Southeast Atlantic Coastal Ocean Observing System (SEA-COOS) Initial Implementation

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LONG-TERM GOALS

Assist the development of the coastal component of the U.S. Integrated Ocean Observing System (IOOS).

OBJECTIVES

Explore the components and interactions necessary to create a vital regional coastal ocean observing system in the southeast U.S.

APPROACH

A consortium of universities with existing observing system components are working together to construct a functional regional coastal ocean observing system. An initial structure has been created and specific projects identified as unifying activities across the region.

WORK COMPLETED

A number of essential tasks were accomplished in the first year of the program. Of particular importance was the development and implementation of an organizational structure that includes establishment of a Board of Directors, activation of five working groups (observing, modeling and products, information management, outreach and education, and federal affiliates) and recruitment of a dozen affiliate members. Associated with creation of the appropriate governance structure for the consortium was the role of SEA-COOS investigators in providing input to the National Federation of Regional Associations formation process (at the Ocean.US sponsored regional summit in Washington, DC, April 1, 2003) and input to the successful proposal for the Southeast Regional Association (SERA) development. The program also organized two broad-based workshop/conferences to further regional coordination and to foster SEA-COOS interactions. The first was a kick-off meeting held in Chapel Hill, NC, to bring all participants together and solidify initial efforts; the second was a progress report and emphasized identification and facilitation of linkages with government agencies, particularly state organizations, and discussion of steps to be taken in forming a regional association. The reports of these workshops are expected to be available in November 2003. An outgrowth of the workshops was the development of a SEA-COOS Strategic Plan, which is currently undergoing its second set of revisions based on comments from workshop participants.

Each of the working groups has completed a number of tasks. The observing team has purchased and deployed 2 types of high-frequency radar that map surface ocean currents. An intercomparison study was conducted in August 2003, and a permanent installation, to assess viability, has been operating since May 2003. Several new in-situ measurement platforms have been deployed, and SEA-COOS also facilitated the real-time capabilities of mooring in the Carolinas Coastal Ocean Observing and Prediction System (Caro-COOPS) by funding surface buoys and providing access to the Iridium satellite network with assistance from ONR. The modeling team coordinated execution of three subregional nowcast/forecast systems using similar bathymetry and forcing to examine the efficacy of a distributed modeling system for the region. They also conducted a series of hindcast studies to begin investigating the regional-scale coastal ocean response to strong storm forcing. The outreach and education working group has held a regional workshop for Sea Grant staff and a subregional meeting in Florida to inform and engage the outreach staff.

Most significant were the advances made by the information management working group in developing, implementing, and testing a regional data management network. After establishing an information management network among the primary institutions, the installation and initial testing of OpenDAP servers for data transfer was complete by spring 2003. Simultaneously they accomplished the initial development of the SEA-COOS website; it is now being upgraded regularly. Following IOOS recommendations, these OpenDAP servers are now being use to facilitate the creation of two web-based products, a blended model output presentation and merged wind observations, both providing regional coverage within a GIS framework.

RESULTS

Examples of meaningful achievements by the working groups will be described; for more information see the project website (seacoos.org) and the publication list below. The successful deployment and ongoing operation of two different high frequency radars is a major accomplishment for the observing working group. The HF radar are being considered as a component of the coastal IOOS and these deployments are intended to evaluate the feasibility of using this type of instrumentation for sustained surface current observations. Perhaps the greatest challenge faced in year one was securing permanent deployment sites, which in most cases involved lengthy negotiations with local and/or national agencies. The radar antenna must be placed with a few hundred meters of the sea to achieve efficient propagation offshore of more than 100 km and of course this beachfront property is highly valued. Along the northeast coast of North Carolina and the west coast of Florida SeaSonde Long Range CODAR units are currently operating at permanent installations. A Wellan Radar (WERA) system was temporarily deployed on the west Florida shelf in August 2003, illuminating the same region that the WFS CODAR system will sample, to provide an intercomparison between the systems in the heavily instrumented region of the University of South Florida’s Coastal Ocean Monitoring and Prediction System (COMPS). It is currently being relocated to the east Florida shelf where is will be deployed permanently.

The WERA test deployment occurred from 27 JUL through 27 SEP 03 along the West Florida Shelf, intended to coincide with the USF deployment of CODAR systems for the purposes of inter-comparison. A major focus of the test deployment was to evaluate the WERA system and its vector current measurement, in addition to understanding the logistics of providing a real-time measurement with WERA (Fig. 1). The system consisted of two independent radar stations at Bradenton Beach and Venice, Florida. Each station transmitted at 16.045 Mhz and measured the backscattered spectrum over a region of up to 120 km range. Range was highly dependent on environmental conditions (thunderstorms and heavy rain were commonplace through the deployment) as well as system setup and local obstructions (e.g., a fishing pier at Venice and concrete groins at Bradenton Beach).

