CTD Data Processing

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1. Set up a series of subdirectories. Original data is in /hex, also need /1_cnv, /2_filter, /3_align, /4_derive, /4a_teos10, /5_bin.

2. Open "SBEDataProcessing-Win32" from the shortcut on Desktop of the CTD laptop. *"SBEDataProcessing-Win32" is a wrapper around the various programs needed to process the data.*

3. "Run" -> "1. Data conversion": to convert the data from hex to raw units.
   - select an appropriate program setup file ("DatCnv.psa" from the "SBE19_3112" or "SBE19_V2_7274" directories)
   - select an appropriate instrument configuration file (".xmlcon" file from the "SBE19_3112" or "SBE19_V2_7274" directories)
   - select the appropriate "Input Directory" and "Input files" (the .hex file for the cast you are processing) and relevant raw data files
   - select the appropriate "Output Directory" (the "1_cnv" directory in your processing directory)
   - under the "Data Setup" tab click the "Select Output Variables to select the variables you wish to output. These are typically "Scan Count", "Pressure, Strain Gauge [db]", "Temperature [ITS-90, deg C]", and "Conductivity [mS/cm]". If using the SBE19 V2, you can also select "Oxygen, SBE 43 [Volts]" and "Fluorescence, WET Labs ECO-AFL/FL [mg/m^3]".
   - hit the "Start Process" button
   - once complete, hit "Exit" and "Yes" to save the .psa file

4. "Run" -> "20. Sea-plot" to take a quick look at your data before processing any further.
   - select an appropriate program set up file "SeaPlot.psa" from the "SBE19_3112" or "SBE19_V2_7274" directories)
   - select the appropriate "Input Directory" and "Input files" (the .cnv file in the "1_cnv" directory you just created)
   - under the "Y Axis" select your y axis variable ("Scan count" (proxy for time) and "Pressure" are both useful y axis variables)
   - under the "X Axis" tabs, select your x axis variables. Make sure the box "Include axis" is ticked for all your X Axis selections. You can use DERIVED SALINITY to look at the (roughly correct) salinity.
   - hit the "Start Process" button
   - take a look at the plot generated to see if there are problems (hit bottom, instrument broke, sensors broke). Then close the window and hit "Exit" and "Yes" to save the .psa file.

3. "Run" -> "2. Filter" to low pass filter various data channels.
   - select an appropriate program set up file ("Filter.psa" from the "SBE19_3112" or "SBE19_V2_7274" directories)
   - select the appropriate "Input Directory" and "Input files" (the .cnv file in the "1_cnv" directory you created in step 1)

- select the appropriate “Output Directory” (the “2_filter” directory in your processing directory)
- under the “Data Setup” tab enter your low pass filter time constants for “Low pass filters A” and “B”; hit the “Specify Filters” button to specify which variables will be filtered and with which time constant. We process the temperature and conductivity sensors with a 0.5 second filter to give them equal time responses (essential to calculate an accurate value for salinity!). We process the pressure sensor with a 1 second filter to remove quantization errors.
- hit the “Start Process” button
- once complete, hit “Exit” and “Yes” to save the .psa file

4. “Run” -> “3. Align” to align the various data channels data relative to pressure (to account for the fact that a given water parcel passes by the various sensor sequentially AND that different sensors have different time responses)
- select an appropriate program set up file (“AlignCTD.psa” from the “SBE19_3112” or “SBE19_V2_7274” directories)
- select the appropriate “Input Directory” and “Input files” (the .cnv file in the “2_filter” directory you created in step 3)
- select the appropriate “Output Directory” (the “3_align” directory in your processing directory)
- under the “Data Setup” tab hit the “Enter Advance Values” button to specify the advance times for each variable. Choose 0.5 seconds for temperature. For oxygen, choosing 5 seconds, and for fluorescence, 2 seconds are reasonable starting point, but you may want to change these in a later iteration after comparing up and down casts.)
- hit the “Start Process” button
- once complete, hit “Exit” and “Yes” to save the .psa file

