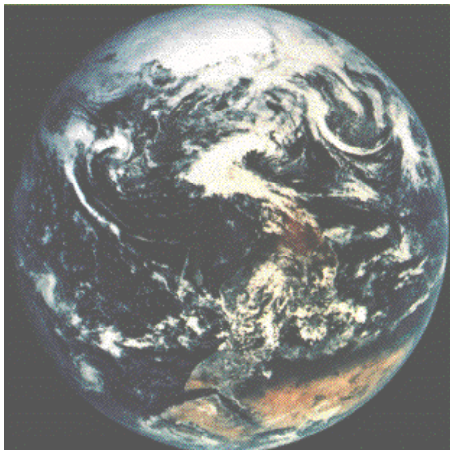
Woods Hole Oceanographic Institution
Ocean Explorer
Vol.4, No.4 May 1995



Here's our home planet, as seen by a computer that got its data from satellites and earth-based instruments. The image combines the topography of continents and the Earth's vegetation.

THE SEA FROM SPACE

When astronauts first traveled to space in the early 1960s, they sent back photographs that showed us our home planet as it really is: a fragile, beautiful sphere, spinning in a lonely orbit in the universe's endless night. From outer space, it's easy to recognize that solutions to problems on the earth must be global, not local.

Oceanographers have always viewed the world ocean as one continuous system. They work to understand the effects of this system on the planet as a whole. They know, for example, that the ocean plays an important part in regulating the earth's climate.

Data collected over the last twenty years indicates that the earth's climate may be heating up, maybe because of natural temperature fluctuations, or maybe because of the release of carbon dioxide into the atmosphere caused by human activities, such as driving cars and operating factories.

Scientists need to know as much as they can about how the ocean affects climate. Studying the sea from space may someday help answer some big questions about how the world's ocean works.

This issue, Ocean Explorer will take you to the skies. You'll find out how oceanographers use pictures from space to grasp the Big Picture.

HOW CAN SUCH TINY PLANTS COVER SO MUCH TERRITORY?

"The stunning patterns hit you," says Heidi Sosik, a WHOI biologist. She's talking about the images she studies that were made by a sensor called CZCS (short for Coastal Zone Color Scanner). From 1979 to 1986, it circled the globe, sending home never-before seen pictures of phytoplankton growing on the sea surface. Scientists are still working to understand these images

"You can go out for months on a ship and cruise around, but you just don't get that type of image," says Heidi. "The images really give a different perspective of the system as a whole."

Heide Sosik with cultures of phytoplankton

Heidi studies the life of microscopic, one-celled drifting plants called phytoplankton that are the basis of the oceanic food chain. "They supply food for all the rest of the ecosystem," says Heidi.

"If you're interested in food production, or how much food is available for fish or whales or even people, you need to know something about what controls the production of the plants."

Because these microscopic phytoplankton take up carbon dioxide ($C0_2$), they also play a role in the global climate that it not yet well understood. Knowing where, when, and why large-scale blooms of these plants take place, and knowing how much $C0_2$ each plant absorbs will help answer big questions about how the earth as a whole uses $C0_2$.

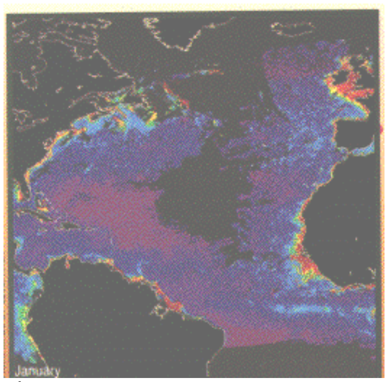
"We're trying to understand how the types of material present in the ocean interact with sunlight," says Heidi. To do this, Heidi and her fellow scientists work on two scalesÑthe gigantic and the microscopic.

FROM MACRO TO MICRO

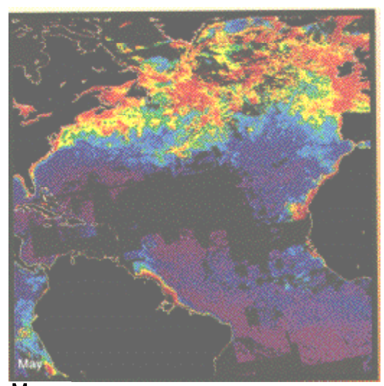
On the gigantic scale, they study images taken by the Coastal Zone Color Scanner. Some of those images are shown on these pages.

How did the CZCS make its images? Pure ocean water appears deep blue. Added materials can change its color. Like all plants on earth, phytoplankton contain the chemical chlorophyll, which absorbs blue light and reflects green light.

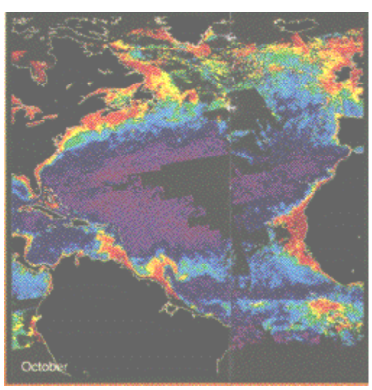
Looking down on earth from high in space, the CZCS sensor was much more sensitive than the human eye, and could detect very subtle variations in ocean color, caused by phytoplankton and other material. When the images were processed, their colors were changed to make the variations as easy to see as possible.



January



May



October

The Rise and Fall of Phytoplankton

In these three images, made by the Coastal Zone Color Scanner, you can see the rise and fall of phytoplankton blooms in the North Atlantic. The largest concentrations of phytoplnakton appear as bright orange. In January, 1979 (top left) there was relatively little phytoplankton growth. In May (top right, the ocean was full of phytoplankton, particularly in the northern portions. By October (left), the plants had died away once again.

HOPES FOR THE FUTURE

While much is learned from these images, the system is far from perfect. For one thing, new data stopped coming in 1986. Since that time, oceanographers have been studying the images that came back, trying to learn as much as they can from them. Many scientists are also looking forward to the launch of a new color sensor called SeaWiFS (which stands for Sea-viewing Wide Field-of-view Sensor). Another problem is that the data that was returned is too general for Heidi's needs.

"When all those beautiful images were processed, it was done with the assumption that all the phytoplankton were the same," she says. "It was the only thing we could do, basically. It was sort of a first cut. It was crude, but it was also extremely valuable."

She has learned through her own research that individual phytoplankton process $C0_2$ at varying rates, which are much too subtle for a distant satellite to record. To answer the questions that drive her research, she works with WHOI scientists Robert Olson and Alexander Chekalyuk to find ways to measure each organism's rate of photosynthesis (the process by which the plant converts light from the sun, $C0_2$ and water into food for itself).

Heidi looks forward to reaching this understanding, and inserting her own piece in the overall puzzle of global climate change.