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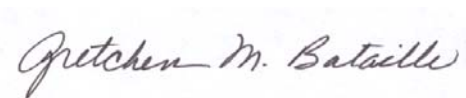
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Year Two of SEA-COOS Implementation

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SEA-COOS Members (parties to the SEA-COOS Master Agreement and Articles of Collaboration):

University of North Carolina at Chapel Hill

University of South Carolina

Skidaway Institute of Oceanography (University System of Georgia)

University of Miami

University of South Florida

South Carolina Dept. Natural Resources

North Carolina Sea Grant

South Carolina Sea Grant

Georgia Sea Grant

Florida Sea Grant

SEA-COOS Affiliate Member nominees:

Naval Surface Warfare Center/USN

Field Research Facility/US Army Corps of Engineers

Center for Operational Ocean Products Services/NOS/NOAA

Naval Atlantic Meteorology and Oceanography Center/USN

National Data Buoy Center/NWS/NOAA

National Centers for Environmental Prediction/NWS/NOAA

Florida Keys National Marine Sanctuary/NOS/NOAA

Atlantic Oceanographic and Meteorological Laboratory/OAR/NOAA

National Coastal Data Distribution Center/NESDIS/NOAA

Jacksonville FL Weather Forecast Office/NWS/NOAA

Miami FL Weather Forecast Office/NWS/NOAA

Southeast Fisheries Science Center/NMFS/NOAA

Coastal Services Center/NOS/NOAA

Beaufort Marine Laboratory/NOS and NMFS/NOAA

Project Summary

The SouthEast Atlantic Coastal Ocean Observing System (SEA-COOS) is a regional partnership that has initiated an integrated coastal ocean observing system for a four-state region of the southeast coastal U.S. The long-term intent of SEA-COOS is to establish a regional coastal ocean observing system for North Carolina, South Carolina, Georgia and Florida that will be part of the coastal component of the national Integrated Ocean Observing System envisioned by Ocean.US. SEA-COOS is accomplishing a major element of the national IOOS program by

developing and implementing the mechanisms for integration of disparate and distributed observations and information products. This second-year effort extends the first year activities, which were focused on the EEZ, and will develop an information system for the coastal ocean inclusive of state territorial waters and engaging state agencies in the four participating states. The four major components of SEA-COOS are the observing subsystem, the modeling and products subsystem, the data management subsystem, and the outreach and education subsystem. As part of the observing subsystem, the partners will deploy new, real-time reporting ocean/atmosphere measurement platforms, continue pilot studies of the long-term stability and accuracy of coastal HF radar for surface currents in the region, collaborate with regional remote sensing groups, and test nearshore directional wave measurement techniques. The modeling and products subsystem will continue development of hindcast and nowcast/forecast models for subregions of the SEA-COOS domain, providing products offering a synthesized view of the ocean state, testable against in-situ observations. The data management subsystem will integrate observations from the new platforms with existing observations using data exchange tools advocated by Ocean.US, and continue development of portals to observations, model output, and more refined data products. An outreach effort with the regional Sea Grant offices will continue a dialog with non-academic users to identify their information needs and the preferred formats and modes of information delivery. A K-12 education effort will be initiated through collaboration and funding of the NSF Centers of Ocean Science Excellence in Education in the southeast (NC, SC, GA) and Florida. Evolution of a system of governance for SEA-COOS will continue as we increase the breadth of data providers and users participating in the system.

SEA-COOS Goal and Objectives

To clarify the intent of SEA-COOS and to help guide its development, we have established the following principles.

Over-arching Goal. To significantly increase the quantity and quality of environmental information from the coastal ocean of the SE U.S. and facilitate its use in a wide range of societal, scientific, and educational applications.

Supporting Objectives. *Promote integration of the Southeast coastal ocean observing system* by (1) functionally linking subregional observing systems and (2) supplementing and enhancing the *de facto* operational coastal ocean observing system (the federal “backbone”).

Establish testbeds and observatories for fostering technology development and introducing new technology through quantitative assessments.

Conducting observing system experiments and assessing various data assimilative coastal ocean models and information products.

Develop and demonstrate new data and information products via a Web-based information management system, and in association with a range of user communities.

Create and operate a regional information system that will foster understanding of coastal ocean processes and coastal ecosystems on a regional scale.

Background and Proposal Organization

The Southeast Atlantic Coastal Ocean Observing System (SEA-COOS) is envisioned as one of the regional systems ringing the continental U.S. to form the coastal component of the Integrated Ocean Observing System (IOOS) (Ocean.US, 2002). In this second year effort we propose to enhance and expand existing observing systems, refine data management capabilities, continue development and testing of assimilative model products, and expand outreach and education efforts. Because these components are required by all coastal observing networks, advances made within this project will benefit the development of the national system.

Creating a fully functional regional observing system that engages broad sections of the coastal and maritime communities and delivers tailored products to users will require major advances in oceanographic *in situ* sensor systems, data transmission, data management, assimilative modeling techniques, and user engagement. Our first year effort began this process by first integrating the local coastal ocean observatories operated by academia and linking this system to the national backbone. We concentrated on the coastal ocean seaward of the nearshore region (i.e. typically more than 3 miles offshore). Our second year effort will target interactions with state agencies and expansion of the observing system in the nearshore. Out years will further develop local interactions and estuarine observing systems.

The spatial domain of SEA-COOS is consistent with those suggested by the U.S GOOS Steering Committee (The Frosch Report, 2000) and OCEAN.US (Ocean.US, 2002). The four states participating in this effort have similar coastal ecosystems, linked by the Loop Current/Florida Current/Gulf Stream system, and share a common weather and climate system, biogeography and socioeconomic profile. As such, this is a natural regional scale that will maintain flexibility needed to address issues of local importance, while providing effective larger-scale coordination of activities to address issues of regional-scale impact.

