# Ocean Color: Student Booklet

In this activity you will be looking at ocean color images obtained from satellites. All answers to the questions below should be noted on a separate sheet of paper or notebook.

1. Go the Landsat 7 website at http://landsat.gsfc.nasa.gov/education/compositor/. Landsat 7 is a NASA satellite specifically designed to take images of the planet in seven different wavelengths of light.

2. Read through this webpage and complete the questions as you go. Write down your answers on a separate piece of paper before clicking "answer".

3. At the end of the webpage, try your hand with the Landsat 7 Compositor. This is where you can combine different images.
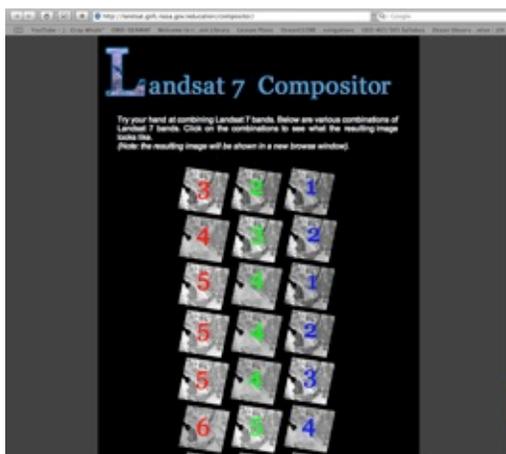

Questions: **What do the different bands show? What do the three bands in each image tell you?**

4. Now go to NASA's Ocean Color website: http://oceancolor.gsfc.nasa.gov/

    ▪ Click on "Level 1 and 2 Browser", this will bring up a data interface for you take a look at ocean color imagery.
    ▪ Under "mission" look for "2008", to the right of this click "Sep" (this will refresh the screen)
    ▪ Now on the world map image, click as near to West Coast/Oregon as you can
    ▪ Once the next page is loaded, choose an image to view. Try to choose an image that is roughly 50% ocean, 50% land (land is brown).

This should bring up three versions of the same satellite image: true color (like a photograph), ocean color (chlorophyll) and sea surface temperature (SST). Look closely at these images.
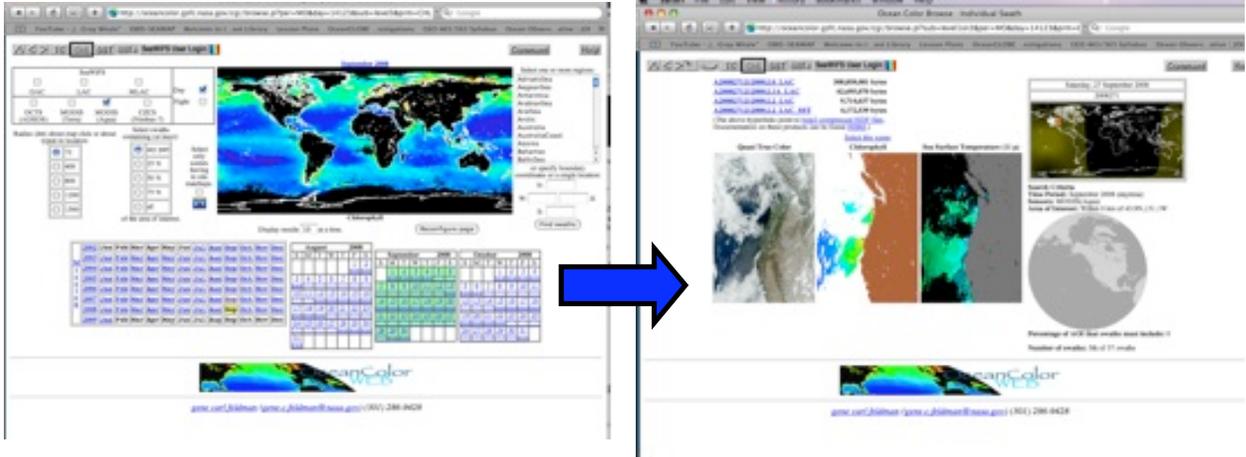
Questions: **What is the difference between the exposed ocean (i.e. no clouds) in the true color and false color images? What effect do clouds have on false images?**

5.   Now go the NASA Giovanni website:
     (http://reason.gsfc.nasa.gov/OPS/Giovanni/ocean.seawifs.2.shtml).

Here you will be able create your own ocean color images! This particular site will help you produce underline monthly satellite imagery, where an entire month's satellite data is composited into one image. This is on contrast to the last images you looked at, which were daily.

