Chemical Oceanography
Spring 2021
Problem Set#3

Assigned 18 March 2021
Due: 6 April 2021 at 3PM

Directions: These problems require use of Ocean Data View and the accompanying GLODAP V1 bottle dataset. The ODV recitation should familiarize you with the use of ODV and how to access the GLODAP V1 data included. Any other technical problems, please contact Professor Altabet (maltabet@umassd.edu) or Alanna Mnich (amnich@umassd.edu). Plots should be saved as jpeg files and then inserted into a PowerPoint file which then can be annotated and sent to Prof. Altabet for grading. Make sure to optimize the visual presentation using at least 300 dpi resolution. The submitted graphics need to include the property sections for problems 1-4 and the property-property plots with corresponding regression lines and equations for each stoichiometric ratio estimate.

To get you started, you have been invited to access a Dropbox containing the database you will be using 'GLODAP-v.v1" which you will copy to your odv_local folder. After starting ODV and opening the GLODAP bottle data collection file, load the view file "A16S_ChemOce" using the "load view" command making sure it is in the path "odv_local \GLODAP-v.v1\views". You should see a salinity section for the South Atlantic and 6 property-property plots. **Important Note**: This 'canvas' may extend horizontally beyond your screen. Scroll to the right and left to check. Can resize plots to fit on your screen if you wish and change the font sizes using the appropriate commands.

Part 1 (2.0 pts) Identify on the salinity section the major water masses present and trace approximate boundaries. Make sure you get this right before going on by checking in *Emerson & Hedges* or asking myself. On the Temp vs Sal plot, identify their corresponding end-members.

In a short paragraph, describe the hydrography of this section and how this relates to the sinusoidal shape of the Temp-Sal plot. On the other plots, calculate the stoichiometric relationships between C:AOU:N:P only where linear relationships are apparent. In a short paragraph, explain why some plots fail to show a neat linear trend.

Part 2 (2.0 pts) Sequentially, change the z variable in the section plot to TCARBN (total inorganic carbon), ALKALI (total alkalinity), AOU, NITRAT (nitrate), PHSPHT (phosphate), CFC11AGE, CONVRADCARBNAGE (^{14}C age), pCO2, OMEGAC (calcite saturation state). Include each of these plots in your submitted work.

In a short paragraph, discuss the geographic/depth distribution of these properties and how they relate to each other and the distribution of water masses along this section. Make sure to discuss the use CFC's and ^{14}C for aging water masses and their limitations.

How does water mass age qualitatively relate to the other parameters, citing specific features of the plots? How does the distribution of Omega-C relate to pCO_2 and what predictions can you make about where high %CaCO3 would be found in seafloor sediments.

Part 3 (2.0 pts) Using the 'Sample Selection Criteria', restrict the data displayed to those points with potential density anomaly greater than 27.8 Remember to check the box that applies the restriction globally.

Which water masses are present? Calculate the stoichiometric relationships between C:AOU:N:P. Why does the potential density anomaly restriction improve the linear relationship between the properties plotted? What are the apparent preformed nutrient concentrations (NO_3^- and PO_4^{-3}) and if >0 what are their origins? Describe how you estimated preformed nutrient concentration. By examining the slope of the linear relationship between alkalinity and DIC (if there is one), determine if $CaCO_3$ dissolution is affecting the ratios with TCarbon (DIC) and by how much? If so, attempt a correction describing your approach in a short paragraph. Using crossplots with ^{14}C Age, what are the average remineralization rates for PO_4^{-3}, NO_3^-, and TCarbon? Why are CFC's not appropriate for aging the water masses present.

Part 4 (1.0 pts) Do the same as in part 3 for the potential density anomaly range 27 to 27.7. You do not need to repeat 1) description of method for $CaCO_3$ dissolution correction and 2) explanation of why linear relationships are improved. You still need to quantitatively estimate the contribution of $CaCO_3$ to the observed stoichiometry, though. Examining a PO_4^{-3} vs CFC11Age plot, discuss if this a valid approach for the water masses present for determining remineralization rates and compare to the ^{14}C approach.

Part 5 (1.0 pts) Do the same as in part 4 for potential density anomaly range 25 to 26.4. However, discuss why using ^{14}C Age is inappropriate for determining remineralization rates for this water mass.

Part 6 (2.0 pts) Assemble all stoichiometric calculation results (C:AOU:N:P and PO_4^{-3} remineralization results) from questions 2-4 into a table with potential density anomaly ranges as the column heading. Compare in a paragraph to values expected from Redfield stoichiometry. Discuss any differences in ratios and rates between potential density anomaly ranges and their possible causes.