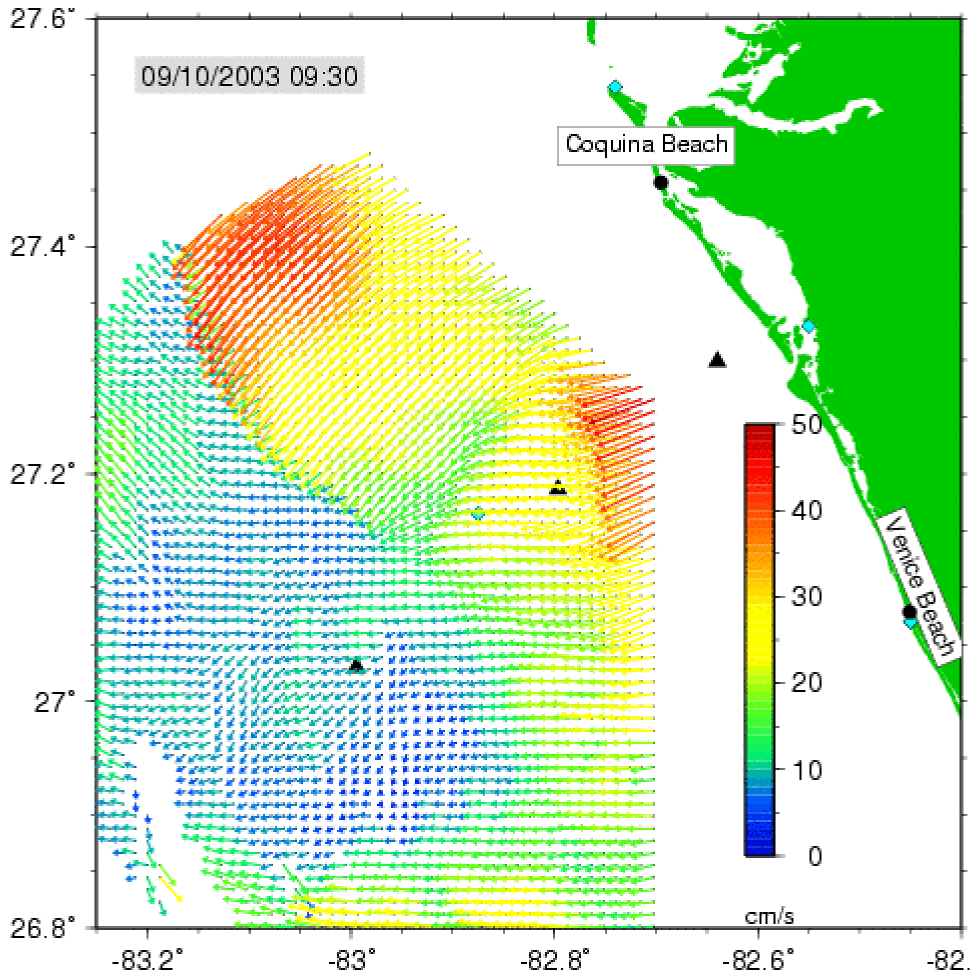

Figure 1. Synoptic surface current map from the WERA for 0930 GMT, 10 SEP 03, off the central west Florida coast. Currents, sampling at 1.2 km intervals, are generally directed offshore but vary from 5 to 40 cm/s. Black triangles mark the locations of current meters maintained by USF.

While the stations did not have Internet access, scripts for computing and plotting the vector currents for direct access from the Internet were tested and employed. Utilization of a robust and redundant data management strategy is the emerging priority. Depending on the measurement mode, up to 4 GB/day can be collected from one station. For this reason, an expandable mass storage server with 1 TB of storage has been planned and will soon be assembled.

Overall, based on its modular design and reliability in the field, the performance of the WERA system was very impressive. The operation and maintenance of WERA is similar to that of OSCR, which was a benefit to the personnel involved. Comparison of the WERA and 3m-bin level ADCP observations at a grid point within 1 km of an ADCP (NA2; 27.186N, 82.928W (ca. 30km offshore New Pass Inlet (Sarasota)); water depth = ca. 25m) maintained by USF (Fig. 2) shows general agreement between the two observing systems, except during the passage of TS Henri on 5 and 6 SEP 03.

