Coastal Observation Technology System Project Summary – 2004

Project Name/Title: The Carolinas Coastal Ocean Observing and Prediction System (Caro-COOPS)

Date Project Initiated: June 1, 2002 (grant start date); July 3, 2002 (the financial assistance award received by University of South Carolina from NOAA Grants Management Division)

Recipient Institution: University of South Carolina (USC) Research Foundation; Belle W. Baruch Institute, University of South Carolina, with North Carolina State University

Primary Contact:

Dr. Madilyn Fletcher, Director
Belle W. Baruch Institute
University of South Carolina
Columbia, SC 29208
Phone: (803) 777-5288
Fax: (803) 777-3935
E-mail: *fletcher@sc.edu*

Project Web Site: *http://caro-coops.org/carocoops_website/index.php*

Brief Project Summary: The central goal of Caro-COOPS is prediction of coastal ocean processes. The overall objectives are to 1) integrate information on biological, chemical, and physical processes in the Carolinas' coastal ocean to provide a thorough understanding of how physical forcing and biological responses are coupled geographically and temporally; 2) assess the predictability of specific coastal processes and events and use this information to develop accurate forecasting models; and 3) create tools for applying and evaluating these predictions to provide user communities with early-warning systems.

Caro-COOPS is a wholly integrated system for coastal observations and their application to user-driven needs, including 1) an extensive array of instrumented moorings in the South Atlantic Bight off South Carolina; 2) a comprehensive data management system, essential for access to, and integration of, high-quality, real-time data; and 3) an advanced suite of integrated models that will markedly improve predictions made from real-time physical data from coastal ocean instrumentation.

An initial demonstration of the real-time interdisciplinary forecast concept for Caro-COOPS is real-time prediction and analysis of storm surge and flooding before and during landfall of coastal storms. This will improve warnings and provide local officials with the information needed for mitigation, preparedness, and prevention measures. Most recently, Caro-COOPS has also been laying the groundwork to develop a pilot project to incorporate predictions of climate variability and other meteorological and oceanic forcings into the development of tools that support commercial and recreational fisheries and their management.

Benefits: Caro-COOPS will systematically acquire and disseminate via Web interfaces real-time data on coastal ocean conditions in the Carolinas. The program will also develop and deliver regular, comprehensive information products to serve the needs of many user groups, including

government agencies, industries, scientists, educators, nongovernmental organizations, and the public. Caro-COOPS will support NOAA and other federal agency missions by providing real-time predictions, and ultimately forecast tools, to mitigate coastal hazards, support management of living resources and marine ecosystems, facilitate safe and efficient marine operations, and support national security efforts. A fully operational Caro-COOPS will reduce the costs and risks to people, the economy, and natural resources from natural and human-induced hazards and increase coastal communities' ability to adapt to changing conditions, resulting in a balance of environmental and economic benefits.

Accomplishments to Date:

- Established a real-time observational network consisting of three cross-isobath lines of stations, including a line beginning at Sunset Beach, North Carolina, and extending into Upper Long Bay, North Carolina; a second line extending from Capers Island above Charleston Harbor, and a third line set north of Hilton Head Island, South Carolina, at Fripps Inlet. Each line includes a National Ocean Service CO-OPS National Water Level Observation Network (NWLON)-compatible shore-based water level (and meteorological) station (WLS) and offshore moorings located on the inner shelf (10 meter isobath) and mid-shelf (30 meter).
- Provided real-time data from the mooring systems, through a Web-based interface, on vector current profiles, water level, sea temperature and salinity at the surface and on the seafloor, and fluorescence near the surface. Data on wave direction and wave energy spectra are collected, but not transmitted in real time. The WLS collect and transmit water-level data, water and air temperature, barometric pressure, relative humidity, and wind speed, direction, and gusts.
- Successfully implemented the use of U.S. Department of Defense (DOD) Iridium Low Earth Orbiting communication satellite system for data transmission from offshore sites.
- Developed computer programs and infrastructure for automated receipt, organization, and delivery of data transmitted by instrumented moorings.
- Developed Web interface and information portal for access to observational data, model predictions, and information products.
- Developed map-based and geographic information system (GIS)-based tools that visualize observational data and model predictions, as well as additional data layers—for example, aerial maps, topographic and bathymetric data, and land use information—for user applications.
- Developed a new technique to model inundation and drying processes of coastal flooding and a state-of-the-art three-dimensional, time-dependent storm surge and inundation and retreat model, and applied the new technique and model to Charleston Harbor.
- In a hindcast analysis, validated the surge and flood inundation model using data from Hurricane Hugo, which struck the Charleston region in 1989.
- Incorporated a new concept for storm surge prediction based on an ensemble approach by perturbing storm tracks and intensity using National Hurricane Center storm forecast guidance, and tested this new ensemble approach during the passage of Hurricane Isabel in 2003.
- Developed a new NOAA WaveWatchIII wave model to Office of Naval Research SWAN model transition, which establishes wave prediction reliability with computation efficiency. This new wave forecast capability was tested during the passage of Hurricane Isabel in 2003.

Current Year Objectives:

1. Ensure that the observing array is reporting data in a reliable and consistent manner.
2. Upgrade observing subsystem by integrating meteorological sensors on all Caro-COOPS moored buoy systems and developing means to reduce the data telemetry time from six to two hours, or possibly one hour.
3. Upgrade the integrated assimilation, management, archival, and distribution system for Caro-COOPS data, metadata, and products, including developing an automated quality assurance and quality control process, improving mechanisms for data delivery from federal backbone providers, and redesigning and streamlining the GIS mapping and analyses capabilities.
4. Validate and enhance the coastal flooding model for Charleston Harbor and develop the models for Hilton Head and Myrtle Beach areas.
5. Develop the user application components of the program, particularly through establishing a coastal flooding prediction tool and planning for the fisheries application component.

Partners: University of South Carolina's Belle W. Baruch Institute, the North Carolina State University (NCSU), the University of North Carolina at Wilmington (UNCW), and the South Carolina Department of Natural Resources (SCDNR).