A vital but challenging aspect of regional coastal ocean observing systems is the establishment of a governance framework for identification of priorities, implementation of tasks, responsibilities of partners, and terms of membership. Our first year effort has developed a model of governance suitable for the academic partnership that initiated SEA-COOS, and all parties have agreed to and signed the Articles of Collaboration (http://intranet.northcarolina.edu/docs/aa/research/initiatives/SEACOS_Collaboration.pdf). Further evolution of the governance structure is already underway through interactions and discussions with state and federal agency representatives.

Developing an integrated information system must begin with the operational reporting of key variables using proven technologies, while providing the basis for rigorously testing new technologies that can eventually become operational. The SEA-COOS system is concentrating on measuring and modeling the physical characteristics of the coastal ocean and atmosphere that dominate the list of identified variables that can be observed operationally. At the same time, SEA-COOS is including pilot measurements of chemical, biological and geological ocean properties that hold the promise of becoming operational and which will broaden the scope of issues that can be addressed.

SEA-COOS supplements the existing federal observation system (“backbone”) in the SE region. Designing SEA-COOS will be an iterative process because a configuration of the system that is adequate to address one issue may not be adequate to address others. Because the assessment of adequacy is a topic of scientific investigation, we chose a scientific problem to focus our initial design effort. In particular, we have targeted the regional response of the coastal ocean to synoptic scale atmospheric forcing (“weather”) and will continue this effort in year two. This selection is consistent with the variables that can be observed operationally, relates to a large number of societal and scientifically relevant issues, and is of common interest to all observing system initiatives in our region. We will begin additional pilot studies, with a particular interest in the measurement of directional waves, but are not yet in a position to implement a complete observing system for this topic in this year. Product development is a cross-cutting activity that in many instances requires the participation of more than one subsystem. In addition to the output of the individual working groups, two cross-cutting products have been identified as initial efforts to establish a methodology for working group interactions: a blended model product, and a merged observations presentation. We will be identifying additional products in the coming months. The remainder of this one-year proposal describes plans for system implementation in the next year for each of the major subsystems.

Observing subsystem

Progress to date. When SEA-COOS was initiated each sub-region had been established independently and hence had somewhat different sets of instrumentation. The goal of the observing component in year one was to incrementally build observing system capabilities in each sub-region, while working toward a degree of commonality through data management/distribution and outreach. The strategy for augmentation of the subregional systems was based on working towards sparse, relatively consistent spatial coverage on the regional scale. The following is a summary of activities underway to augment the existing national observational components. Figure 1 shows the locations of some of the existing federal and regional observing platforms, and anticipated new deployments over the next 1-2 years. The four broad areas of the year one observing subsystem endeavor were to: 1) maintain existing academic components, 2) deploy additional fixed platforms, 3) initiate an HF radar pilot program, and 4) advance new technology development efforts.

Maintain existing academic components. SABSOON off the Georgia coast and COMPS on the WFS were already operating as SEA-COOS was created. Both systems were partially supported to ensure continued observations. The SABSOON platforms R2, M2, and R8 have been maintained. Redundant meteorological observations were added to M2 and R2. Navy renovations in June and July, 2003 of the R2 and M2 platforms have led to month-long observation outages but include critical repairs to the platforms that are now expected to be functional for the next 20 years. At the start of the SEA-COOS year one, two of four real time COMPS moorings telemetered all measurements and two telemetered only surface meteorology data. COMPS has designed, built, and tested a new data logger/transmitter for the remaining sub-surface data. One of these is presently active, and the second is scheduled for a Sept. 2003 deployment.

Deploy additional fixed platforms. New fixed installations are being added to Navy platforms off North Carolina and SABSOON, and a new mooring is being added to COMPS. SEA-COOS is also contributing to Caro-COOPS to support the delivery of real time observations from the SC coast.

UNC-CH has developed an in-situ measurement system to deploy on Navy platforms off Oregon Inlet, NC. A data acquisition system based on a single-board computer developed at UNC-CH is currently being tested. It uses RS485 communications to reduce cabling needs and Iridium satellite communications for telemetry. Instrumentation includes a full meteorological suite, surface and bottom water temperature and salinity sensors, and a current profiler with directional wave capability. Navy liability concerns have delayed deployment at the NC Navy platforms so a trial deployment of the prototype system is planned at the SABSOON range R4 tower in late summer or early fall. This will include testing of a wind profiling package (REMTECH SODAR). The second unit will be deployed on the NC platforms pending resolution of liability issues. At SABSOON instruments were added to a third platform, R8. COMPS will add a new buoy northeast of the Dry Tortugas. Equipment (for currents, T/S, and meteorology) is procured, and deployment is scheduled for Sept. 2003. Separate (NOAA MERHAB) funding will add another buoy at the shelf break. By Sept. 2003 we anticipate a total of six telemetering COMPS surface buoys.

HF radar pilot program. Two types of HF radar systems, WERA and CODAR, were purchased with a two-fold purpose. The first is to perform a comparative side-by-side test of these systems on the WFS where several moorings are available for direct comparisons with conventional velocity measurements by ADCPs. The second is to initiate permanent installations at three locations: the coasts of northeast North Carolina, southeast Florida, and west-central Florida.