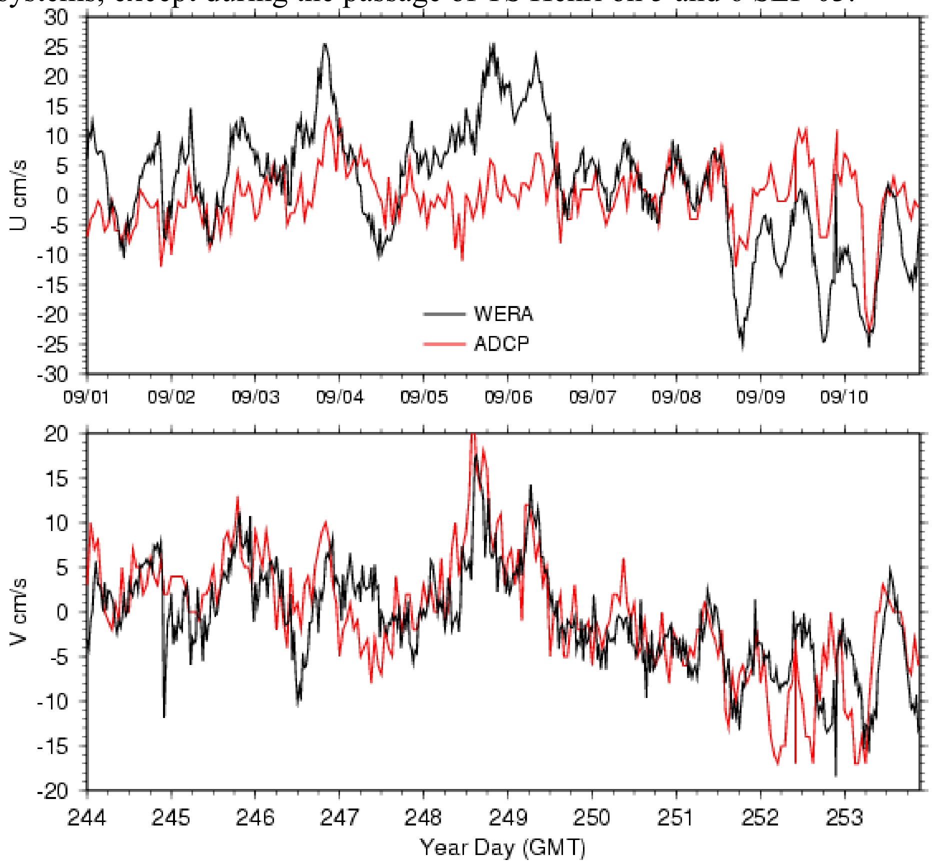

Figure 2. Comparison of surface velocities from WERA with those from 3m bin depth ADCP velocity, 1 to 11 SEP 03. The comparison is favorable except for the roughly 10 cm/s offset in the east-west current component during the passage of Tropical Storm Henri.

The coordinated execution of three coastal ocean circulation models provides a unique view of the coastal ocean in the southeast. Presentation of the combined information in an operational mode has provided an opportunity for testing and regular exercising of the OpenDAP servers installed at the various institutions. Each group is now producing a daily hindcast and forecast for their subdomain and making the output available on an OpenDAP server. Agreements on the sources of the forcing functions (wind fields and tides), bottom topography and coastlines were struck to minimize differences in the modeled circulation fields. An interesting complication is that two different primitive equation models are being used, the Princeton Ocean Model and QUODDY. In this first iteration of preparing a combined model output, density variability is not considered (the models capture only the barotropic response of the coastal ocean to forcing); the baroclinic response is being pursued in year 2 of the program. Development of a consistent cloud-free sea surface temperature product (He et al., 2003a) is a significant advancement toward achieving a realistic modeled density field.

The model fields are interpolated to a common grid, then extracted for graphical display within MapServer, an open-source GIS platform. At present the interface supports the display of water levels and depth averaged currents with the ability to pan and zoom without loss of resolution, and the ability to display user-selectable animations of the modeled output. An example of the web-served output is presented in Figure 3.