5. “Run” -> “6. Derive” to calculate salinity, density, sound velocity, oxygen, potential temperatures, dynamic height etc. based on EOS-80 (Practical Salinity) equations.
- select an appropriate program set up file (“Derive.psa” from the “SBE19_3112” or “SBE19_V2_7274” directories)
- select an appropriate instrument configuration file (“.xmlcon” file from the “SBE19_3112” or “SBE19_V2_7274” directories)
- select the appropriate “Input Directory” and “Input files” (the .cnv file in the “3_align” directory you created in step 4)
- select the appropriate “Output Directory” (the “4_derive” directory in your processing directory)
- under the “Data Setup” tab hit the “Select Derived Values” button to specify the variables you wish to derive (this is up to you!) Potential Density, Potential temperature, Practical salinity, and oxygen (ml/l, umol/kg, and/or % saturation) are common choices. Others may be useful for different scientific issues.
- hit the “Start Process” button
- once complete, hit “Exit” and “Yes” to save the .psa file

6. “Run” -> “20. Sea Plot” as in Step 2 but now using the .cnv file in the “4_derive” directory
- with “Pressure” on the y-axis you should notice some of the traces are smoother (due to the filtering applied) and there is better alignment of the up-down casts (due to the alignment applied)
- now is a good time to check:
  - that the up and down casts are similar (i.e. big steps in the profile occur at ~ the same pressure); dissimilar casts arise when the alignment advance times are set

inappropriately and may indicate that these need to be tuned. Dissimilar casts also arise when the plumbing is blocked, either with an air bubble or mud (if you hit the bottom).
- With "Scan Count" as the y-axis check that there are no problems at the start of cast, and find the (approximate) scan number when the CTD begins to drop after the soak period (this number is needed in binning later)

7. "Run" -> "7. Derive TEOS-10" to calculate thermodynamic properties based on TEOS-10 (Absolute Salinity).
- select an appropriate program set up file ("DeriveTEOS_10.psa" from the "SBE19_3112" or "SBE19_V2_7274" directories)
- select the appropriate "Input Directory" and "Input files" (the .cnv file in the "4_derive" directory you created in step 5)
- select the appropriate "Output Directory" (the "4a_teos10" directory in your processing directory)
- under the "Data Setup" tab, select "Other" for "Instrument type", enter the appropriate latitude and longitude and hit the "Select TEOS-10 Variables" button to specify the variables you wish to derive (this is up to you too - Absolute Salinity, Conservative Temperature and density, TEOS-10 are common choices)
- hit the "Start Process" button
- once complete, hit "Exit" and "Yes" to save the .psa file

8. "Run" -> "8. Bin Average" to average the data in evenly-spaced bins based on pressure, depth, scan number, or time range.
- select an appropriate program set up file ("BinAvg.psa" from the "SBE19_3112" or "SBE19_V2_7274" directories)
- select the appropriate "Input Directory" and "Input files" (the .cnv file in the "4a_teos10" directory you created in step 7)
- select the appropriate "Output Directory" (the "6_bin" directory in your processing directory)
- under the "Data Setup" tab, specify the "Bin type", the "Bin size"(typically 0.5 - 1 m but this may vary depending on your scientific question), the number of scans to skip over (typically we skip over the data from the soak period as diagnosed in terms of number of scans in step 7 above), and the cast to process (typically the downcast)
- hit the "Start Process" button
- once complete, hit "Exit" and "Yes" to save the .psa file

9. "Run" -> "20. Sea Plot" again to check your final profiles but now using the .cnv file in the "5_bin" directory

10. Generally you will use the final profiles from the .cnv file in the '5_bin' directory. Do your science (this is up to you!).

For more information see "Seasoft V2:SBE Data Processing" User's Manual available here: http://www.seabird.com/pdf_documents/manuals/SBEDataProcessing_7.23.1.pdf.