The WFS HF radar comparison is expected to occur during August and September of 2003. Two transmit/receive stations for a Long-Range Seasonde (CODAR Ocean Systems) deployment have been procured by USF. We anticipate augmentation by a third station from Rutgers University to span the coastline from Gasparilla Island in the south to Indian Shores in the north, a total baseline of approximately 140 km. We have tentative approval for a permanent north site, and we are negotiating temporary approval on the south site. It is within this baseline that the RSMAS WERA system will be deployed. A dual station WERA HF Radar system was procured for delivery to RSMAS in June 2003. A deployment on the WFS for an approximate two month period is part of the WERA system acceptance tests. Sites for the WERA system along the WFS are at Venice and Holmes Beach FL for which written approval has been acquired from the City of Venice and from Holmes Beach representatives pending finalization of plans for antennae layout and power requirements. Depending on the actual radar range achieved (200 km being the advertised range), we may have five (real time) surface moorings and two bottom (self recording) moorings within the vector footprint of the Seasonde and at least three moorings within the vector footprint of the WERA. Actual overlap will depend on site approvals. We also expect NRL INSAR flights by the NOAA WP-3D.

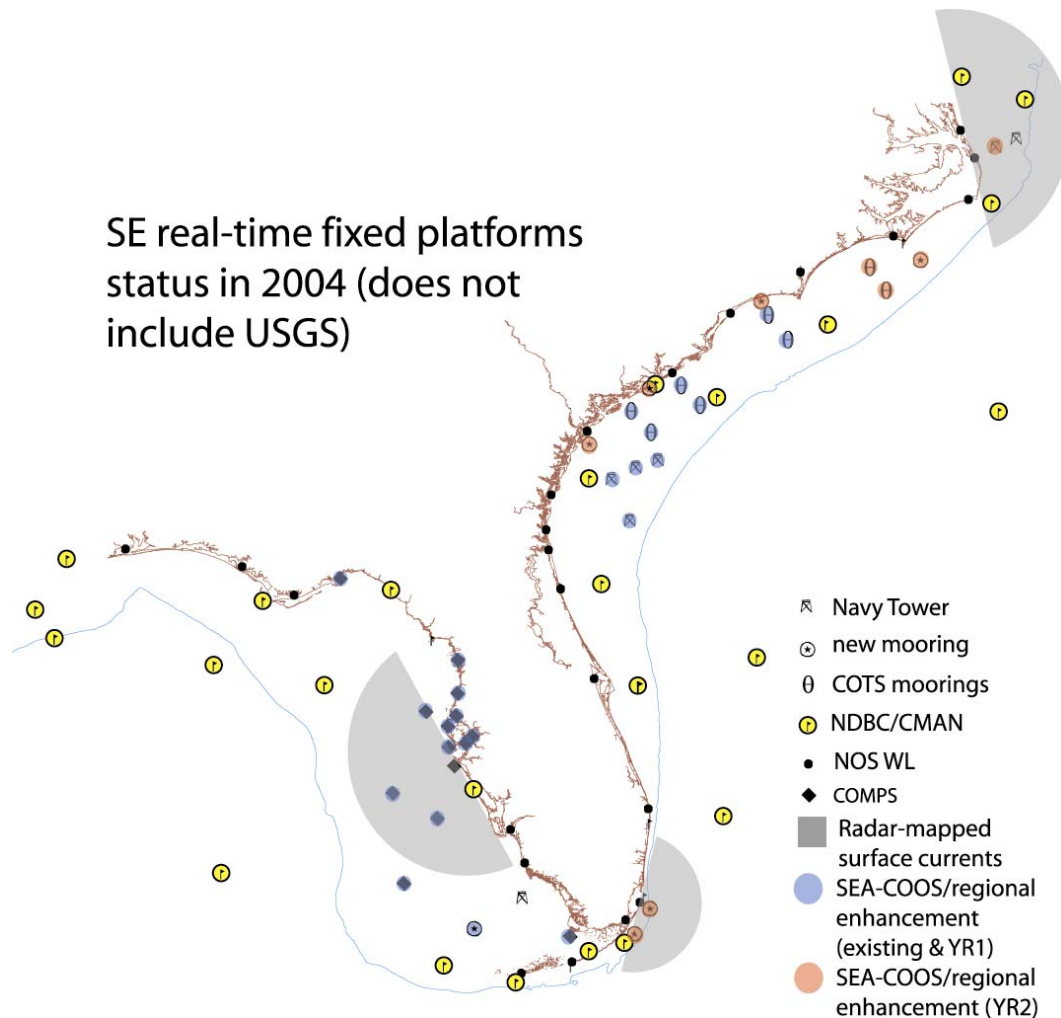


Figure 1 - the distribution of real-time *in-situ* measurement platforms over the SEA-COOS domain excluding USGS stations. Yellow and black dots mark the locations of NOAA assets; blue dots show regionally maintained platforms that already exist or are to be deployed by August, 2003; and orange dots show some of the additional platforms anticipated by August, 2004.

These two radar systems, and an additional Long-Range CODAR unit, are being deployed permanently as part of a test of the operational capability of this observation technique. Currently two sites, at the Field Research Facility in Duck, NC and at the Cape Hatteras Coast Guard Station in Buxton, NC, are approved by the FCC and have CODAR systems installed and operating. Beam pattern calibrations have been run and are being processed, and preliminary observations should be available on the internet by the end of July. Three potential WERA sites have been surveyed along the EFS at the Nature Conservancy in Crandon Beach Park, State-owned land in Key Largo, and South Florida Test Facility (SFTF) in Ft. Lauderdale. Analysis of surface current measurements from previous EFS Ocean Surface Current Radar (OSCR) deployments were completed to assist in planning the new HF radar systems (Lekien et al, 2003; Olson et al., 2003; Shay et al., 2003a,b). Negotiations are underway with county, state and federal officials to use these lands, and an FCC request will be filed shortly to transmit at 16 MHz as part of our long-term monitoring plans along the EFS and the development of a radar test bed (RTB). The USF installations on the WFS as part of the radar comparison will also be permanent installations.

Other technology development efforts. A number of pilot studies and development activities are also being pursued. These include: 1) testing Iridium satellite modem communications as part of an Ocean.US testbed, 2) the continued development of an underwater video camera system by SC DNR at SABSOON; 3) testing of solid lithium polymer batteries for power systems in support of TACTS (Navy) operations; and 4) design by SABSOON of a profiling CTD package for tower usage.