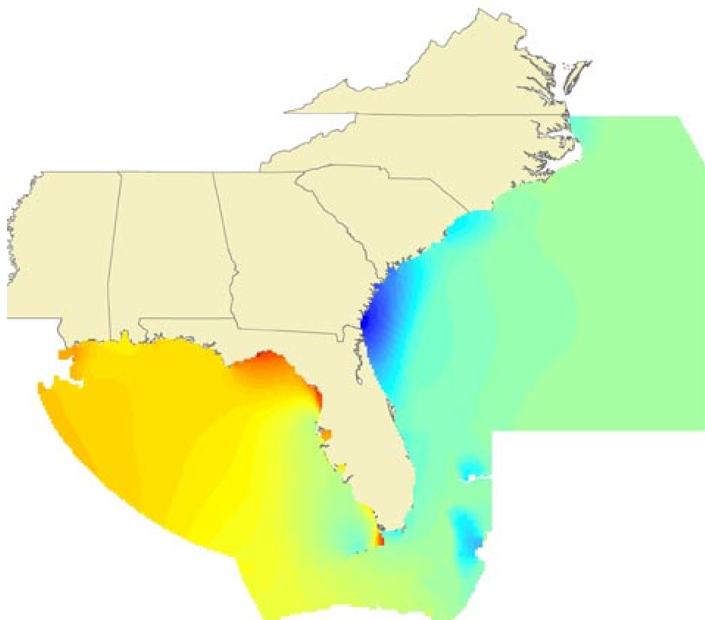

Figure 3. Merged/blended model results for sea-level (atmospherically- and tidally-forced) at a point in time on 26 August 2003.   The three model domains are overlain without any smoothing, i.e., these are model results without any post-processing.   The absence of "seams" along model boundaries provides a visual indication of the agreement between the models. Blue shading corresponds to low sea-level, red corresponds to high sea-level values, and reveals low tide in the South Atlantic Bight and high tide in Appalachicola Bay at this time.

A number of other projects are being pursued, including use of Iridium satellite modems for transfer of observations colleccted offshore; a model hindcast study to examine the region-wide response of the coastal ocean to strong wintertime storms; development of a web-based map display of wind observations from roughly 400 stations in the southeast, and the development of a model-observation wind product for the southeast (He et al., 2003b); and links to several Centers of Ocean Science Educational Excellence (COSEEs) to create directed educational outreach products for schools.

IMPACT/APPLICATIONS

SEA-COOS is developing many of the components necessary for creation of a 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 an operational structure and coordination policies needed 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: 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/), Florida COSEE.

REFERENCES

He, R., R.H. Weisberg, H. Zhang, F. Muller-Karger, and R.W. Helber. 2003a. A cloud-free, satellite-derived, sea surface temperature analysis for the West Florida Shelf, *Geophys. Res. Lett*., 30, 15, 1811, doi:1029/2003GL017673.

He, R., Y. Liu, and R.H. Weisberg. 2003b. Coastal ocean wind fields gauged against the performance of a coastal ocean circulation model, Manuscript submitted to *Geophys. Res. Lett***.**

PUBLICATIONS

Blanton, B. O., A. Aretxabaleta, F. E. Werner and H. E. Seim, 2003. Monthly climatology of the Georgia Bight, *Journal of Geophysical Research*, **108**, 3264, doi:10.1029/2002JC001609. [published, refereed].

Fiechter, J. and C. N. K. Mooers (2003). Simulation of "ocean weather" (frontal eddies) on the East Florida Shelf. *Geophysical Research Letters* [resubmitted, refereed].

He, R., R.H. Weisberg, H. Zhang, F. Muller-Karger, and R.W. Helber. 2003a. A cloud-free, satellite-derived, sea surface temperature analysis for the West Florida Shelf, *Geophys. Res. Lett*., 30, 15, 1811, doi:1029/2003GL017673 [published, refereed].

He, R., Y. Liu, and R.H. Weisberg. 2003b. Coastal ocean wind fields gauged against the performance of a coastal ocean circulation model, *Geophys. Res. Lett*. [submitted, refereed]

Seim, H., F. Werner, M. Fletcher, J. Nelson, R. Jahnke, C. Mooers, L. Shay, R. Weisberg, M. Luther, 2002. SEA-COOS: Southeast Atlantic Coastal Ocean Observing System. IEEE Proceedings, Oceans2002 meeting, Oct. 2002. [published]

Seim, H., B. Bacon, C. Barans, M. Fletcher, K. Gates, R. Jahnke, E. Kearns, R. Lea, M. Luther, C. Mooers, J. Nelson, D. Porter, L. Shay, M. Spranger, J. Thigpen, R. Weisberg, F. Werner, 2003. SEA-COOS - A Model for a Multi-State, Multi-Institutional Regional Observation System, *MTS Journal*, [in press, refereed]

Weisberg, R.H., R. He, M. Luther, J. Walsh, R. Cole, J. Donovan, C. Merz and V. Subramanian. 2002. A coastal ocean observing system and modeling program for the west Florida shelf. IEEE Proceedings, Oceans2002 meeting, Oct. 2002. [published]

Weisberg, R.H. and L. Zheng. 2003. How estuaries work: A Charlotte Harbor example. *J. Mar. Res*., [in press, refereed]