Chemical Oceanography
Fall 2019
Problem Set#4

Assigned Nov. 21, 2019
Due: Dec. 10, 2018 at 3PM

Directions: These problems require use of Ocean Data View and the accompanying GLODAP bottle dataset. The ODV recitation should familiarizd you with the use of ODV and how to access the GLODAP V2 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 xview files will be emailed directly to you (there appears to be a problem with posting them on the class web page). After starting ODV and opening the GLODAP bottle data collection file, load the view file "A16S_ChemOce_2017" using the "load view" command making sure it is in the path "ODV \GLODAPv2\ GLODAPv2_bottle.Data\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.

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), pCFC-11 (partial pressure of CFC-11), DELC14 (the difference in the $^{14}C/^{12}C$ ratio of total inorganic carbon relative to a standard in ppt), ^{14}C Age (apparent age of total inorganic carbon from radioactive decay of ^{14}C), 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 of pCFC-11 and DELC14 (14C Age) 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 OMEGAC relate to pCO2 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 neutral 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)? 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?

Part 4 (1.0 pts) Do the same as in Problem 2 for the neutral 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.

Part 5 (1.0 pts) Do the same as in Problem 3 for neutral density anomaly range 25 to 26.4 . However, discuss whether using 14C Age is appropriate for determining remineralization rates for this water mass.

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