The Ocean.US Iridium satellite modem communications testbed activity involves the in-situ measurement system development work at UNC-CH and includes the provision of equipment for real-time data telemetry via Iridium systems for seven Caro-COOPS moorings to be deployed in July-August 2003 (www.carocoops.org). While NOAA is supporting the mooring costs for Caro-COOPS, SEA-COOS is providing the real-time aspects of the Caro-COOPS systems.

At SABSOON, the present underwater fisheries video system is being maintained with upgraded hardware and software. A web site making the images available to the public is being upgraded and the development of a fisheries video data logger to gather data directly associated with oceanographic buoy systems is being investigated. There are also plans to test solid lithium polymer batteries for remote power systems in support of TACTS (Navy) operations. The design of remotely operated water samplers and a profiling CTD/optical package for tower deployments are underway.

Second year activities. The four broad areas of year one will continue to guide the year 2 activities. The specific plans are as follows.

Maintain existing academic components. It is likely that UNC-CH instrumentation of the NC tower will occur in year 2, as development and legal issues are resolved in year 1. The two systems (at SABSOON and off NC) will be maintained and assessed for reliability and servicing needs. For the NC site this will occur through an agreement with the new Coastal Studies Institute of UNC in Dare County, NC. Existing SABSOON/SEA-COOS offshore systems at the R2, M2 and R8 platforms, including instrument, power and communications systems, will be maintained. SABSOON data analyses will continue in coordination with SAB modeling. The COMPS/SEA-COOS coastal and offshore network maintenance will emphasize improving reliability through acquisition of sensor spares for swapping out complete systems.

Deploy additional fixed platforms. A number of new platforms are included in the second year. The design is intended to continue filling large gaps in the offshore observational network, and to establish several nearshore stations.

There will be several additions to the offshore network. In response to local requests and to fill an observing system coverage gap along the NC coast a buoy/mooring system will be deployed approximately 20 nm off Cape Lookout, in collaboration with Fort Macon, NC Coast Guard station. Instrumentation will include a full meteorological suite, surface and bottom water temperature and salinity sensors, and a current profiler with directional wave capability. Personnel at the Institute of Marine Sciences, UNC-CH, Morehead City, will take prime responsibility for this installation. SEA-COOS will provide equipment for real-time telemetry on five new Caro-COOPS moorings to be deployed in fall 2003 or spring 2004. New SABSOON

tower installations are planned for SABSOON at M1 (southern Master) and R4 (SE remote) towers. These will include dissolved oxygen sensors, automatic water samplers, and a profiling CTD system at the M1 platform. Deployments of *in-situ*, real-time oceanographic profiling systems will be initiated within the East Florida Shelf Radar Test Bed (EFS RTB). These SWAMP (Shallow Water Autonomous Moored Profilers) systems were developed with ONR DURIP and ONR program funding. They contain an upward-looking ADCP and a buoyant CTD probe that is periodically released to the surface and winched back to the bottom. Two SWAMP systems will be deployed in early 2004, nominally off Carysfort Reef and off the northern end of Elliott Key, both at the edge of the reef tract in ~35 m depth. All data will be telemetered, presently by short-range radio, but a change to Iridium is proposed. Operationally, we will collect hourly current profiles and 6-hourly CTD profiles transmitted once per day to RSMAS for incorporation into the EFS RTB, EFSIS evaluation, and the SEA-COOS real-time data stream.

There will also be a number of new nearshore installations. Two inner-shelf monitoring sites for currents, directional waves (using an ADCP), and meteorological data will be established by USC in South Carolina. These sites will be located off an arcuate strand (Long Bay) and barrier island (Folly Island) coastline environment, respectively. The data will be analyzed for the joint wave, wind, and current climate at each location. The U.S Army Corps of Engineers Wave Information System output (a wave hindcast product) will be evaluated against actual data, followed by recommendations for use by coastal managers/engineers. Studies will be made on the relationship between the near-shore hydrodynamics and the coastline responses at a regional level. A similar near-shore directional wave/current measurement and wireless communications system off Tybee Beach, GA will be developed in collaboration with Georgia Tech. COMPS will continue development of near-shore moored systems for surface meteorology, currents, T/S, and directional waves using acoustic telemetry to decouple sensors from platforms and wireless telemetry from platforms to shore.

HF radar pilot program. There are three main components to the HF radar program in year 2: 1) analyze the results of the intercomparison study; 2) operate and assess the reliability of the permanent HF radar installations; 3) identify sites for future deployments.

As part of the intercomparison study on the WFS radar-derived surface currents from the CODAR and WERA systems will be analyzed and intercompared. The observations will also be compared to data from moored ADCPs and NRL INSAR over the approximately 2-month deployment. Results will be published and used as rationale for future system purchases.

We will evaluate the reliability of the HF radar systems as operational systems in year 2 in a number of ways. This will include assessment of down time, variations in range, variations in beam pattern, and limited calibration tests (against *in situ* observations) at each site. In NC this will include observations from the Oceana Navy towers and from shorter-term self-contained ADCP deployments. Surface current radar sites will be deployed and maintained along the EFS to establish a Radar Test Bed (RTB) in a regime with large gradients that occur over short-time scales. These data will be compared with ADCP transect data from the Explorer of the Seas and new profilers. A third radar station will be added along the EFS (probably at SFTF at Dania Beach). The initial WFS long-range Seasonde system will be completed by establishing

permanent locations for three antennae sets. At all locations real time surface current information will be provided on the web, to include overlays with other data that can be mapped such as SST and winds.

