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GLOBAL WARMING DRIVES NEW OCEAN TESTING

New instruments being tested on a platform in the Atlantic Ocean will help scientists to gain a more precise understanding of how the Earth's oceans relate to the problem of global warming and could eventually be used to detect coastal problems such as red tides.

The new underwater instruments include "HiROS," a high resolution optical system developed by researchers at the University of California, Santa Barbara. The instruments are placed on a buoyed platform called the Bermuda Testbed Mooring (BTM).

The mooring, located 80 kilometers off the coast of Bermuda, is a deep water platform for testing and comparing new oceanographic instruments. First deployed in 1994, it is an international, interdisciplinary research effort led by UC, Santa Barbara and funded by the National Science Foundation (NSF), NASA and the Office of Naval Research (ONR).

The Bermuda Testbed Mooring contains more than a dozen

technologies developed by a number of institutions -- from Woods Hole Oceanographic Institution to the University of Paris -- located from the surface to 205 meters below the surface. UCSB scientist Tommy Dickey calls it one of the most highly instrumented moorings ever put in the ocean, as well as the most diverse set of sensors on an ocean mooring.

Dickey, principal investigator and professor of geography at UCSB, will present a talk about research being conducted at the mooring on August 24 at the American Chemical Society National meeting in Boston.

"Global warming is one of the big drivers," said Dickey of the effort to improve scientific understanding of the world's oceans by getting more and better data from new chemical and bio-optical sensors on the deep ocean platform. "We do a lot of interdisciplinary things, we're trying to see how physics and chemistry and biology all fit together and how they affect each other."

Carbon dioxide, one of the key greenhouse gases that contributes to global warming, is taken up by phytoplankton (microscopic marine plants), just as it is by plants on land. Tracking the various types of phytoplankton, their chlorophyll production cycles, growth and movements helps scientists to understand the global carbon cycle, and hence climate change.

To study phytoplankton and to separate it from dissolved organic material, scientists from UCSB, in collaboration with WET Labs, Inc., have developed HiROS, which was installed on the BTM just a few months ago by university researchers.

HiROS measures light in the visible region at 100 wavelengths -- very high spectral resolution -- and allows scientists to measure the absorption and attenuation of light. By studying these optical qualities of the ocean water, scientists can determine what it contains. A goal is to differentiate the types of phytoplankton.

"We are trying to sort out phytoplankton by groups," said Dickey. "Different phytoplankton have different absorption characteristics. Some might absorb more light in the red part of the spectrum, while others might absorb more in the green or the blues."

Certain types of phytoplankton tend to grow more at certain times of the year. For example, diatoms tend to thrive in the spring in mid-latitudes. Because this type of phytoplankton is relatively large and sinks rapidly, it contributes proportionately more to the carbon flux in the deep ocean than

smaller types of phytoplankton. As diatoms sink, they "export" particulate organic carbon from the upper ocean to the deep ocean, reducing carbon dioxide availability in the atmosphere.

Observations from the optical instruments on the moored platform provide scientists with far more information than could be obtained by taking samples from ships, the usual way that data has been gathered. "In the past, toreally do detailed kinds of analyses of plankton, people went out on ships --which is very expensive -- and took water samples, then put the samples under microscopes," said Dickey. "But only a very limited number of samples can be taken, and studying them under microscopes is very tedious, slow and labor intensive, plus you can't see the variability. With the new technologies you can see how the populations vary on time scales of minutes, and hopefully over very long periods of time, over years. That's a very distinct advantage of the new system.

"In a sense we're automating the whole process, to get lots more samples so we can understand more about how the ecology of the upper ocean works in terms of phytoplankton and the zooplankton that graze on them. We also measure the available light, available nutrients, and

temperatures."

Dickey explained that plankton respond on very short time scales, so their ability to absorb light fluctuates, even clouds going over or waves can affect them. They change their pigments and their physiological conditions, to absorb more light, or in some cases to protect themselves from too much light. "So you need to sample rapidly in order to see those kinds of changes. And, certainly, there are very important things that happen on the daily cycle, with the turning on and off of the sun. The doubling time for a lot of these plankton is from a half day to maybe two or three days. These fast fluctuations are yet another argument for the rapid kinds of sampling that we can do with these automated systems."

After the data are collected on the mooring, they are sent to the surface buoy where they are relayed via satellite back to shore using "near-real-time telemetry."

Measurements taken by the moored optical instruments are also used to "ground-truth" satellite observations, as well as to see exactly what optical characteristics of the water match up with observations made by satellite.

As the lead institution, UCSB directs and organizes the operation of the mooring. In terms of the technological and scientific work, UCSB is focused on physics and optics. The ocean engineering for the physical mooring and the hardware of the buoy and weights are managed by Woods Hole Oceanographic Institution. The telemetry operation is a joint project between Woods Hole and UCSB.

Funding for the Bermuda Testbed Mooring has just been renewed for three years by the NSF and NASA and will be supplemented with a new grant (Ocean Systems for Chemical, Optical, and Physical Experiments, OSCOPE) to UCSB and five collaborating laboratories under the National Ocean Partnership Program (NOPP). NOPP facilitates oceanographic research by partnering academic institutions, government laboratories, and private companies through funds provided by NSF, ONR, NASA, NOAA and other agencies.

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