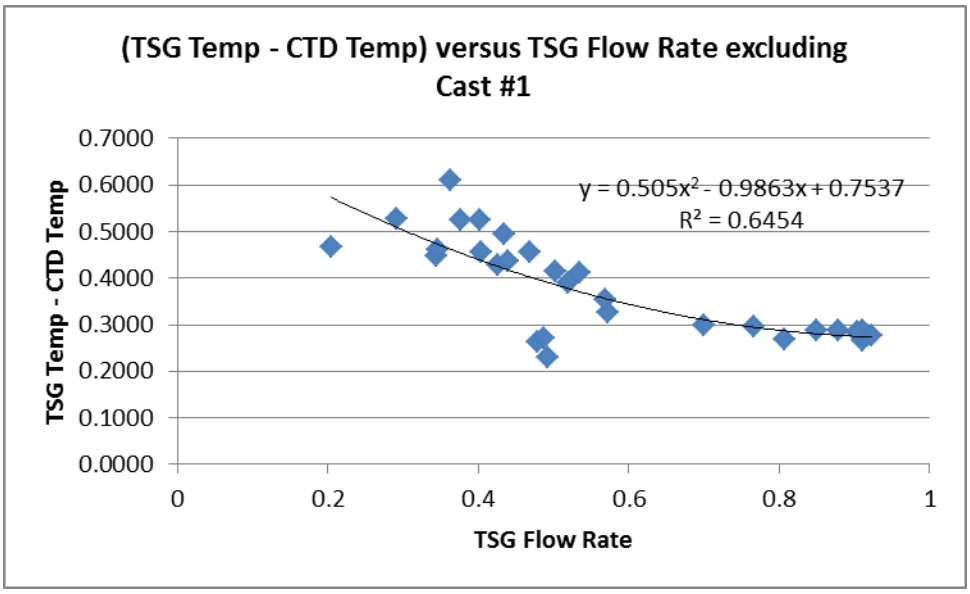
- TSG vs CTD The spreadsheet comparing CTD and TSG files was then examined to find the differences between the salinity, fluorescence and temperature channels for the CTD and the TSG. The following table summarizes the results.

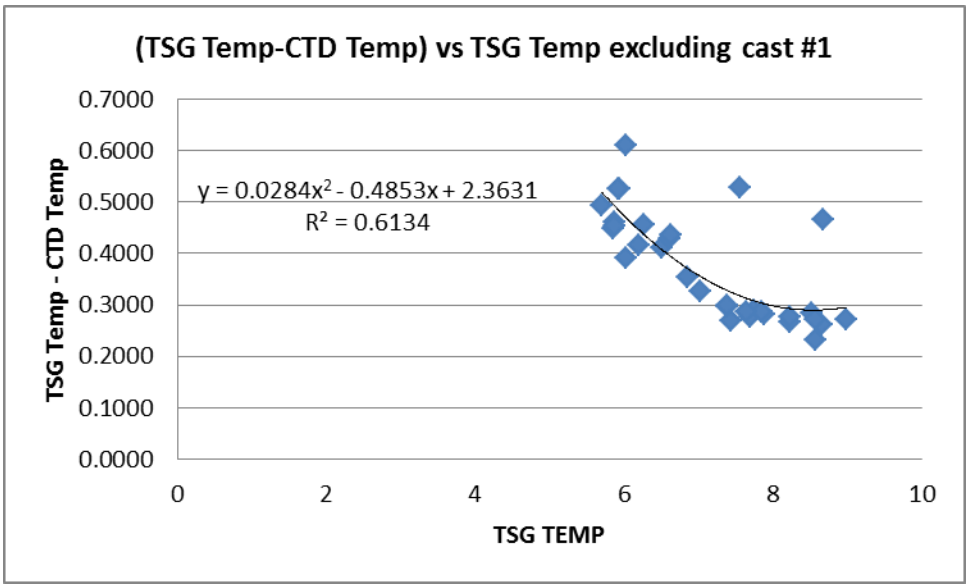
		TEMPtsg-TEMPctd	SALtsg-SALctd	FLUORtsg /FLUORctd
using all data	average difference	0.3584	0.0063	1.4147
	std deviation	0.1259	0.0876	0.4741
	maximum	0.6091	0.3251	3.2111
	minimum	-0.0518	-0.3150	1.0209
excluding outliers	average difference	0.3713	-0.0008	1.3602
	std deviation	0.1037	0.0027	0.3577

