Building Cross-Disciplinary Bridges: Graduate Education in Marine Sciences at the University of Connecticut

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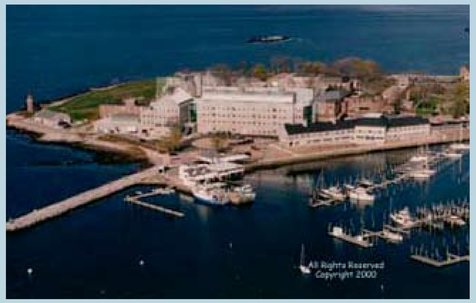
Abstract



Graduate students in the Department of Marine Sciences at the University of Connecticut, located primarily on the Avery Point campus on the shore of Long Island Sound, work toward M.S. and Ph.D. degrees in Oceanography. Their graduate education and training reflect the breadth of disciplines within the department, including biology, chemistry, geochemistry, meteorology, optics, and physics. Coordination with UConn's new GeoSciences Program adds further breadth. Graduate students currently complete a rigorous curriculum, with survey and specialty courses crossing all disciplines, although degree criteria are tailored to meet each student's educational and research goals. Curriculum planning ensures that graduate classes are available for in-depth study in the students' core disciplines, and students are urged to take advanced classes outside their discipline. Frequent seminars build common ground among the community of oceanographers at Avery Point, and an annual graduate research colloquium gives students the experience of a professional society meeting. An interdisciplinary coastal ocean observing project (LISICOS) serves as a professional training ground for students. To date, UConn has resisted the trend to further compartmentalize disciplines and specialize graduate education within oceanography. Marine Sciences has an excellent record of placing graduates in academic, research, regulatory, and private industry jobs upon graduation. We are now working to further evaluate the effectiveness of our essentially interdisciplinary approach in terms of professional success and satisfaction among our graduates.

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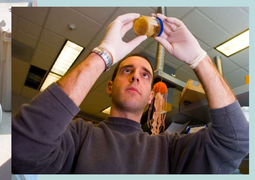
Biological Oceanography

Students at UConn Marine Sciences carry out research in Biological Oceanography, Marine Ecology and Marine Biology, although such distinctions are not formally recognized. Faculty interests range from genes to ecosystems, and current students study benthic population and community ecology, marine invasive species ecology, physiology, ecology and evolution of planktonic organisms (bacteria to gelatinous zooplankton), nutrient dynamics of coastal embayments and estuaries, effects of harmful algal blooms in coastal waters, biogeochemistry of microbial mats, ecology and biomechanics of shellfish feeding, and the role of marine protected areas in fish ecology.



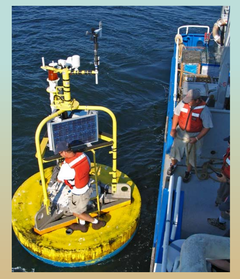
Marine Chemistry

Marine geochemistry seeks to define the biogeochemical reactions, fluxes, and interactions among the water, atmosphere, sediments, solid Earth, biota, and physical transport processes in the oceans, atmosphere, and the coastal environment over time and space. It aims to understand the processes that control the chemical and physical composition of seawater; abiotic and biotic chemical reactions in seawater, the atmospheric boundary layer, and sediments; the impact of biota on water chemistry; and the processes that control the fluxes of chemicals between seawater and the atmosphere, as well as seawater and the sediments.

Physical Oceanography

Physical oceanographers at UConn seek to understand the physical processes that determine the circulation in the coastal ocean. Research topics include the physical dynamics of estuarine and coastal systems, as well as how currents and density fields respond to winds, surface heat flux, tides, and buoyant river inputs.

With their students, researchers construct and test models and develop observational techniques. Interdisciplinary efforts include study of fundamental geophysical and environmental fluid dynamics, as well as the application of mathematical and statistical methods for the development of biogeochemical models. At UConn, physical oceanographic studies include analysis of water quality in river plumes, circulation in Long Island Sound, and mathematical models of environmental processes.

