Scientists deploy underwater observatory to track warming, acidic buildup

Coleen Jose, Environment & Energy Publishing, 9-24-13

Equipped with scuba-diving gear off the coast of Motobu Peninsula in Okinawa, Japan, scientists from the United States and Japan carried parts of a machine that is one of the first to serve as an underwater observatory that monitors temperature, salinity, and other chemical, physical and biological data in the Pacific Ocean.

As expeditions that traverse hundreds of miles of ocean become increasingly difficult to fund, scientists are turning to innovations in technology and data storage to monitor and project changes in the ocean. The observatory, dubbed the "OceanCube," is the result of a years-long partnership between scientists at the Massachusetts-based Woods Hole Oceanographic Institution (WHOI) and the Okinawa Institute of Science and Technology Graduate University (OIST).

The OceanCube is situated 2 miles offshore, with a central node sitting at a depth of 72 feet in a location known as a biodiversity hot spot. In addition to the high diversity of endemic species, plants and animals that are abundant in Okinawa's corals, the area is also the site of the confluence of two major currents in the Pacific Ocean.

"The location is a highly diverse area for coral reef fish and for corals themselves," said Scott Gallager, one of the principal investigators on the project and a scientist at WHOI.

"The idea is that we can quantify materials in a sample of water that will give us a base line of how the ocean responds to climate change and ocean acidification," Gallager said.

There are only a few oceanographic observatories around the world. A scientific expedition in Panama in the early 2000s, also led by WHOI scientists, led to the construction of the "Liquid Jungle Lab" on a remote island to enhance oceanographic research.

Sprinkle the sea with OceanCubes

The OceanCube, which is about double the size of an air conditioning radiator, is encased with plastic and is connected to steel-armored fiber optic cables snaking along the ocean floor. The cables transmit real-time data from the OceanCube to a laboratory inside the Okinawa Churaumi Aquarium.

The scientists opted for plastic to protect the heart or main node of the OceanCube because it is less prone to corrosion than metal. It protects sensors, acoustic Dopplers and 10 cameras attached to the observatory to gather second-by-second data.

The instruments calculate water motion and observe the underwater environment, creating a three-dimensional map of the current's velocity and the flux of water. As the ocean warms and fresh water from melting ice increases, scientists have yet to fully know how that will affect fish communities and coral reefs.

The changes will "induce large water meanders," Gallager said, meaning that water along the coast will roam out to the sea, causing large ringlike currents to form and, in some instances, trapping organisms within the circles. Plankton, a critical source of food for whales, tuna and numerous other fish, will be the first organism affected by the changing current, altering the composition and dynamics of the food web.

Only some species of plankton can adapt well to the changes in temperature and salinity.

"In the past 20 years, the frequency of rings has increased dramatically in five years compared to the changes that have occurred in decades," Gallager said.

The OceanCube is approaching its second week since being installed underwater. The scientists planned an earlier deployment in August but were stalled because of two typhoons.

"We can build a number of OceanCubes and spread them globally," Gallager said. The next observatory is planned to be deployed near the coast of Tokyo, while sites in Southeast Asia's Coral Triangle region, the Indian Ocean and the Arctic Ocean are being considered as future locations.

A network of underwater cameras

Rapid image capturing of microscopic organisms, such as single-celled protozoa, are adding to the collection of data that researchers are now using to create a picture of the sea change.

The cameras and microscopes attached to the OceanCube are equipped with strobes that light up the underwater darkness to provide microscopic exposures of the organisms. The imaging is "being perfected," said Gallager. Each image is transmitted through the fiber optic cables and is piped back to the laboratory on land.

The information gathered from the cameras amount to 2 terabytes of data each hour, which is a challenge to the amount of available data storage. The current technology allows the scientists to decide which images to keep because processing the images is automated, and the type of fish or organism is classified by the characteristic of each pixel.

Imagery in the ocean is becoming increasingly important in terms of data that scientists need to measure multiple physical and biological changes occurring underwater. In monitoring the movement of fish communities and their food source, the OceanCube may help alert regions to the state of their fish stocks.

"The big picture is to develop enough OceanCubes around the world so that we can begin to take synoptic measurements in each site and see how the world is changing at once," Gallager said. "We can build a story on what is causing the change."