	maximum	0.6091	0.0036	2.3545
	minimum	0.2310	-0.0087	1.0209

For temperature and fluorescence the only cast excluded as an outlier was cast #1 in Saanich Inlet where high surface gradients usually lead to a poor comparison. For the salinity channel outliers were casts #1, #9 (P5) and #22-27 (P12-P15). Those correspond to the very noisy parts of the TSG salinity. The average difference between TSG and CTD salinity for the remaining casts, and the standard deviation is reasonably low at ~0.003. We do not expect a much better match than that. No recalibration is required.

For temperature the picture is much more complicated. Users want to know the intake temperature which is not available for this cruise. So we would like to use the comparison with CTDs to estimate heating in the loop, and then subtract that from the lab temperature to serve as a proxy for intake temperature. Loop heating is dependent on intake temperature and flow rate, both of which varied considerably through the cruise. Fits were made of the differences versus both variables and there are always some significant outliers. CTD cast #1 is an outlier in all plots, likely because of a high temperature gradient. When that cast is excluded, fits of differences against flow rate and TSG temperature both look like they might be used to estimate heating in the loop, and thus to enable an estimate of intake temperature. However, there are significant outliers from times when flow rate was <0.5. Outliers include a wide range of temperatures.





The average difference between TSG lab temperature and CTD temperature for cases where the flow rate is >0.6 is 0.28Cº. Subtracting that value from the lab temperature as a proxy for intake temperature is reasonable when the flow rate is >0.6. For other February Line P cruises heating in the loop has ranged from 0.21Cº when the temperatures were fairly high and flow rate was high at ~1.2, to 0.30Cº for cooler waters and a moderate flow rate. Since the higher flow rate for these data corresponds to the inshore waters with higher temperatures, the value 0.28Cº looks reasonable. This will provide a proxy for intake temperature for file #2 and about half of file #3.

For flow rate <0.6 the warming in the loop is much higher than we are used to seeing; this applies to casts #34 onwards. So, just as the TSG salinity got better, the temperature got worse. Perhaps the flow was deliberately slowed to reduce the noise in the salinity. There is no note of this in the log book and it seems unlikely since the flow slowed gradually to zero and was very noisy as the ship approached P26. Examining plots of flow rate does not suggest that it varied between stops and underway records.

The ratio between the TSG and CTD fluorescence is a little high, perhaps not surprising given the way the TSG fluorometer was calibrated; during 2012-13 the TSG fluorometer was mounted on the rosette for one cast and compared to the CTD fluorometer to estimate a scale factor and offset. It looks as though the fluorometer is reading a little high, but is reasonable. Users need to be warned that these values are nominal until the fluorometer is replaced or recalibrated. There was no dependence on the flow rate.
(See 2013-01-ctd-tsg-comp.xls.)

- Rosette – Loop Sample Comparisons
  The loop CHL ranges from 85% to 99% of the rosette CHL with an average of 95%.
  The loop salinity is higher than the rosette salinity samples by an average of 0.002 and standard deviation of 0.002. This may reflect a slight difference in depth of sampling and is at about the limit of analysis errors.

  The comparison of nutrients from the loop and rosette samples were as follows:

	Loop - Rosette Nitrate+Nitrite	Loop - Rosette Silicate	Loop - Rosette Phosphate
average	-0.17	0.04	0.00
stdev	0.41	0.11	0.05

(See 2nd page in 2013-01-loops-tsg-rosette-comp.xls.)

- Loop Bottle - TSG Comparisons The spreadsheet described in section (c) contains all loop sample data with TSG salinity and TSG fluorescence (median values over 2 minutes). Looking first at extracted CHL, we find that the TSG fluorescence is higher than the Loop CHL by an average factor of 1.2. We saw in the comparison above that the TSG fluorometer was higher than the CTD fluorometer by a factor of 1.4, but that was during CTD stops. When we break down the comparison of loops to fluorescence we get a factor of 1.5 while stopped and 1.0 while underway. This is reasonably consistent with the results in the previous section which are all from stops. The CTD fluorometer was close to the rosette CHL. The loop CHL is about 95% of the rosette CHL. Taking all these observations together it looks like underway fluorescence compares well with the CTD fluorescence. This shows that CHL sampling is most important while underway. Why the TSG fluorometer reads higher than the CTD fluorometer while stopped is a puzzle. As mentioned above the loop CHL is close to the rosette CHL. What affects the fluorometer but not the CHL? Is there a difference in the phytoplankton seen while underway from those when stopped that leads to the change in this ratio?