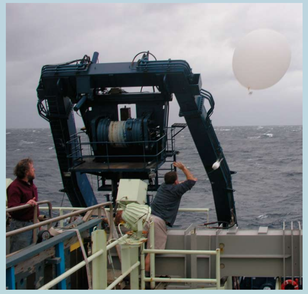


Interdisciplinary Education and Cross-Cutting Projects

The UConn Marine Sciences graduate program involves individually-tailored curricula that combine traditional core courses in the oceanographic sub-disciplines with interdisciplinary advanced offerings taught by specialists in each field, as well as intensive seminar courses on a wide range of topics. Our graduate degree program in Oceanography offers M.Sc. and Ph.D. degrees. Research and education in our department is enhanced by support facilities, which include a fleet of small vessels and our 76-foot RV Connecticut, a seawater facility with environmental controls, walk-in environmental chambers and clean rooms, an electronics shop, and a fully equipped dive program that offers SCUBA certification. The goals of interdisciplinary education and research training are furthered through departmental projects, programs, and facilities.

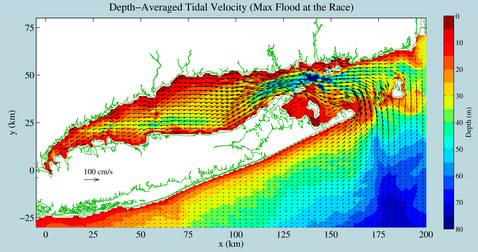
Marine Meteorology

An important focus of marine meteorology is how the atmosphere and ocean interact, i.e., air-sea interactions. One way to think about the processes that drive these interactions is as follows: 1) the ocean acts as a huge fuel tank that stores the sun's energy as heat, 2) this energy is released to the atmosphere to drive atmospheric circulation, i.e., storms, and 3) the resulting exchange of momentum from the atmosphere to ocean drives waves and currents. This exchange of momentum and energy represents air-sea interaction in a nut-shell. Our challenge to design experiments to investigate the key processes responsible for this exchange, and then to translate these findings into results that can be incorporated into numerical models to improve atmosphere and ocean forecasts.



Coastal Ocean Modeling

Researchers at UConn adapt hydrodynamic models to construct simulations and idealized process models. Realistic simulations are powerful tools for describing flow fields, diagnosing physical dynamics, and predicting circulation in coastal and estuarine waters. The idealized process models are well-suited to isolating forcing-response relationships and generalizing findings.



Center of Marine Molecular Analysis (COMMA)

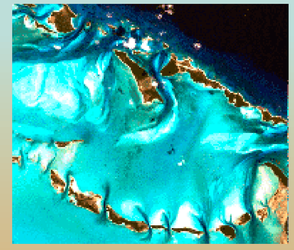
In 2005, the Center of Marine Molecular Analysis (COMMA), a multiple-user molecular facility, was established on the UConn – Avery Point campus. The COMMA facility includes standard molecular genetic apparatus, automated DNA capillary sequencers, a real-time PCR machine, and associated computers and computer software. Additional molecular and biotechnology resources, facilities, and expertise are available at UConn's Center for Applied Genetics and Technology, on main campus at Storrs, 40 miles away from Avery Point. Marine Sciences students have many opportunities to learn about and integrate new molecular approaches into their research efforts.

Long Island Sound Integrated Coastal Observing System (LISICOS)

The goal of this interdisciplinary coastal observing effort is to develop capability to observe and understand the LIS ecosystem, and to predict its response to natural and anthropogenic changes. LISICOS comprises observational, process and modeling studies. The current focus of process studies is on the problem of eutrophication and hypoxia. One function of LISICOS is graduate student training. Currently, two Ph.D dissertations and two Master's theses have been directly developed within LISICOS, and another six Ph.D students use LISICOS data as a part of their dissertation research. Along with the principal investigators, students directly participate in cruise design and execution, data analysis and publication (see poster by Morata et al., OS16F-03).

Ocean Optics

UConn marine scientists use coastal optics and remote sensing to address questions related to biological and physical processes in the ocean. This research employs new observational tools for monitoring coastal ecosystems, including remote sensing from satellites and aircraft, autonomous underwater vehicles, and profiling moorings. A particular focus of this effort is to exploit satellite ocean color imagery in shallow ecosystems.



International Programs

UConn Marine Sciences participates in international exchange programs in Brazil, Mexico, and other countries. Currently, more than 15 graduate students from 10 countries are enrolled in graduate studies in Marine Sciences.