Year Two of Southeast Atlantic Coastal Ocean Observing System (SEA-COOS) Implementation

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LONG-TERM GOALS

To significantly increase the quantity and quality of environmental information from the coastal ocean of the SE U.S. and make this readily available for a range of societal, scientific and educational applications.

OBJECTIVES

Explore the components and interactions necessary to create a vital regional coastal ocean observing system (RCOOS) in the southeast U.S. Assist the development of the coastal component of the U.S. Integrated Ocean Observing System (IOOS).

APPROACH

A consortium of universities with existing observing system components are working together to construct a functional regional coastal ocean observing system. Through practical application, best practices for further development of the regional (and national) COOS network are being identified.

WORK COMPLETED

A number of critical tasks were accomplished in the second year of the program. Progress towards creation of IOOS and the National Federation of Regional Associations (NFRAs) has been rapidly advanced by OceanUS in the past twelve months. SEACOOS helped form and plays an active role in the SouthEast Coastal Ocean Observations Regional Association (SECOORA), the RA development program for the Southeast funded by NOAA's Coastal Services Center. SECOORA is developing a suitable governance structure for the RA that will provide broad representation from the coastal ocean community. SEACOOS serves as a prototype RCOOS, developing the infrastructure of an umbrella program uniting a number of sub-regional observing systems. Together, SECOORA and SEACOOS

are pursuing an initial organizing effort for the Southeast which should facilitate RA certification by OceanUS.

Within SEACOOS, the governance structure continues to be refined. In Year 2, an Executive Committee composed of the chairs of the working groups, the PI and project coordinator, was responsible for daily operations and planning. The budgeting process and program were overseen by the Board of Directors that includes institutional and external representatives. SEACOOS organized two broad-based workshop/conferences in Year 2 to further regional coordination and to foster interactions within SEACOOS and with an expanding number of affiliate programs. An initial Strategic Plan for SEACOOS has been adopted and a SEACOOS Implementation Plan, similar in structure to a business plan that has been requested of the RAs by OceanUS as part of the certification process, is currently in draft form and is undergoing its second set of revisions based on comments from SEACOOS PIs.

Each of the working groups has made advances. Satellite remote sensing has been a very active component of the Observing Working Group (OWG). Satellite imagery has been merged with existing information delivery systems, as has data from the *Explorer of the Seas* (instrumented commercial cruise ship). The OWG has successfully operated two types of shore-based, high-frequency radar that map surface ocean currents at three sub-regional sites, and valuable experience in sustained operations of these systems has been acquired. Several new *in-situ* measurement platforms were deployed in Year 2, although a number of the planned installations have been delayed for a variety of reasons. The Modeling Working Group has maintained the coordinated execution of three sub-regional nowcast/forecast systems, and has drafted a manuscript based on hindcast studies investigating the regional-scale coastal ocean response to strong storm forcing. Formal links to GODAE HYCOM and NAVO Global NCOM have been established to explore coupling to basin-scale modeling efforts. The Outreach and Education Working Group supported an initial user characterization study, funded a study of regional economic benefits that could result from development of IOOS, and formally partnered with the SE and Florida COSEE programs (NSF) as a cornerstone of SEACOOS educational programs.

Significant advances continue to be made by the Information Management Working Group. In late 2003, by sharing technologies with other regional programs, the IMWG played a significant role in the development and implementation of the national interoperability site (www.openioos.org). The IMWG also assisted other regions in making their observations available using Web Mapping Services protocols for geospatially referenced, web-based presentation of information. A new SEACOOS website has been constructed (based on the open source, content management system, "Plone") to enable distributed management of the site. A variety of displays of merged observations and merged modeling results are available through www.seacoos.org and are regularly updated.

RESULTS

Selected examples of achievements by the working groups are described here. For more information, see the project website (www.seacoos.org) and the publications listed below. Inclusion of near real-time satellite remote sensing imagery was a significant advancement in Year 2. SEACOOS remote sensing products presently include: sea surface temperature (SST) from AVHRR, MODIS AQUA and MODIS TERRA, (e.g., Fig. 1); a SEACOOS experimental optimally interpolated SST product (He et al., 2003); MODIS true color (RGB) images, at low resolution for the entire region (Fig. 2), and higher

resolution RGB imagery for selected nearshore areas; QuickScat winds from the JPL PO DAAC; and the MODIS chlorophyll *a* product.