  TSG Salinity reads lower than the Loop Salinity by an average of 0.034, but when loops before P16 are excluded the average is 0.0004, with a range from low by 0.013 to high by 0.0035. Excluding the data from the noisy section leaves just 9 samples. Of those the average is -0.005 when the ship is stopped and +0.005 when underway. This is likely just chance and there are many sources of error including some inexactness in timing of the sampling especially during CTD casts.
  (See 1st page in 2013-01-loops-tsg-rosette-comp.xls.)

- Calibration History

The TSG primary temperature and conductivity were recalibrated in March 2012 and there is no record in the sensor history of the system being used since then.

Conclusions

1. The TSG clock appears to have worked well.

2. The flow rate was variable especially in files 3 and 4, with some patches with zero flow.

3. The temperature in the loop increases by about 0.28C° based on comparisons with CTD temperature when the flow rate is >0.6, but it increases significantly when flow rates go below that. Because there is dependence on both flow rate and temperature it is not obvious how to do this correction, so intake temperatures will only be calculated for flow >0.6.

4. The TSG Salinity is unreliable before P16. A median filter size 5 will reduce the noise there and remove spikes from the latter half of the cruise. The noise level in the first half should alert the user to the limited value of that data.

5. The TSG salinity appears to be slightly lower than loop salinity when the ship is stopped, but slightly higher when underway. There are not enough data available to have much confidence in

this comparison, but it does suggest that underway sampling of salinity is critical. The TSG salinity is as close to the CTD salinity as can be expected given the problems with the TSG data.

5. The TSG fluorescence compares well with extracted chlorophyll from the loop in underway samples, but it reads about 50% higher while stopped. The loop CHL agrees well with the loop CHL while stopped. The TSG fluorometer also reads about 40% higher than the CTD fluorometer while stopped, suggesting that something happens in the loop that affects fluorescence, but not CHL. Since most TSG data are taken while moving, it is most important for fluorometer calibration to do underway sampling of CHL.

f.) Filtering Salinity
A median filter, width 5, was applied to the salinity in the ATC files, output was *.FIL
Plots were examined and no further editing was deemed necessary.

g.) Recalibration
ADD CHANNEL was run to add channel Temperature:Lab which was set equal to Temperature:Primary.

The only recalibration required is to the Temperature:Primary to create a proxy for intake temperature. CALIBRATE was used to subtract 0.28C^{o} from Temperature:Primary using equation 2013-01-tsg-recal1.ccf.

h.) Editing
The COR1 files were opened in CTDEDIT. Output was saved as ED1.
File #2 – The initial 10 records were removed as the flow rate increased and the system equilibrated. Some salinity points were also removed as they are clear spikes, but in most cases there is too much noise to pick out spikes.
File #3 – A few spikes in salinity were removed.
File #4 – The Temperature:Primary data were removed.

There were sections of a few hours in both files #3 and 4 when the flow rate was near zero. Ultraedit was used to replace the Temperature:Lab, Salinity and Fluorescence data were replaced with pad values where flow rate was <0.1. The output were saved as ED1.
The ED1 files were copied to EDT, then the ED2 files were copied to EDT to ensure all editing is preserved.

i.) Preparing Final Files
REMOVE was used to remove the following channels: Scan Number, Temperature:Secondary, Temperature:Difference, Conductivity:Primary, Flag and Position:New.
The Temperature;Primary was not removed from file #4 even though there is no data, to avoid users selecting Temperature:Lab and thinking it is Temperature:Primary.

The flow rate channel was not removed since there were flow problems and users may need the information.

HEADER EDIT was used to add a comment, change file names UPLOY0 to Flow_Rate, change the DATA TYPE to THERMOSALINOGRAPH and add the depth of sampling to the header. Those files were saved as TOB files.

The TSG sensor history was updated.
As a final check plots were made of the cruise track and it looks fine.

The cruise plot was added to the end of this report.
Header Check was run to ensure calibrations were applied correctly and they were.

