Ocean Instruments

Salinity Sensors for Monitoring the Global Water Cycle

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A major uncertainty of global climate change is the degree to which the global water cycle will intensify with global warming. A warmer atmosphere can hold more water vapor; thus, stronger evaporation and precipitation patterns are expected to emerge as the planet heats up. This could mean more intense droughts in some regions and more catastrophic floods in others.

The oceans are key to understanding the future evolution of the water cycle. The oceans contain 97% of the planet's water and experience about 90% of the global evaporation and 80% of global precipitation. The patterns of evaporation and precipitation over the ocean are reflected in changing salinity patterns at the ocean surface. Understanding the global water cycle and its role in climate change will require a cost-effective monitoring effort that measures ocean salinity. Limited measurements of ocean salinity reveal striking trends that are the best evidence yet of a changing water cycle. However, the data are not yet available on a global scale.

A large number of surface-drifting ocean instruments are deployed every year throughout the global ocean. Unfortunately, these instruments do not include salinity sensors, largely because the salinity sensors available today have significant problems with biological fouling. Marine plants and animals grow on the surface of the sensors and impair their function. To solve this problem, we designed a new sensor that cleans itself. Our design includes time-released anti-fouling agents and a mechanically rotating head that sweeps clean the active area of the sensor. It was a challenge to design the sensor in a way that it could be swept and still operate efficiently. We utilized sophisticated numerical models to guide the design process and took advantage of new advances in electronics to achieve the desired end-product.

With support from the Comer-funded program at WHOI, we built and tested new salinity sensors. We tried different anti-fouling coatings on the sensor heads of two units and tested them in the water off the WHOI dock from August to November 2007. After a four-month test period, the support structures were heavily fouled on both units, but the sensing volumes remained clean (see figure). Overall, we were pleased with the outcome of our test and are proceeding with plans to install the new sensors on surface-drifting instruments scheduled for ocean deployment in 2008. Ultimately, this work will provide unprecedented monitoring capabilities for ocean salinity and enable the first truly global study of the water cycle.

When deployed throughout the world's oceans, salinity sensors such as these will help us better understand the global water cycle and its response to climate change.

[Left] Two salinity sensors, prior to their test deployment in August 2007. The sensing elements are at the lower ends, where a rotating mechanism sweeps the sensing volume clean on a regular basis. Two different anti-fouling agents were tested, one on each sensor.

[Right] The two sensors after a 4-month deployment at 1-meter depth at the WHOI dock. The support structures are heavily fouled, as is the rotating head of the right sensor. However, the sensing volumes (not visible here) of both units remained clean, due to the regular mechanical sweeping and time-released biocide.