There will also be initial preparations for HF radar installations in SC and Georgia. These will include assessment of user needs, site surveys, and initiation of permitting. A wide range of possible radar configurations is possible and we therefore will need considerable time to determine the best setup. We also note that one of the lessons learned in year one was the difficulty in siting coastal radar; extra time spent preparing for deployment is not wasted.

Other technology development efforts. The fisheries video system and Iridium testing will continue, with a new effort in sampling from moving platforms.

The fisheries video system will be maintained with upgraded hardware and software. Fisheries video data logger prototypes will be built and evaluated for long-term deployments on buoys. Modifications of the MBARI Video Information System will be investigated for application to the acquisition of large data sets from all project video systems as a way to develop simple digital records from the video system (of specific species abundance as a function of time, for example).

COMPS presently uses GOES telemetry for all offshore buoys. They will investigate Orbcom (used in BSOP) and Iridium as alternatives. In concert with the USF COT and the NOAA MERHAB and ACT Programs, COMPS/SEA-COOS will provide a test-bed for nutrient and other biological and chemical sensors for deployments on moorings, profilers, and other platforms.

The Explorer of the Seas will be fully incorporated into SEA-COOS in year 2. It will provide daily real-time data from the Straits of Florida and the northern Caribbean Sea. These observations include ADCP, bulk and skin SST, sea surface chemistry, standard meteorological measurements, incoming radiation, aerosol characterizations, upper air wind profiles, radiosonde profiles, pCO₂, and wave height estimates. The Explorer also serves as a testbed for instruments from both the oceanographic and meteorological communities, including a SeaKeepers automated sea surface and meteorological measurement system.

We will also begin testing two types of unmanned moving platforms. UNC-CH will purchase and test a Slocum glider for the SAB. Initial testing will be at SABSOON. Mapping exercises coordinated with the R/V Savannah will test the glider capabilities. On the WFS the bottom stationed ocean profiler (BSOP) data will be integrated into the real time web-based data stream. USF will be collaborating with Mote Marine Lab and Rutgers scientists on the joint use of BSOP and gliders for mapping missions over the WFS.

SEA-COOS Modeling and Products Subsystem

Modeling: Progress to date. During Year 1, there were two overarching modeling goals: (a) to implement a nowcast/forecast system, and (b) to undertake hindcast studies of specific atmospheric-forcing events to better understand the responses of the continental shelf regions in the SEA-COOS domain. Details follow:

- *Nowcast/forecast:* Each modeling team has successfully implemented a nowcast-forecast system of its SEA-COOS sub-region. As anticipated in our Year 1 plans, 3-D barotropic model results for three regions [(West Florida Shelf, USF), (East Florida Shelf, UM) and (South Atlantic Bight, UNC-CH)] are now running in an uncoupled mode, forced by NCEP winds and astronomical (open ocean) tides. Hourly displays of velocity fields, sea surface elevation and Lagrangian (particle) trajectories are available daily for a 24-hour hindcast and a 48-hour forecast period (see <http://www.seacoos.org/modelling/index.html>). In the coming months, we will examine the barotropic skill of the model results and we will work with the data-management team and submit our model results via DODS for blending of the model results into one data product (see Figure 2 for a depiction of the overlapping domain coverage).
- *Hindcast:* During the January 2003 Modeling and Products Coordinating Committee meeting at the North Carolina Supercomputing Center, we identified March 2001 as the study period for the hindcast experiment. During this period, two strong extra-tropical storms produced significant shelf responses at the beginning (March 5-7) and the end (March 21-22) of the month. Historical data for the common study of these events (coastal sea level, currents, and hydrography as well as atmospheric forcing) are being sought and we anticipate the barotropic hindcast study to be completed this summer.
- *Publication of results:* During the summer of 2003, we anticipate submitting papers for publication describing the scientific findings.

Modeling: Second year activities. We will continue developing the nowcast/forecast structure laid out in Year 1 through increased grid resolution and the inclusion of baroclinic fields (and associated evaluation of baroclinic skill). We will also begin formal data assimilation experiments, and we will explore forcing of our limited area models with offshore/deep ocean model products.

- *Regional enhancements:* in each of the SEA-COOS regions (and for different reasons) we anticipate the need to refine the geometric fidelity of the present model meshes.
 - UNC-CH: In the region of the South Atlantic Bight we have found that capturing the response of sea-level at semi-diurnal frequencies depends on proper resolution of the inlets-sound-estuary system of the South Carolina and Georgia coastline. We will continue the study of this response at other frequencies (diurnal and weather band) to determine the optimal grid resolution needed to capture the relevant physics.