25 Producing final files
A cross-reference listing was produced for CTD and CHE files.
The sensor history was updated.

An initial surface/loop file was prepared with rosette samples above 10db and all loop samples.
The CHE files were put through DERIVE to calculate sigma-t. They were then exported to a spreadsheet and sorted on pressure. All bottles below 10db were removed. The loop sample data prepared for the TSG processing was then added to the file and lined up appropriately with the CHE data. The data were then ordered on time.
The sampling method column was added entered ROS or UWS for rosette data and true loop data, respectively.
This file was saved as 2013-01-surface1.csv.

Next, the 6-line header was added.
The original header line was removed leaving the 6-line header.
The file break column was filled with value 1 so all data will be in a single file when converted later.
The file was then saved as 2013-01-surface-6linehdr.csv.
CONVERT was run to get an IOS Header file, followed by CLEAN to get start and stop times and positions.

Header Edit was used to add general comments from the CHE files. Comments were added concerning flags on samples from Niskin bottles. The flags from the loop samples were entered automatically in the conversion process.

The final file was named 2013-01-surface.loop. A track plot looks reasonable and a plot of salinity versus date looks right.

<u>Particulars</u>
1. Test Cast - 7 bottles sampled; rest of bottles fired at surface but not sampled. Niskin #8-24 removed from bottle file.
6. Niskin 13 did not close.
13. Niskin 13 did not close.
22. Niskin 13 did not close; Niskin 24 was closed at same depth as 13; Niskin 1 closed twice, second case was removed from bottle file.
23. Two Niskin bottles were not closed at correct depth, so plan altered – revised rosette log was prepared.
25. Bottle 24 replaced; #13 release mechanism replaced.
27. Niskin2 was closed at 100, Niskin 3 at 50, Niskin 5 at 10.
39. No 10db bottom spigot leaking.
41. Bottle #10 bottom spigot leaking.
42. Cable realignments – so some up and down movements.
59. Stop to realign cable.
61. Went up to 85db and then down again.
63. Cast #63 was renamed as 66. Niskins 3-24 were closed but no samples were taken. Not needed in CHE file.
66. Bottles #3-24 closed but not sampled.
TSG – Computer crashed after last station – files 4 and 5 lost.
Casts with bottles fired out of order: 6, 13, 22, 23, 28, 34, 58, 61, 74, 75
Casts with PAR sensor mounted: 1-8, 23, 28, 41, 61, 75, 78

CRUISE SUMMARY

CTDs

CTD#	Make	Model	Serial#	Used with Rosette?	CTD Calibration Sheet Competed?
1	SEABIRD	911+	0585	Yes	Yes

Calibration Information CTD #550

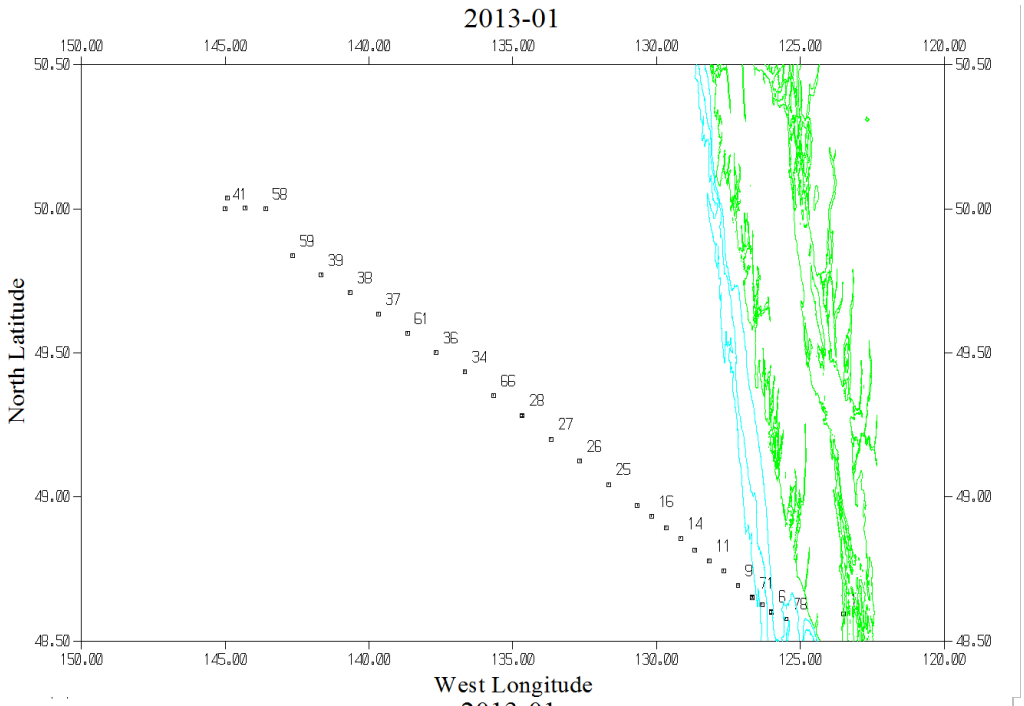
Sensor		Pre-Cruise		Post Cruise	
Name	S/N	Date	Location	Date	Location
Temperature	4054	5Apr2011	Factory		
Conductivity	3321	30Mar2011	Factory		
Secondary Temp.	4700	1Apr2011	Factory		
Secondary Cond.	1766	29Mar2011	Factory		
Transmissometer	1396DR	31Jan2013	IOS		
SBE 43 DO sensor	1438	2Apr2011	Factory		
SeaPoint Fluorometer	2228				
PAR	4601	16Mar2011	IOS		
Pressure Sensor	77511	22Apr2011	Factory		
Altimeter	1204				