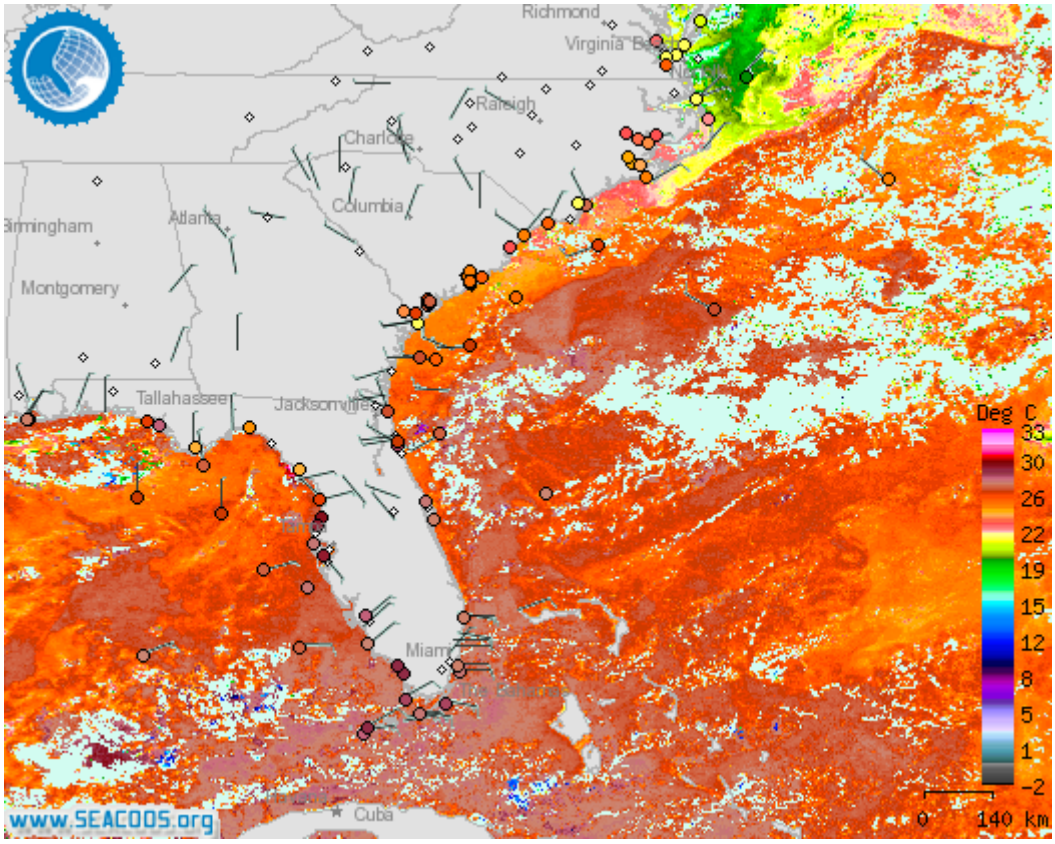

Figure 1* - In-situ *wind and sea surface temperature measurements overlaid on AVHRR-derived sea surface temperature for 5am, Oct. 4, 2004

Merging *in-situ* and remotely sensed observations is a central objective for IOOS because it provides both the synoptic coverage available with remote sensed imagery and the regular time series view of ocean processes available from in-water observations. The graphic presentations developed for the SEACOOS merged products also provides a simple means to assess observational quality and consistency (e.g. the color-coded presentation of *in-situ* and remote SST in Fig. 1), and is a first step in implementing quality assurance in a user-accessible way.

One of the challenges faced in making the remotely sensed observations available through the SEACOOS website concerned access procedures. Data transport and web-based visualization can be quickly bogged down by large file transfers. In collaboration with GoMOOS and DMSolutions (a private company), a solution was found that provided rapid transport of image files, registration of color palettes, and single-point data query through a GIS-enabled web portal. The collaboration and technology development attending this effort served as a springboard for the IOOS interoperability program.

The web "portal" developed as part of SEACOOS can also serve as a powerful and flexible outreach tool. Within days of the beginning of the onslaught of hurricanes in early August, 2004 the remote sensing and information management groups included hurricane tracks and merged weather radar reflectivity generated at Texas A&M (Figure 2).

Operation of various fixed and moving observational platforms in the region has met with varied success. Existing SEACOOS-sponsored and affiliated platforms generally performed well over the last year (non-Federal assets account for 38 of the 84 fixed platforms shown in Fig. 3). It is notable that both COMPS and SABSOON rode out hurricanes during the summer of 2004 without serious damage. Observations acquired during the recent storms (e.g. Fig. 3), demonstrates the robustness of these installations. Observations were provided to the National Weather Service in near real-time and were thus available to national and international weather prediction systems.