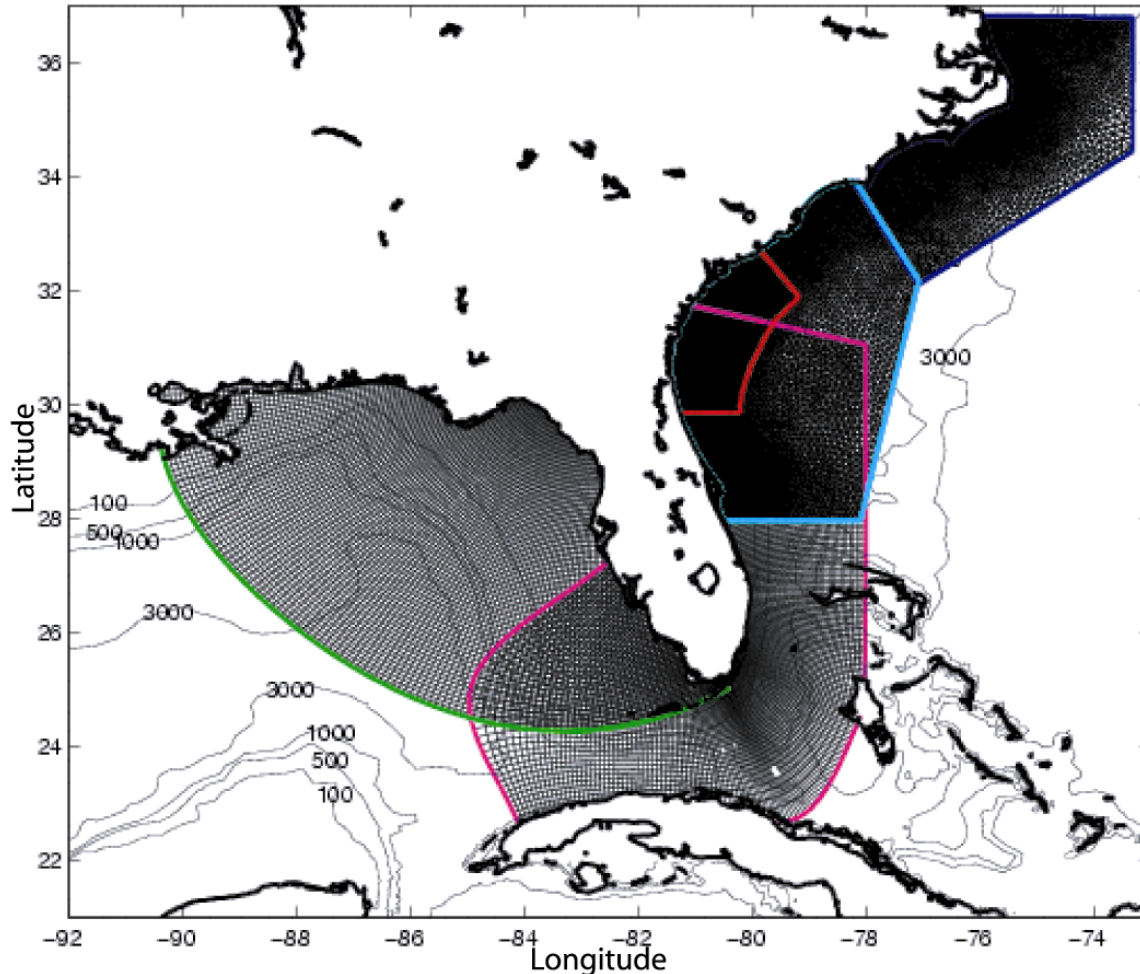


Figure 2 - domains and grids of the three circulation models running as part of SEA-COOS. The green line marks the boundary of the University of South Florida model; the magenta line the boundary of the University of Miami model; the light blue line the boundary of initial University of North Carolina at Chapel Hill (UNC-CH) model, and the dark blue line the extended boundary of the UNC-CH model domain. The red line off the Georgia-South Carolina coasts marks the boundary of the NOPP-funded South Atlantic Bight Limited Area Model that is actively exploring data assimilative techniques using *in-situ* observations.

- UM: In the region off southern Florida, nested modeling for the Dry Tortugas sub-domain will be continued, and Lagrangian characterization of the circulation will be extended to three-dimensions in anticipation of future biological/management applications. Preparations will be made for a nested sub-domain in the WERA footprint between Key Largo and Port Everglades. This will be necessary during a model validation and verification phase when the WERA surface current data become available.
- USF: Off the west Florida shelf, high resolution studies of the estuaries will be conducted to determine their response to category 2 and 4 hurricanes making landfall into the Tampa Bay region, at several locations, from several directions, and with several approach speeds. By combining the flooding/drying capabilities of the model with the most recent merged NOAA/USGS bathymetric/topographic data, we have a high-resolution simulation with important emergency management implications. A second application is in a study of the Pinellas Co.

Inter-Coastal Waterway (ICW). Starting sufficiently offshore to properly force the tides we pare down to 40 m resolution within the ICW to look at its time varying flow fields and how the various inlets exchange water with the coastal ocean.

- *Baroclinic fields:* we will examine the effect of imposing heat fluxes and river discharge in hindcast mode as we build to their inclusion in the nowcast/forecast system. This will enable the study of the formation of tidal fronts during summer and the cooling of nearshore waters and associated water-mass subduction during cold-air outbreaks, as well as the formation of low salinity fronts during wet seasons. We will begin by using optimal interpolation (O/I) techniques to (a) composite SST fields from different satellites (AVHRR and TMI) to produce cloud-free daily images (He et al., 2003) for surface heat flux relaxation and (b) composite surface wind fields from EDAS (model) and buoy and coastal observations for improved surface momentum flux forcing. The ocean model results from these O/I fields are demonstrably better than from the nominal EDAS fields alone (He, Liu, and Weisberg, 2003).
- *Data assimilation:* we will begin to examine the possibility of routine data assimilation into the SEA-COOS modeling sub-regions. Some success has already been achieved in a related project (<http://sablamm.unc.edu>) and we will consider the feasibility of using the approaches that worked in the smaller SABLAM domain over the larger SEA-COOS region. We anticipate that sea level and ADCP data may be available for assimilation during the coming year, but we will also consider assimilation of surface current data from HF radar after a period of validation and verification. The latter is an open research topic requiring development of formal methods. It forms part of a community-wide effort and will be carried out jointly by the three modeling groups.
- *Deep Ocean Model Products:* NRL is providing real-time global and basin-scale products, and, over the next years, GODAE anticipates providing basin-scale model products, which we need to evaluate for their veracity and utility as a source of open boundary conditions. We will collaborate with GODAE teams to use their analysis and forecast products to force our limited area models. Forcing will include initially the open boundary sea surface elevation (based on recent findings on the seasonality of the variations on Gulf Stream transport and its effect on the sea level on the continental shelf, inclusion of offshore forced solutions should improve our forecasts), but we anticipate including momentum, temperature, and salinity as well. This activity will be carried out jointly by the three modeling groups.
- *Applications:* in collaboration with Dr. Jon Hare of the National Marine Fisheries Service (Beaufort, NC) we will study and quantify the transport of larvae (of selected species) on the SAB shelf. Archived model (current) fields will be used to reconstruct the evolution of the flow field on the SAB shelf to quantify its retention of planktonic organisms. Comparisons with drifters over long periods (several months) will provide an additional measure of model skill and perhaps provide information on seasonal and inter-annual variability. This effort has already begun, and results of this study will be assessed in relation to their impact on the design of Marine Protected Areas (MPAs). A second

application we anticipate is that of sediment transport. In this coming year we will explore availability (and capabilities) of models of high-frequency waves. Inclusion of these models may provide a better forecast of bottom stress and thus a more quantitative statement on sediment transport processes.

