Factors Affecting Primary Productivity Data Exploration Lab

Developed by Jean R. Anastasia

Part 1: Examining Factors That Affect Primary Productivity

Go to the Factors Affecting Primary Productivity- Invention webpage. When the site loads, you will be viewing graphs showing the chlorophyll concentration and the temperature at a site in the Southern Ocean that lies north of Antarctica, to the west of the southernmost tip of South America in the Pacific Ocean.

Practice interacting with the graphs. You can interact with the data by:

- Moving your mouse over the plotted line, as you do this a dot will appear at that point on the line and the actual data plotted (date and chlorophyll level for example) will be listed at the top right of the graph.
- Zooming in and out of the data to look at different time scales that interest you by changing the width of the highlighted section of the small gray graph in between the large graphs (it loads with all of the data highlighted). Click and drag the small bars at each end of the gray graph to accomplish this.
- Selecting a different part of the time series to explore the data in ways that interest you by moving the highlighted section of the small middle gray graph to the right or left.
- Changing the data that is plotted in the bottom graph by selecting a different parameter under the graphs. You can choose to show the plot of water temperature, light, nutrients, or salinity.

Now be sure the graph is set to show the entire dataset by sliding the bars on the gray graph all the way to the edges. Answer the following questions about the graphs:

1. a) What variable appears on the x-axis (horizontal axis)?

   b) What is the range of that variable on this graph? _____

2. a) Think about where this data was obtained (you can look at the map at the bottom of the webpage under "Background Information"). From which hemisphere is this data collected (Northern or Southern)?

   _____

   b) Which months are summer? _____

   c) Which months are winter? _____

3. a) Focus on the top graph. What variable appears on the y-axis (the vertical axis)?

   _____

   b) Explain why this variable is used to indicate the amount of primary productivity. (Refer to your lecture notes or textbook if needed):

NAME_____

4. Describe how primary productivity changes over time by describing the pattern that you see in the first graph for the time frame shown.

5. On what specific date does the primary productivity peak? (Remember you can move your mouse over the line to view specific dates shown on the top right of the graph) _

   _____

6. What factors do you think will have the greatest effect on primary productivity? (Refer to the lecture notes and textbook if needed)

7. a) Now examine the different parameters that you can select on the bottom graph. Start by leaving "Water Temperature" selected. What is the range of temperatures shown on the graph (be sure to give units too)?

   _____

   b) Convert those temperatures to Fahrenheit by using the formula (__^{o}C x 9/5) + 32 = __^{o}F
   Give the temperature range of the data on the graph in degrees Fahrenheit:

   _____

   c) During which month does the water temperature reach its maximum at this location?
   _____

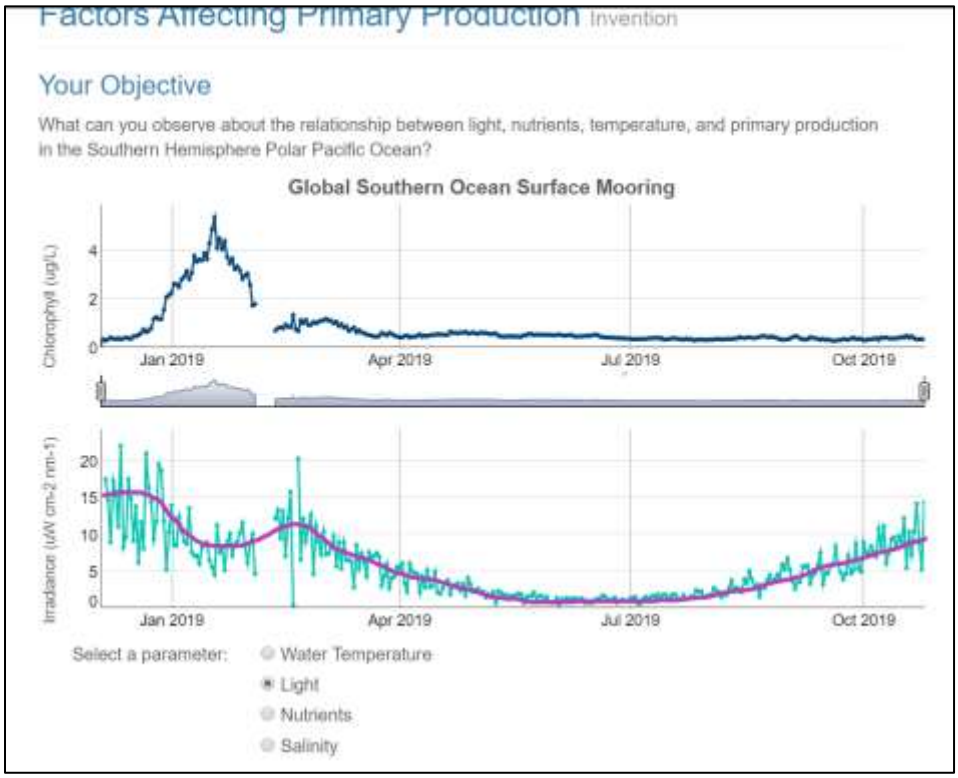
   d) Does the peak of phytoplankton production correspond to the warmest temperature?

