

**Unit 2 – Ocean Acidification Pre-homework****NAME**

**Overview:** Scientific data are available to the public in databases. In this assignment, we will access ocean acidification data and plot it using Microsoft Excel. You will access data from the National Oceanic and Atmospheric Administration (NOAA), which supports scientific research regarding changes in our atmosphere and ocean.

**Instructions:** Access the NOAA Ocean Acidification Data Portal at this link:

[http://www.nodc.noaa.gov/oceanacidification/stewardship/data\\_portal.html](http://www.nodc.noaa.gov/oceanacidification/stewardship/data_portal.html)

Alternatively, you can search for “NOAA Ocean Acidification Data Portal” in a web browser – the data portal should be the first link. From here you will search for ocean acidification data by following the instructions below:

- Make sure the button beside “Search the OADS managed data sets” is selected.
- Make sure the boxes beside “Alkalinity”, “Dissolved inorganic carbon”, “pCO<sub>2</sub>/fCO<sub>2</sub>-water”, and “pH” are checked.
- We are going to look at data in the Northern Atlantic Oceans, so type “North Atlantic Ocean” in the box below “Additional Terms” in the lower right.
- To search for data click “SEARCH” in the bottom center of the page.

This search list a number of studies/ocean expeditions that have produced data in the Northern Atlantic Ocean. One of the top results should be NODC Accession 0100064, which contains data collected between 10/2/1995 and 11/25/2009 on vessels named *Meteor*, *Poseidon*, *Taliarte* and *Victor Hensen*. Follow the instructions below to access the data:

- Click “NCEI Metadata” in the appropriate box. This will open a new page with a link to the data files. Next, click on “HTTP” in the Download Data row near the bottom of the page – this will open a new page with the actual data files.
- Download the files (save to downloads folder or desktop) by clicking on “100064.1.1.tar.gz”.
- Find the file and unzip it (double-clicking or right-clicking to select “unzip” should work) to access the folder named “0100064”.
- Open the folder then the “1.1” subfolder, then the “data” subfolder, and finally the “0-data” subfolder.
- You will be working with the “ESTOC\_TS\_Data\_1995-2009.csv” file. Double-click to open.

At this point, you should be looking at a spreadsheet of data in Excel – If not, copy and past the data into an Excel spreadsheet. The names of each column with meaning are listed below:

<b>STATION</b>		Station name as designated by the research team
<b>LATITUDE</b>		Latitude
<b>LONGITUDE</b>		Longitude
<b>DATE</b>		Date presented as decimal to make it easier to plot
<b>SST</b>	<b>DEG_C</b>	Sea surface temperature in degrees celsius
<b>SSS</b>		Sea surface salinity
<b>ALKALI</b>	<b>UMOL/KG</b>	Alkalinity in micromoles per kilogram of seawater
<b>PH_TOT</b>		pH total
<b>PH_TMP</b>		Temperature at which pH was measured
<b>TCARBN</b>	<b>UMOL/KG</b>	Total carbon in micromoles per kilogram of seawater
<b>FCO2</b>	<b>UATM</b>	Fugacity of carbon dioxide in microatmospheres. Describes how much CO <sub>2</sub> is dissolved in seawater.
<b>PCO2</b>	<b>UATM</b>	Partial pressure of carbon dioxide in microatompsheres. Describes how much CO <sub>2</sub> is dissolved in seawater.

### Questions:

1. First, we will determine exactly what part of the Northern Atlantic Ocean these data come from. Look at columns 2 and 3 to find the approximate latitudinal and longitudinal coordinates for the expedition. Write those coordinates below:  
**Latitude: 29.066**  
**Longitude: -15.833**
2. To determine the geographic location at which these data were collected, access this website (<http://itouchmap.com/latlong.html>). Enter the lat-long coordinates from question 1 into the Decimal Deg. Latitude and Decimal Deg. Longitude boxes on the right below the map and click "Show Point" so see the location this lat-long represents. What is the approximate location (Write the coast of the closest continent? For example: southwest coast of Australia)  
**Northwest coast of Africa or west of Morocco or Canary Islands**

Now you will plot the data in Excel so we can see how ocean conditions have changed in this region from 1995-2009. Return to the ESTOC\_TS\_Data\_1995-2009.csv data file and follow the instructions below:

- There is one anomalous data point in row 145 ( $p\text{CO}_2$  reads as -999). Delete this entire row by clicking on the grey box labeled 145 (this will highlight the row), then clicking "Edit" then "Delete".
- Create a scatter plot of your data. The exact instructions will vary depending on your version of Excel and the operating system you use (Mac OS vs. Windows). Instructions for your version can be found with a simple Google search. Generally you can click on "Insert", then "Chart", then choose "Scatter" or "X-Y Scatter".
- Make the x-axis date by selecting the data (numbers only) in the "DATE" column (column 4).
- Make the y-axis sea surface temperature by selecting the data in the "SST" column (column 5).
- Insert a trendline by right-clicking on an actual data point (any will work) and selecting "Add Trendline...". Chose "Linear" and click "OK" (note that you can change the color and thickness of the trendline in this same menu).
- Sometimes Excel isn't the best at displaying data in a way that makes it easy to see trends. To improve this, change the x-axis values by double-clicking on the axis (you can also right-click on the axis numbers and select "Format Axis...". Make the minimum value 16 and the maximum value 26. You should not need to do this when you plot pH, but will need to make the minimum "300" and maximum "420" when you plot  $p\text{CO}_2$ .

### Questions continued:

3. In the space below, describe how sea surface temperature has changed through time (increased? decreased? stayed the same?). Use your trendline to provide an approximation for how much sea surface temperature has changed.  
**Small increase in SST through time. The change appears to be less than 0.5°C.**

Now plot the pH data. Use the above instructions to create a new chart with the date as the x-axis and pH (PH\_TOT or column 8) on the y-axis. Label the axes and give the chart the title “ESTOC Northern Atlantic Seawater pH 1995-2009”.

4. In the space below, describe how pH has changed through time. Use your trendline to provide an approximation for how much pH has changed.

pH decreases through time. The change appears to be ~0.02 pH units.

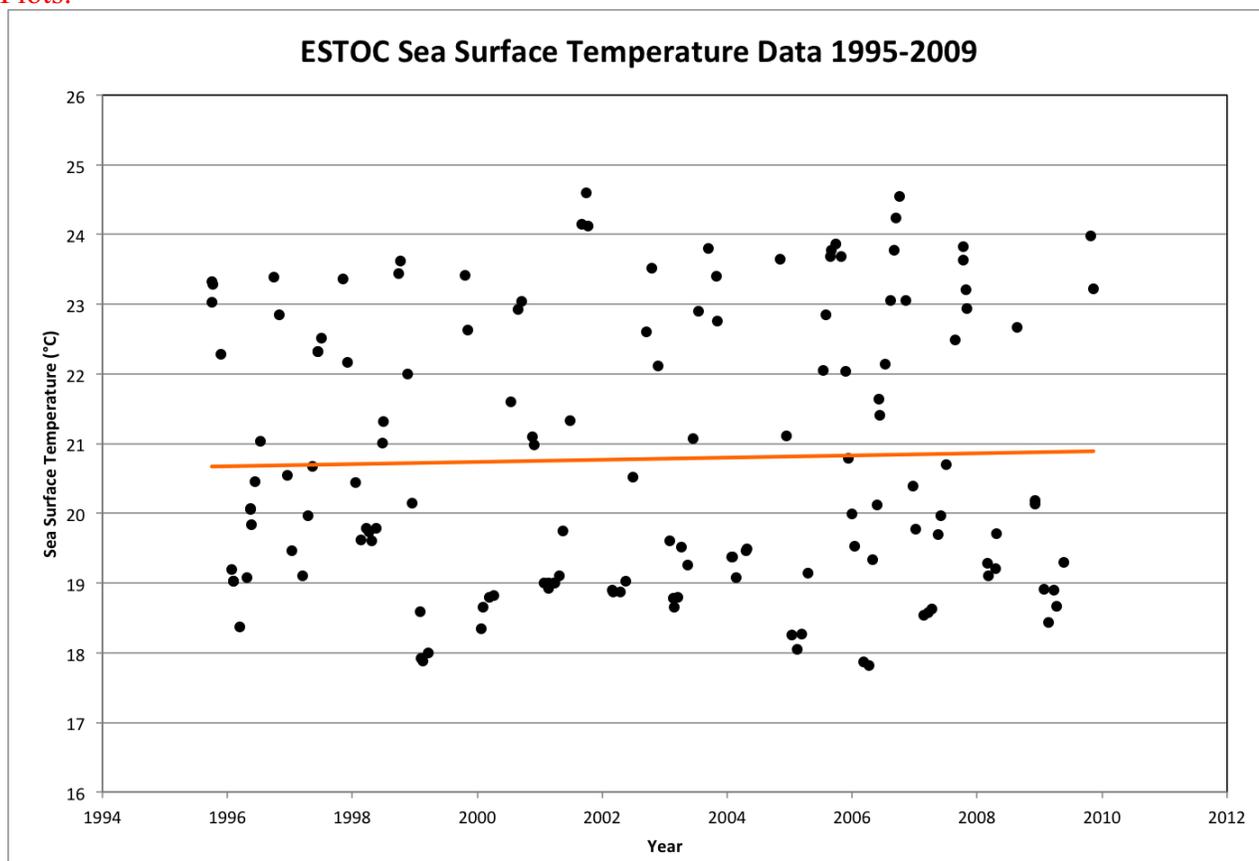
Lastly, create a third chart with the date on the x-axis and partial pressure of carbon dioxide (PCO2 or column 12) on the y-axis. Label the axes and give the chart the title “Partial Pressure of CO<sub>2</sub>”.

