

Lesson Plan, Oceanography Spring 2020 – Natasha Gownaris, OOI Data Labs Fellow 2020
OOI 4: Primary Production

Audience:

100-level Oceanography class, 35 non-major students (mostly juniors and seniors); Gettysburg College, PA

Time Allotted:

~30 minutes, in-class activity conducted during Coronavirus remote learning (students allowed to log off or stay on and work in groups in breakout rooms)

OOI Data Exploration:

<https://datalab.marine.rutgers.edu/explorations/productivity/activity1.php>

Learning Goals:

- Describe spatial and temporal variation in primary production based on chl_a data
- Apply knowledge of limiting factors (nutrients, light, stratification) and evidence from data to understand the drivers of this variation
- Understand the concept of CDOM and its relationship to primary production
- Differentiate bottom-up vs. top-down and biotic vs. abiotic factors that influence primary producers
- Develop an appreciation for the importance and diversity of phytoplankton

Prior Knowledge:

In my Oceanography class, we discussed primary production throughout the semester, but I saved the nuanced discussion of this topic until the last portion of the course (which focuses on biological oceanography and marine ecology/conservation). Students have therefore learned about relevant concepts in chemical oceanography (nutrients, acidification, etc.) and physical oceanography (stratification, upwelling, etc.). Before this activity, students learned about the types of phytoplankton, seasonal and temporal variation in productivity, top-down and bottom-up factors influencing productivity, and marine food webs/the role plankton play in these food webs.

Invitation:

A subset or combination of the follow brief invitations can be used to get students interested in (and visualizing) plankton

- 1) A brief video with amazing visuals called "The Secret Life of Plankton".
https://www.youtube.com/watch?v=xFO_fO2D7f0.
- 2) The "Drop of Seawater" photo can be used to talk about how phytoplankton are sampled and to show the diversity of plankton (phyto and zoo).
<http://www.deepseanews.com/2014/05/the-sea-is-full-of-life-but-not-quite-that-full>
- 3) A "1-Minute Science" audio clip about phytoplankton fleeing zooplankton.
<https://www.scientificamerican.com/podcast/episode/marine-plant-flees-predators-12-10-05/>

Exploration:

Students are asked to examine annual trends in chl_a levels without other variables and describe any seasonality in these trends. Students are also asked to hypothesize drivers of these trends and to question whether these trends fit the expected "textbook" diagrams (with spring and fall blooms).

Concept Invention:

Students will be asked to read about CDOM, a concept we did not specifically cover in class. We did, however, discuss light absorption in the ocean and the fact that high sediment loads can lead to lower rates of primary production.

Application:

Students then "test" their hypothesis by zooming into two periods – one where they expect sunlight to be higher and one where they expect sunlight to be low – and to describe the relationship they see.

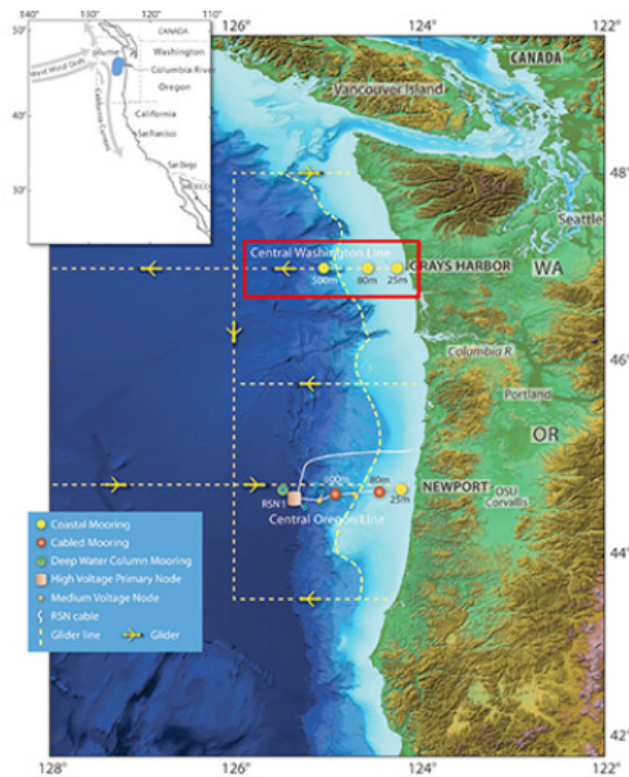
Reflection

Students are asked to brainstorm and come up with at least one top-down and one-bottom factor that we do not have data for but that would be useful in understanding this system. They are asked to describe how they would expect this factor to interact with primary production.

Name:

Primary Production in the North Pacific Ocean

Today, we are going to explore seasonal trends in primary production off the coast of Washington and link these trends to variation in colored dissolved organic matter.



Seasonal Patterns in Primary Production

1. Briefly describe the seasonal patterns you see in primary production throughout the year at the Coastal Endurance Array off the coast of Washington.
2. Do these patterns match those we expect to see in temperate regions?

3. Briefly describe some of the drivers of the seasonal patterns you see in primary production.

Colored Dissolved Organic Matter



Source: <https://earthobservatory.nasa.gov/images/88906/hurricane-matthew-floods-the-carolinas>

First, take a couple of minutes to read through the Wikipedia page on [CDOM](#).

4. Do you expect CDOM to show a positive or negative relationship with chl_a?
5. Test your hypothesis by zooming into two time periods, one where you expect there to be high sunlight availability and one where you expect there to be low sunlight availability. Briefly explain the patterns you see and any relationships between CDOM and chl_a.

High

Date Range:

What do you see?

Low

Date Range:

What do you see?

Other Factors Influencing Phytoplankton

6. What are two variables that were not measured by this study but that you think would help you to understand phytoplankton dynamics in this system? Discuss at least one abiotic and one biotic variable.
7. Do these variables influence phytoplankton abundance through top-down or bottom-up mechanisms?