TSG

Make/Model/Serial#: SEABIRD/21/2487 Cruise ID#: 2013-01

Calibration Information

Sensor		Pre-Cruise		Post Cruise	
Name	S/N	Date	Location	Date	Location
Temperature	3363	26Mar11	Factory		
Conductivity	3363	26Mar11	"		
Wetlab/Wetstar FL	WS3S-713P	1Feb12	IOS		
Temperature:Secondary	?	03Mar11	"		
Flow Meter					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140.00
135.00
130.00
125.00
120.00
50.50
50.00
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North Latitude
West Longitude
41
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71
6
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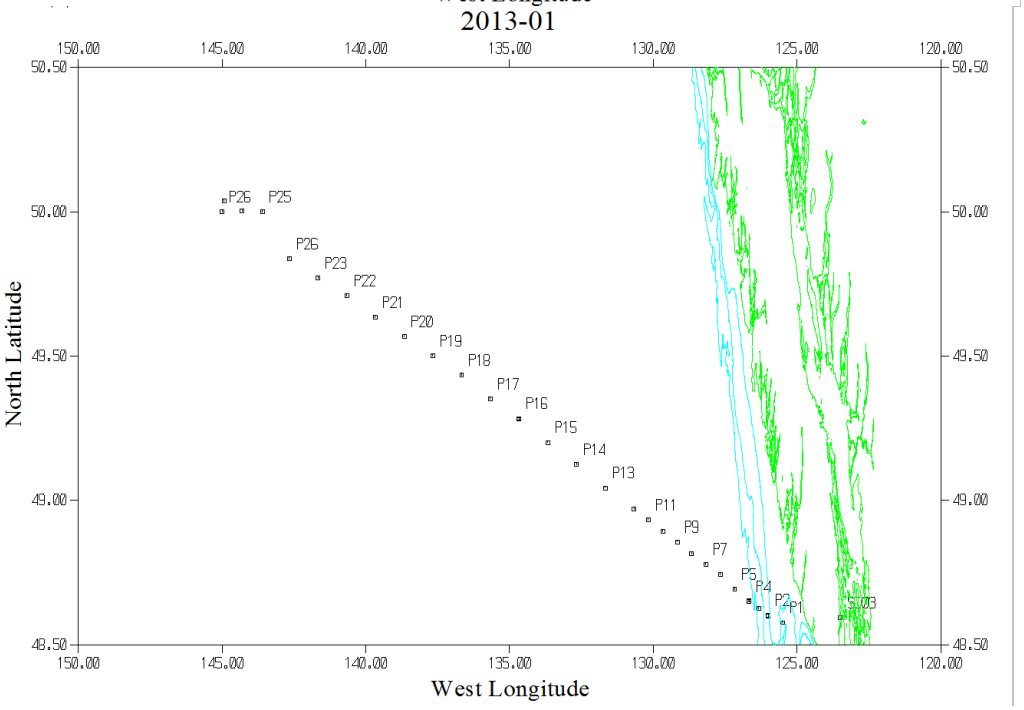
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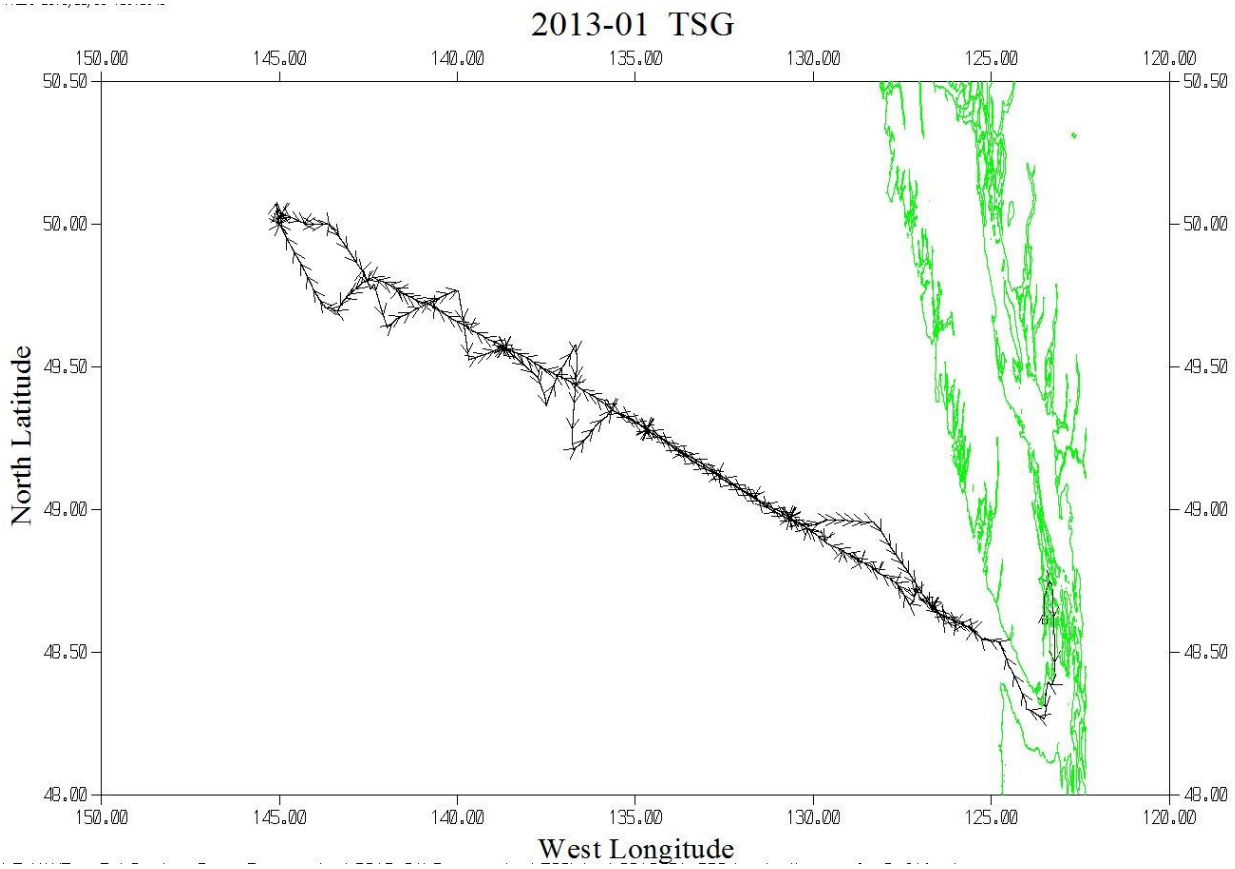
145.00
140.00
135.00
130.00
125.00
120.00
50.50
50.00
49.50
49.00
48.50
North Latitude
West Longitude
P26
P25
P26
P23
P22
P21
P20
P19
P18
P17
P16
P15
P14
P13
P11
P9
P7
P5
P4
P2
P1
P3


2013-01 TSG
150.00
145.00
140.00
135.00
130.00
125.00
120.00
50.50
50.00
49.50
49.00
48.50
48.00
North Latitude
West Longitude