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2009 Annual Report: Center for Ocean, Seafloor, and Marine Observing Systems (COSMOS)

The Center for Coastal Ocean, Seafloor and Marine Observing Systems (COSMOS), established in 2006, continued in 2009 to bring scientific oceanographic research opportunities to WHOI through ocean observatories and observing systems. Ocean observing systems integrate state-of-the-art instruments with stationary and mobile platforms, to collect real-time data over a region and through time. They enable scientists to obtain more oceanographic, chemical and biological information than can be obtained from ship-going activities. Observing systems are being established worldwide, and COSMOS is working with scientists at WHOI and at other universities and institutions to advance our ability to measure, monitor and analyze the fundamental processes shaping continental shelf ecosystems.

Enlarge Image

WHOI biologists Rob Olson and Heidi Sosik, the new COSMOS director, examine plankton-filled water samples on a prototype version of the Imaging FlowCytobot (IFCB) in Olson's Woods Hole laboratory. The Cytobot, which is automated and submersible, counts microscopic plants in the water and photographs them. The images and data are relayed by cable to a shore-based laboratory, where specially developed software classifies the plankton into taxonomic groups. The instrument was recently used to detect a bloom of harmful marine algae (*Dinophysis acuminata*) in the Gulf of Mexico and prevent human consumption of tainted shellfish.
(Photo by Tom Kleindinst, Woods Hole Oceanographic Institution)

Related Links

» Center for Ocean, Seafloor and Marine Observing Systems (COSMOS)

COMOS is involved in several major programs. It oversees the Massachusetts Technological Collaborative John Adams Innovation Institute (MTCJAII) grant, which supports four ocean observing initiatives. One is to improve marine and weather forecasts for New England through enhancement of National Data Buoy Center weather buoys. The second is to establish an acoustic communications test bed at the Martha's Vineyard Coastal Observatory (MVCO) to provide opportunities for academics, corporate and government users to test developing instrument technology. The third is to improve the MVCO as a science and technology facility. The fourth is for management of the project and outreach to regional industry and corporations interested in observing systems.

Now into the second year of funding, all projects have made successful progress. COSMOS will be working with the Commonwealth of Massachusetts to secure sequential funding that was initially awarded in the John Adams Grant as part of a match to the OOI (Ocean Observatories Initiative) Implementing Organization Award that WHOI received from the National Science Foundation (NSF). COSMOS is working with regional and national groups of researchers to begin coordinating plans for new science activities enabled by the new ocean observing infrastructure coming from OOI.

In September 2009, the directorship of COSMOS changed from John Trowbridge, who had been director since 2006 and is now chairman of the AOP&E department, to Heidi Sosik, a senior scientist in the Biology Department. She is also chief scientist of the MVCO, a role she will continue. One of her first activities as COSMOS director was to collaborate with others groups at WHOI on a recently funded proposal to the National Institute of Standards and Technology construction program for a $10 million building at WHOI for ocean observing systems work. In addition to housing the OOI program led by Bob Weller, the new building will provide new facilities for the MVCO team.

MVCO is operated through COSMOS. For the past eight years, this cabled observatory on the southern coast of Martha's Vineyard has collected and transmitted data from offshore instruments connected through an undersea power and communications node to an onshore station and ultimately to researchers, policy-makers and industry. The MVCO platform was used by various researchers in 2009 on a diverse range of topics.

- Rob Olson (Biology) and Sosik have been advancing the ability to continuously sample single celled marine microbes through flow cytometry. They have used MVCO to improve the durability and flexibility FlowCytobot and Imaging FlowCytobot, submersible flow cytometers developed at WHOI, and to collect unique time series that show changes in phytoplankton communities on the New England shelf. This new technology will vastly improve the ability of researchers to study ecological and physiological processes of marine microbes at ocean observatories.
- Trowbridge has supplied the sensor array at the offshore tower at MVCO with additional instrumentation to measure temperature, salinity, optical transmission, velocity and bottom stress. These instruments are supported continuously by the MVCO and greatly enhance coastal oceanographic research funded by the Office of Naval Research and other agencies.
- A collaborative research project, including Trowbridge, has been using a combination of MVCO sensors to characterize aggregation and disaggregation of particles from measurements of particle size, distribution and concentration in the water column near the seabed. Utilizing acoustical, wave and current measurements from MVCO, they are improving models that link the properties of particles with how light and sound travel through the coastal ocean.
- Burkard Baschek of UCLA, a former WHOI postdoctoral scholar, has collected a high-resolution time series of dissolved gases (CO_2, O_2, N_2) and supporting measurements (temperature, salinity, pressure, and chlorophyll a) at MVCO. Gas bubbles were measured using sound and optical cameras. These unique measurements will provide new knowledge about air-sea gas exchange mechanisms and bubble dissolution, especially how they are related to physical and chemical properties of the gases and affected by wind and wave characteristics. Ultimately this kind of knowledge will help us understand and predict effects of

climate change. This research is an on-going component of the SPACE '08 program at MVCO.

- Colm Sweeney (NOAA) is monitoring CO_2 and sampling air properties at MVCO offshore tower in support of the Carbon Cycle Gas Group greenhouse gas network at the NOAA Earth System Research Laboratory (ESRL). These measurements provide a vital eastern boundary data set that enables a more accurate assessment of the North American carbon ocean budget.
- Lee Freitag (AOPE) has continued research to improve underwater acoustic communication. His group will begin testing their new systems at the MVCO facility in the coming year.
- Sosik, with MVCO project manager Janet Fredericks and technicians Jay Sisson and Hugh Popenoe (all AOPE) have upgraded MVCO, adding new power and fiber-optic capabilities, enhanced continuity of core measurements, and on-line documentation and data access through the MTCJAII grant.

Another focus of COSMOS in 2009 was to work with partner institutions in NOAA's Integrated Ocean Observatory System (IOOS) program. WHOI coordinates and manages the funding of this NOAA project to partner institutions in the Northeast: Bedford Institute of Oceanography (BIO), Universities of Maine, Connecticut, New Hampshire, Massachusetts at Dartmouth and Rhode Island, the Gulf of Maine Ocean Observing System (now merged with Gulf of Maine Research Institute), and the Northeast Fisheries Science Center. The goals of this project are to build on the accomplishments of the past by continued operation of selected existing observing systems, and to enhance present–day observing capabilities. COSMOS efforts are in parallel with the Northeastern Regional Association of Coastal Observing Systems (NERACOOS) projects awarded in 2008—to Scott Gallager (Biology) for the Northeast Benthic Observatory System; to Hauke Kite-Powell (Marine Policy Center) for maximization of the socio-economic benefit of NERACOOS; and to Fredericks to work on the integration of procedures for quality assurance and quality control in real time ocean data.

COSMOS anticipates a new decade of innovative and exciting interdisciplinary research, building on ocean observing system capabilities to provide much needed measurements of ocean properties that influence our climate and ecosystems.

—Heidi Sosik, Center Director

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