Data management subsystem

Progress to date. The data management infrastructure for SEA-COOS provides the capacity for exchange, sharing, and integration of information and information products developed within the SEA-COOS framework. Moreover, the infrastructure is being designed in a flexible and expandable manner that incorporates the principles of IOOS and addresses potential needs of coastal and ocean data generators within the broader community. The following summarizes objectives and progress for the first year.

Formation of Data Management Coordinating Committee (DMCC): The DMCC was formed, comprised of the data managers at each institution and a team at USC that is tasked with coordination and centralization activities and to provide assistance to all institutions. The DMCC met early in the year, established a working relationship, and identified two near-term goals: (1) to provide access via a web interface to SEA-COOS-supported, quality controlled data and associated metadata and derived products, and (2) to implement DODS servers and provide feedback as to how well DODS servers meet the needs of SEA-COOS and our users.

Assessment and organization of collective data management capabilities: The DMCC has completed an assessment of data management capabilities, limitations, expertise, and institutional requirements of primary SEA-COOS partners. Each participating institution has documented current data collection efforts, including instrumentation, types of data collected, and documented procedures for data management including QA/QC and archival.

Development of mechanisms for information exchange: SEA-COOS is establishing distributed regional “nodes” using (1) NVOADS (National Virtual Ocean Data System)/OPeNDAP (Open Source Project for a Network Data Access Protocol) and (2) metadata gateways. DODS servers are established at all of the five participating institutions and evaluations are underway. Interactive visualization of merged SEA-COOS observations and model products through our web-based portal will utilize LAS. A NCDDC Gateway will be evaluated for a limited set of variables measured by SEACOOS when the necessary tools are available from NCDDC. In the meantime, metadata can be searched and accessed via the FGDC Clearinghouse and by searchable nodes provided by the Cast-Net Program (see below).

Establishment of web site: The development and publishing of the initial static SEA-COOS web portal for dissemination of data and data products to all partners and external users has been completed (www.seacoos.org), and the web portal is maintained at the UNC-CH. Development of enhanced semi-dynamic and dynamic web portals are underway. This involves the development of new tools for data access, visualization and analyses, as well as linkages and clarification of relationships among the various related Web locations, including our own institutions, related observing systems, and nested relationships. Particular attention is being paid to communication with various user communities.

Development of software and processes required for data integration. To date, the DMCC has agreed upon netCDF as our standard data format where appropriate and has adopted the FGDC metadata standard. To facilitate metadata development, we are using the Cast-Net metadata tool (ACET; see www.cast-net.org), an online metadata entry form developed under the auspices of the Southern Association of Marine Laboratories (SAML) and the Southeastern Universities Research Association (SURA) and funded by NSF EPSCoR. With ACET, and other tools where appropriate, each institution is developing metadata for submission to a national metadata clearing house via a Cast-Net node maintained at USC. USC is providing technical support for database development strategies and for metadata development.

Establishment of archives for data and information products. Currently, primary partner institutions are maintaining their own archiving procedures, and a long-term archive is being established for SEA-COOS data and data products. Until a “deep” archive is identified for the IOOS information products, local storage will be at our individual institutions and at a central repository at USC.

Establishment of functional relationships with external partners: To optimize capacity and minimize redundancy, we have been identifying generators of data complementary to those produced by SEA-COOS primary partners and ways in which linkages can be established for transfer, exchange, compilation, or archiving of information. Close working relationships have been established with the NCDDC and the NOAA Coastal Services Center (CSC, Charleston, SC) to ensure that we take advantage of ongoing NOAA and IOOS developments and avoid redundant data management efforts. In addition, a working relationship has been established with the GoMOOS observing system organization in Maine, and we are identifying ways to share efforts and expertise.

Second year activities. Project Year 02 data management and information technology activities build upon groundwork laid in Year 01, and the DMCC will provide coordination and oversight of all primary partner data management activities.

Continuation of specific Year 1 activities: The networking and problem-solving activities of the DMCC will be enhanced, and constructive linkages with additional data management activities will be utilized, such as those with GoMOOS and SURA/SCOOP. DODS and LAS functions will continue to be tested by exchange of information among the partner institutions. Efforts will continue to establish consistency among vocabularies, where needed. One anticipated demonstration will be to identify and test a concrete example of model data (stored on a DODS server) over-laid with integrated data product utilizing real-time data (also stored on a DODS server).

Evaluation of OPeNDAP to non-gridded datasets: Historically OPeNDAP is better suited to supporting gridded data, but efforts are being made to improve support to in-situ datasets, which may have data and metadata collected in Relational Database Management Systems (RDBMS) utilizing commercial systems such as Oracle and SQL Server, and open source systems such as MySQL and PostgreSQL.

Enhancement of Web portals for dissemination of data, metadata, and information: This will involve the maintenance and further development of the SEA-COOS portal (www.seacoos.org), as well as linkages and clarification of relationships among the various related Web locations. Particular attention will be paid to communication with various user communities. Community bulletin boards have been established at several sites (www.carocoops.org/bb, <http://redington.me3.com/php/gomoos/phpbb/index.php>), which cross-reference discussion and documentation as it affects data management issues within the community. These discussion threads are keyword searchable within the bulletin board and also searchable by popular search engines such as 'google'.

