GIS, Satellite Remote Sensing, and Oceanography
Part 2

The SMILE Program
Teacher Handout

The last lesson looked at some of the seasonal changes in Sea Surface Temperature (SST), and Ocean Chlorophyll (or Color). This lesson addresses more about plankton and other biology connections.

Look at the biological data:

First click on the ocean color for the early summer months, in this case June

Click on the first Birds Layer for June:

The larger and more darkly colored circles represent higher bird concentrations.

Click the select tool and highlight some of the birds.

Written Questions: In the space below write you answer

What species of birds are in this area?

Where are the birds located?

Write down three common names in the space below

Then type a name into Google and click on the Images tab at the top

Google should show you a picture of the bird sited.

Before moving on, click off the birds layer, then click on the mammal data for June.

Repeat the same process for the August images
First look at the Birds, then the Mammals

To review: look back at the SST from both periods then at the Chlorophyll for both periods

Discussion Question: Phytoplankton are very small plants, so they need light and water to grow. Why then does the phytoplankton grow best close to or just off shore? What else to they need to grow?

If we look back at the sea surface temperature we notice that the cold water that is upwelling is where the phytoplankton grow best. Why is this? With the circulation of the ocean off the coast, cold water from the bottom of the ocean is brought up to the surface. Along with the colder water come nutrients from decaying animals and plants in the ocean. The key component that is missing in other places in the ocean for growing abundant phytoplankton is nutrients.

The change in quantities of nutrients off the coast varies from low productivity in the winter, to high productivity in the summer due to no upwelling in the winter to large upwelling circulation in the summer. Since phytoplankton is at the bottom of the food chain it is the grass of the ocean that other larger animals eat. As the phytoplanktons grow in large numbers other larger animals move in to take advantage of a good food resource.

Discussion Question: Why are we interested in measuring chlorophyll?

Chlorophyll is the main pigment in plants that is responsible for photosynthesis, a plants process of turning sunlight and nutrients into energy. Phytoplankton the most abundant plant in the ocean and we can see on the SeaWiFS images where the highest concentrations of phytoplankton exist.

Discussion Question: Why is phytoplankton important in a larger sense?

Phytoplankton is the grass of the ocean, where the phytoplankton grows so do the larger organisms in the ocean. If two large a phytoplankton bloom occurs this can be bad because the plankton use a lot of oxygen in the water and can drive the levels down so low that the animals in the water can't get enough oxygen and die.

Discussion Question: What eats phytoplankton?

Zooplanktons, which are tiny animals, eat phytoplankton. Small fish and other sea creatures eat zooplankton and on up the food chain.

Discussion Question: Where are the bird and mammals most often sited?

The birds and mammals are still for the most part in the same areas that have the higher concentrations of phytoplankton. This is again because the small animals eat zooplankton, which eats the phytoplankton. The big animals of course eat the smaller animals so they are going to move to where the food is abundant.

Click the Ocean Color, the birds for June on, the Mammals on, and the phytoplankton,

Then do the same for the August data

Discussion Question:

What are some of the large assumptions we are using when we look at the data in the IMS and make connections?

1. **All the data was taken on the same day at the same time**.
   What is really going on: The SST is from one day with the fewest clouds. The Ocean color image is a composite of 8 days worth of data. The largest value in each cell from 8 days was then used to make a composite image of ocean color. In order to make viewing easier the biological data was divided into to two time periods, for example: the Bird Layer for June is made up of dates from 2^{nd} - 4^{th}, 7^{th} – 8^{th}, 12^{th}.

2. **In a static map display as in the case of the IMS we tend to not think about the points as mobile**.
   Birds and mammals are defiantly very mobile, and if the data is taken on multiple days what are the chances the surveyors are counting the same birds in different locations? How would we account for that?

3. **Same Colors Different Values!**
   We only have so many colors to make a scale from and have it easy to read. In the SST images if we used the same colors over the same values for both images we wouldn't be able to see the temperature variation. For example the Red on the first image may start at 15, while on the second image it could start at 19. When looking back and forth between the two we may think the same color is the same value but this may not be the case.

4. **The real world is 3-D, maps are flat.**
   In the 2-D map view, especially with ocean data, we are not dealing with the 3^{rd} dimension, which is way more expansive than just the surface of the ocean. All the data we looked at in this site maps well in 2-D so it was selected for use in this project but there are many more important relationships at work under the surface of the ocean.

5. **It is easy when looking at a map to assume that all the data was collected without errors and in the same way**.

This is not always the case. There may have been some equipment failure, or in a visual survey for Birds or Mammals how do you account for differences in data collectors. Examples of possible variations between different sets of data: one was collected during the day the other at night, one used an old method another a new method, it could have been foggy for an hour, or a whole day of the survey.

On the same map we tend to think they everything is homogenous but this is not always the case. We need to look into the metadata (data about data) to see how it was collected and ask questions about potential problems with making comparisons between the data. One chlorophyll layer may have been collected in a band from 990-1110 and another may have been from 1000-1120.