First, make a test image by putting in the following parameters:

West Longitude: -160 North Latitude: 65
East Longitude: -120   South Latitude: 20

Parameters: Chlorophyll a concentration
Data Type: Parameter
Plot Type: Lat-Long Map Time-averaged
Begin Years: 2008 Begin Month: August
End year: 2008   End Month: August

Color options: Pre-defined
Time series Plot Y axis: Dynamic
ASCII Output Resolution: 1.0
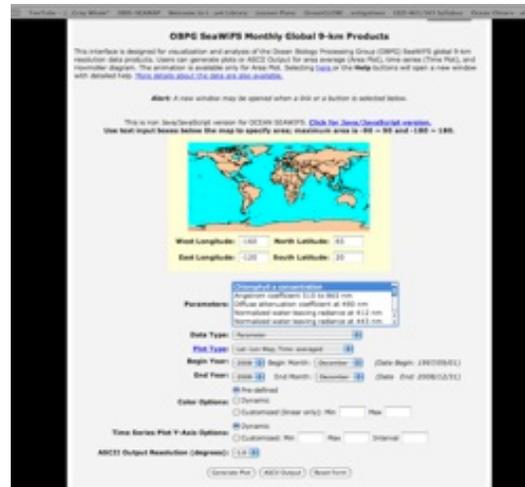
Click "Generate Plot"

The image this creates shows chlorophyll concentration in the North Pacific Ocean. Use the color bar on the right of the image to determine the scale, all concentrations are in milligrams of chlorophyll per cubic meter of water (mg/m^3)

Questions: **Where are the gaps in data from cloud cover?** (Note down the approximate latitude and longitudes). **Do you think this monthly image shows more or less data than the three daily images from the ocean color website? Why?**

6.   Make a similar plot, only changing the Begin and End months to December.

Questions: **How is this image different to the August 2008 image? Why would there be a difference in chlorophyll concentration between these months?**

7.   Now create an animation! Change the following parameters:

Plot Type: Animation, Lat-Long Maps
Begin Year: 1997   Begin Month: September
End Year: 2008   End Year: September

Generate the plot (this may take a while!). To play the animation, click "S(0)", then ">". Speed up the animation by clicking "+"
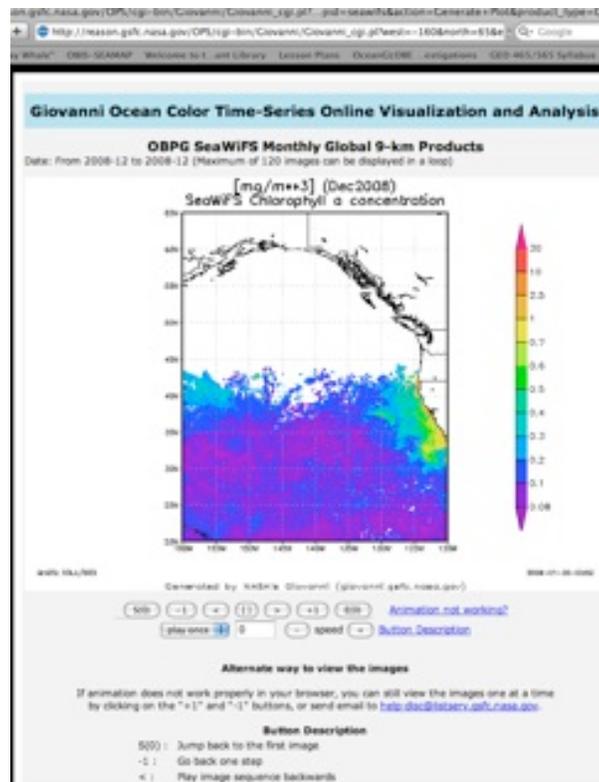
Questions: **Do you see any repeating patterns in chlorophyll concentration?** (Pay attention to the middle of the Pacific Ocean). **Where are the highest chlorophyll concentrations generally located? What time of year shows the most cloud cover? How do you know this? Are there any unexpected patterns forming?**

8.   Now create your own images. Explore different latitudes and longitudes (i.e. different oceans than the North Pacific).

Questions: **What similarities and differences do other oceans show? Which is more productive, the Pacific Ocean or the Atlantic Ocean?**

9.   Lastly, take a look the TOPP (Tagging of Pelagic Predators) data site at:
        http://las.pfeg.noaa.gov/TOPP_recent/. This website uses ocean color data
        alongside animal tracking data.

- On the left side of the screen click "Browse all tracks" and choose one of
  links to cetacean images. This will bring up a screen of different
  animations.
- Explore these animations by clicking "forward" to play any of them. Once
  you have explored this page, click the back button and take a look any
  other data from another marine animal of your choice.

Questions: **Why is ocean color data useful when tracking marine animals? Are there
any patterns between the information ocean color is presenting and the tracks the
different animals are taking?**