5. In the space below, describe how  $p\text{CO}_2$  has changed through time. Use your trendline to provide an approximation for how much  $p\text{CO}_2$  has changed.

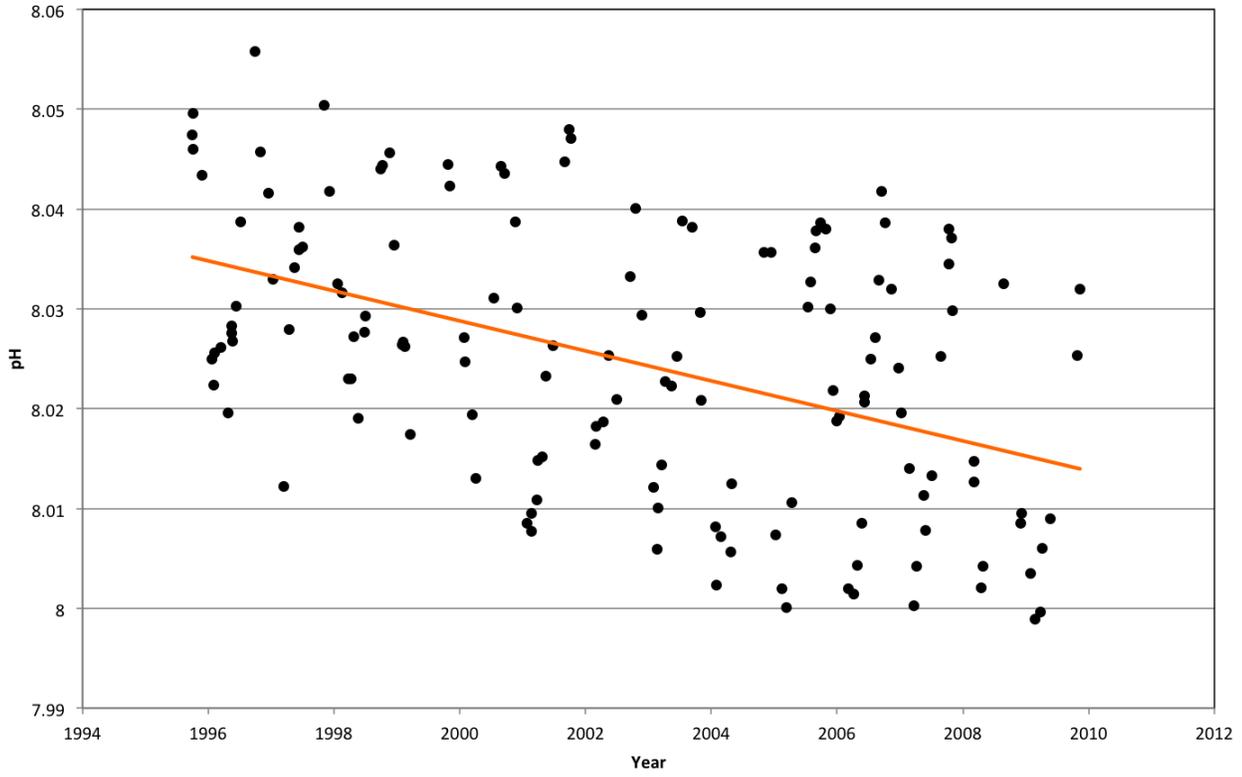
$p\text{CO}_2$  increases through time. The change appears to be ~12-15  $\mu\text{atm}$ .

In class we will discuss how sea surface temperature, pH and  $p\text{CO}_2$  are linked. Print your three plots and attach them to this assignment.

Plots:



ESTOC Seawater pH Data 1995-2009



ESTOC Seawater pCO2 Data 1995-2009