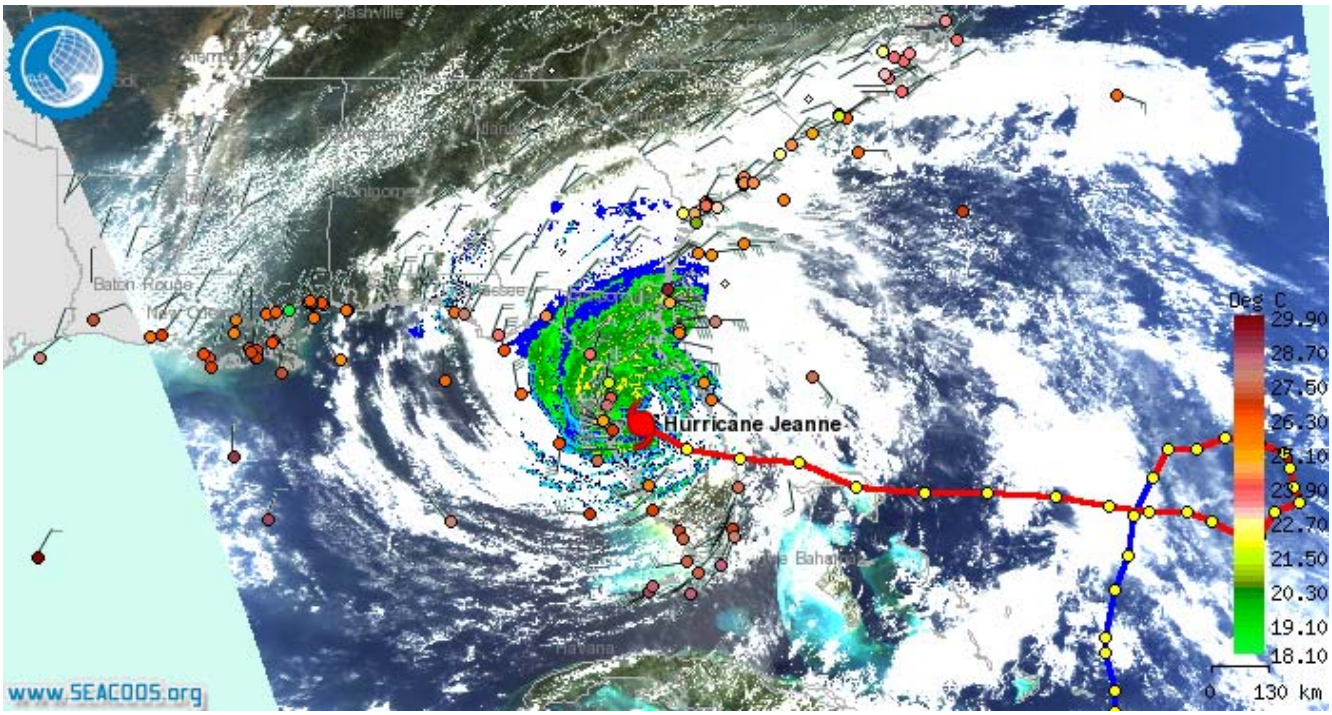

Figure 2. **In-situ** ***winds and temperature observations overlain on radar reflectivity and MODIS low-resolution true color image September 26, 2004 as Hurricane Jeanne crosses Florida. The image was generated through the SEACOOS website.***

Planned new installations have been delayed for a number of sites. Permitting issues have slowed some HF radar system deployments and the shore environment has provided challenges for sustained operations. For example, the CODAR system on the North Carolina Outer Banks collected observations for approximately 40 weeks out of the last year, with periods of downtime due to site remediation (at the Cape Hatteras Coast Guard station), component damage due to lightning strikes (on 3 separate occasions), and severe beach erosion that forced relocation of antennas (three times) and even the main electronics shed. New *in-situ* systems have been installed off Georgia and Florida; however, the planned buoy deployment off North Carolina, and beach-face ADCP installations in South Carolina, have been delayed because of problems with permitting, equipment delivery and vessel availability. All of these observational assets are expected to be deployed before the end of 2004. However, it is increasingly obvious that substantial augmentation of observational assets will be a multi-year process.

