Remote-Sensing Satellites: **Learning about the ocean from space!**

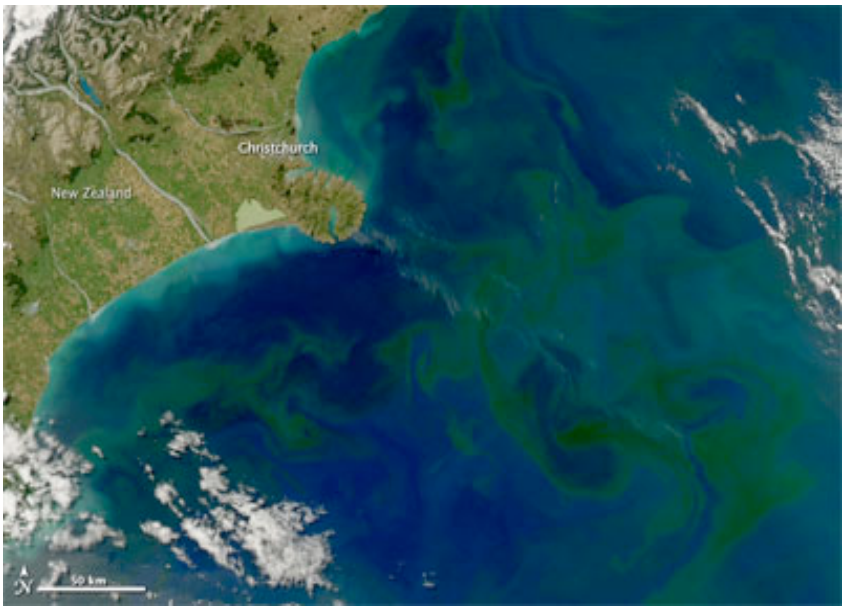
Did you know that viewed from above the ocean is many different colors? Water in the open ocean far from land is as transparent as glass, a deep navy blue when viewed from above. So why is it sometimes shades of green, brown and even red? Scientists are collecting data about phytoplankton and their chlorophyll to distinguish different types of water and the constituents that determine a particular color.

NASA in collaboration with the scientific community designed a sensor machine that would could collect very specific data. The sensor mounted to a rocket was launched into space via an airplane and sent out into orbit. The sensor is called the SeaWiFS. The SeaWiFS is flying 705 kilometers above the Earth collecting and transmitting data.

How do satellites work :
Earth observing satellites measure the characteristics of light, or radiance, coming from the Earth's surface. The SeaStar satellite carries the SeaWiFS instrument which is designed to monitor the color of the world's oceans. Various ocean colors indicate the presence of different types and quantities of marine phytoplankton

Sensors such as SeaWiFS can "see" phytoplankton because the chlorophyll-bearing phytoplankton reflect predominantly green light back into space as opposed to the water itself which reflects predominantly blue wavelengths back to space.

Further evaluation of the satellite generated radiance data will determine the concentrations of phytoplankton. The concentration is determined by comparing the satellite radiance values to standardized radiance values with known corresponding concentrations of phytoplankton and chlorophyll.



NASA image of phytoplankton off New Zealand

The satellite will monitor subtle changes in the ocean's color to assess changes in marine phytoplankton levels, Complete coverage of the Earth's oceans will occur every two days.

How can satellites be used to study HABs:

If scientists can define a relationship between certain amounts of plankton (or chemicals made by plankton) with a certain radiance measurement, then they will be able to make a pretty good estimate of what amounts and kinds of plankton might be living in a particular place just by measuring the radiance. This would be very useful because a satellite can measure radiance much faster than a scientist can count and categorize lots of tiny sea creatures!

Radiance can be used to estimate other kinds of measurements, such as the amount of chemicals being produced by algal blooms. This can indicate both the amount of phytoplankton present, as well as their health. One chemical commonly produced by phytoplankton is chlorophyll, a pigment used in photosynthesis. Chlorophyll has a very recognizable green color that stands out form the blue color of the ocean. If only one type of phytoplankton lives in a particular part of the ocean, then it is fairly easy to calculate the concentration of that phytoplankton based on the color of the chlorophyll--The darker the color, the more phytoplankton exist. But if there are many different types of phytoplankton, plus other kinds of particles in the water, it is much more difficult to use this data to measure phytoplankton populations.

When scientists notice a sudden increase in the amount of chlorophyll being produced in a certain part of the ocean, that can indicate that an algal bloom is occurring. Scientists may need to do further tests to know whether the bloom is toxic or not, but by using satellite information they can find many blooms that they would not have known about without them.

Questions for students:

How can satellites "see" phytoplankton in the oceans?

Define "radiance." How can radiance be used to measure the amount and type of phytoplankton in a given area?

What do different ocean colors indicate? How can these colors be transferred to a satellite image?

Darker colored results don't always indicate higher phytoplankton concentration. Think of a different ocean condition that could result in a darker satellite image. What are some potential sources of error when using radiance?

How long does it take a satellite like SeaStar to get complete data for all of the world's oceans?

Use the internet to research a satellite that measures something else besides phytoplankton. Record your findings.

A useful page with information and wonderful images of oceans and phytoplankton blooms:
http://science.nasa.gov/earth-science/oceanography/living-ocean/remote-sensing/

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