   _____

   e) Now put all of this information together and compare the patterns of primary productivity and temperature. Summarize and explain any relationships that you see:

NAME_____

8. Now select the parameter "Light" on the bottom graph. There is a great deal of variation in light levels as cloud cover and other factors can affect the amount of sunlight on any given day. Focus on large scale trends instead of day to day variations in the graph. For example, on the picture below I drew a purple line that represents approximate average light levels over longer time periods and smooths out the daily variations.



a) Over which month are light levels the highest in general? _____

b) Is primary productivity increasing or decreasing during the month when light levels are highest?

_____

c) What happens to light levels during the peak of primary productivity? Do they increase or decrease? _____

d) Remember that phytoplankton are the main primary producers and that high primary productivity (chlorophyll levels) indicates a large amount of phytoplankton in the water. Explain how and why having a large amount of phytoplankton in the water would affect light levels.

NAME_____

e) Now put all of this information together and compare the patterns of primary productivity and light levels. Summarize and explain any relationships that you see:

9. a) Now select the parameter "Nutrients" on the bottom graph. What is the variable plotted on the y-axis (vertical axis)?

_____

Aside from nitrogen (nitrate is one form of nitrogen), what other nutrients do primary producers need (refer to the lecture notes or text if needed):

_____

b) Over which months or season are nutrient levels the highest in general? _____

c) Do nutrient levels increase or decrease during the peak in primary productivity? _____

Explain why.

_____

e) Now put all of this information together and compare the patterns of primary productivity and nutrient levels. Summarize and explain any relationships that you see:

10. Synthesize your overall observations by explaining which factors lead to the pattern of primary productivity shown:

NAME_____

Part 2: Predicting Factors That Affect Primary Productivity

Go to the Factors Affecting Primary Productivity- Application webpage. When the site loads, at the top of the page where it says Variable 1 – Light, you will be viewing graphs showing the chlorophyll concentration and the light levels at a site in the Southern Ocean that lies north of Antarctica, to the west of the southernmost tip of South America in the Pacific Ocean.

Answer the following questions about the graphs:

1. a) What range of dates are shown on the x-axis (give months and years)?

   _____

   b) How does that compare to the graphs in Part 1 of this lab (refer to Question 1b from Part 1)?

   _____

2. The top graph shows the pattern of primary productivity for a three-and-a-half-year period, but the bottom graph only shows the light availability for the last several months of that time frame. Based on what you learned about light level patterns and their relationship to patterns of primary productivity in Part 1 of this lab, you are to predict what the light levels would be for the missing part of the graph (from December 2015- December 2018). On the bottom graph, use your mouse to draw your prediction for what the rest of the light level (Irradiance) dataset should look like. After you have made your estimate, click the "Check Prediction" box to see the actual observed data. Take a screen shot of the graph with your drawn prediction shown and paste it into a word file that has your name at the top.

3. Scroll down the page to "Variable 2- Nutrients". Once again, the top graph shows the pattern of primary productivity for a three-and-a-half-year period, but the bottom graph only shows the nutrient levels for the last several months of that time frame. Based on what you learned about nutrient level patterns and their relationship to patterns of primary productivity in Part 1 of this lab, you are to predict what the nutrient levels would be for the missing part of the graph (from December 2015- December 2018). On the bottom graph, use your mouse to draw your prediction for what the rest of the Nitrate dataset should look like. After you have made your estimate, click the "Check Prediction" box to see the actual observed data. Take a screen shot of the graph with your drawn prediction shown and paste it into the same Word file that you pasted your light level prediction graph in. Save the file and submit it with this completed worksheet.

Unfortunately, due to an instrument issue, we do not have a complete record of nitrate data for this location. However, based on what you can see from the relationship between chlorophyll and nitrate for the periods where we do have data, explain your reasoning for your prediction?