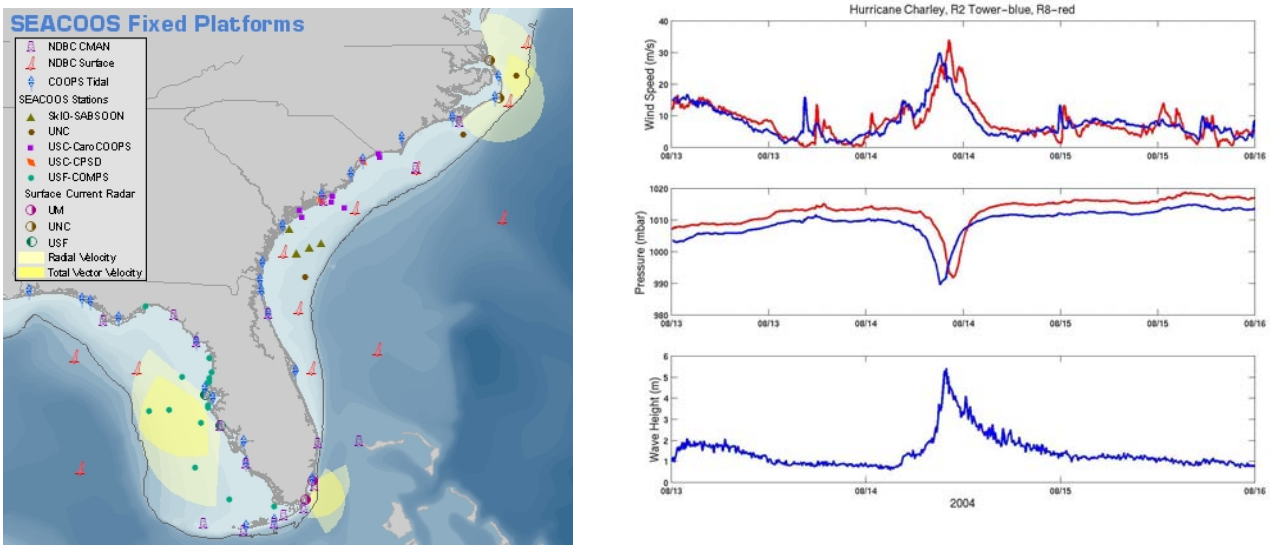

Figure 3 (left) Locations of fixed platform measurement locations in the SEACOOS region. Non-federal assets account for roughly half of the sites. (right) Time series of (top) wind speed, (middle) barometric pressure and (bottom) significant wave height off the Georgia coast during the passage of Hurricane Charlie

The coordinated operation of three coastal ocean circulation models has provided an opportunity to explore model dependencies and subregional responses to strong regional-scale wind forcing. A joint analysis was conducted for March 2001, when two strong extratropical cyclones impacted the region. Model skill was reasonably good, with correlation coefficients between observed and measured water levels of 0.3-0.95, typically 0.8, with similar values for current comparisons. The study suggests that the South Atlantic Bight and West Florida Shelves can be represented as relatively isolated domains, but that the East Florida Shelf, which include the Straits of Florida, is a more challenging domain and may require further coupling to the offshore to improve results.

An economic benefits study was sponsored by the Outreach and Education Working Group. This indicated that the creation of IOOS could have a significant positive impact on the economies of the southeast states. The study considered a number of benefit categories, including: maritime commercial transportation; commerical fishing, recreational boating and fishing; search and resue operations; oil spill prevention; recreational activities at beaches; coastal erosion control; hurricane prediction and evacuation; recreational cruises; and shipping accidents. The study makes conservative estimates of the incremental improvements that may be realized with the advent of IOOS, and estimates the total annual benefits to be $170 million (in 2003 dollars). Sectors most strongly impacted include beach recreation, search and rescue, and the cruise industry. The results of the study will be considered in setting priorities for SEACOOS investments in the coming year.

IMPACT/APPLICATIONS

SEA-COOS may be considered a pilot regional coastal ocean observing system. It is testing recommended methods of measurement, modeling and data exchange to establish their viability in sustained operation. It is also developing the operational structure and coordination of policies needed by the RCOOS to provide broad-based participation and input to regional systems.

RELATED PROJECTS

An abbreviated list of programs associated with SEACOOS that receive other funding include: SECOORA (http://www.secoora.org); USF COMPS (http://comps.marine.usf.edu/index.html), SABSOON (http://www.skio.peachnet.edu/research/sabsoon) , SABLAM (http://sablam.unc.edu), Caro-COOPS (http://carocoops.org), Explorer of the Seas (http://oceanlab.rsmas.miami.edu), the Southeast COSEE (http://www.scseagrant.org/se-cosee/), and the Florida COSEE (http://floridacosee.net).

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