Further development of data integration software and processes: These include (1) QA/QC procedures, including those for (near) real-time data streams; (2) procedures for updating, refining, or correcting QA/AC documentation; (3) documentation of metadata, identification and establishment of metadata standards; and (4) implementation of processes to facilitate metadata documentation.

Access to external data streams to support modeling and outreach efforts: Required data will be (1) static data, i.e. those that do not change or change only slowly in time, and (2) the real-time or near-real-time data. The management of those data will evolve as finer resolution or more accurate static data become available and as new technologies affect the delivery of data.

Create the East Florida Shelf data distribution system: The Explorer's shore-side real-time data stream and the high-resolution archival data system will be integrated with the data streams from other Miami SEA-COOS investigators (modeling - EFSIS, HF radar-WERA, in-situ profilers) and the RSMAS Remote Sensing Laboratory (Terra- & Aqua-MODIS ocean color and SST, AVHRR SST). The goal is to both conserve computer and personnel resources and to provide seamless Internet access to the available real-time and archival observations, model products, and satellite observations from the East Florida Shelf.

Development of geospatially-referenced, web-based products: The development of GIS applications and presentations of data, model outputs, and other data products will be initiated in Year 2 and are expected to be important SEA-COOS products. Visual and layered presentations are particularly useful and instructive for a variety of user groups, ranging from resource managers to education platforms. We anticipate that some of this activity will be closely allied to the Outreach Working Group's work and SURA/SCOOP activities.

SEA-COOS Outreach and Education

Progress to date. Outreach activities have focused on identification of regionally-representative user groups, observations of greatest interest, and establishment of existing interactions.

Survey of SEA-COOS initial partners. To understand the current level of partnering with non-academic users a brief survey of participants at the September 2002 SEA-COOS meeting in Chapel Hill, NC was conducted by email in the fall of 2002. While this informal information scan cannot be considered rigorous social science research, it does provide useful baseline/benchmark data. To summarize the survey findings, current and future partners were

grouped into eleven major categories which included: coastal community and county managers, commercial fishing, recreational fishing, oil and hazardous waste responders, port and harbor managers, beach goers, commercial shipping, sail and powerboat marinas, state and local emergency management coordinators, mariculturists, and surfers and kayakers. Among all user groups the most commonly requested information was data concerning waves, wind and water temperature.

Outreach Workgroup Workshop. In December 2002, SEA-COOS researchers met for a workshop in Charleston, SC with 32 SG outreach personnel and partners from state, federal and private industry. This two-day program included participants from each of the southeast Atlantic SG extension programs, US Army Corps of Engineers, NOAA Coastal Services center, North Carolina marine Trades Association, NOAA Marine Biotoxins Network, the Boating News, South Carolina Marina Association, University of Georgia Marine Extension, and the state Climatologist for Georgia. The purpose was to inform them about the types of data and information available from SEA-COOS and to begin identification of projects. The workshop also included a facilitated session for gathering input from the participants. This information will be used to identify the case studies for further study in each of the states. This meeting also served as an opportunity to begin planning the long-term project needs, and developing specific tasks and budgets.

Outreach Partner Identification. SEA-COOS survey information, workshop results and informal networking within the outreach workgroup and between the other workgroups are currently being used to select several priority situations from within the region for in-depth study and collaboration. In this phase several cases (possibly one situation from each state) will be identified. These cases will be illustrative of one of two possible situations; 1) where nonscientific coastal users have established productive working relationships with SEA-COOS researchers and are actively utilizing information and sharing ideas or 2) where conditions exist for the establishment of a successful partnership between researchers and users.

These cases will be analyzed to determine how successful partnerships originated (a historical perspective of the institutional and individual relationships), how they are being maintained (the specifics of the two-way flow of information) and the potential avenues for further development of the relationship. Although work with specific case studies will not begin until summer 2003, several possibilities have been identified including the Tampa Bay PORTS program, the regional NWS rip current prediction project in North and South Carolina, and the Georgia Ports Authority (Savannah and Brunswick).

Second year activities. Year 2 outreach and education activities will be guided by the realization that all workgroups need to be more closely integrated. Product specific teams (comprising of outreach/education, observations, and data management personnel, modelers and users) will design information delivery systems to establish and improve the types of information, delivery format, evaluation, and dissemination techniques that perform best under the circumstances. This process and the outcomes will be reported to the region and will result in a better understanding of how to match users' need with available information. This will initiate a process of implementing an integrated system (observations, data management., models,

outreach, education, users) for use by other regional associations. This process is envisioned as dynamic and iterative to allow for continual improvement.

Two primary concepts will guide our outreach and education efforts. One is that SEA-COOS can provide multiple situation-dependent educational products. These are 1) information (data), 2) products (forecasts, nowcasts, hindcasts), 3) training (how to interpret and best use information), 4) informal education networks (specific user groups in multiple locations), and 5) formal education networks (K – Gray). The second concept is that the SEA-COOS team needs to prioritize our opportunities and focus on what we can deliver. This may best be accomplished by a “phased approach” to user engagement and assistance:

- Phase I: User groups we can help now with information currently available
- Phase II: User groups we can help in the near future with information available in 2-3 years
- Phase III: User groups we can help in 3-5 years

Together these two concepts form a matrix that will be used to provide a structural dimension for identifying outreach and education opportunities and tracking project performance. Table 1 illustrates this matrix in which different types of user assistance can be categorized by type and temporal availability.

Table 1. Type of assistance by temporal availability

	Phase I (current)	Phase II (1-2 years)	Phase III (3-5 years)
Information			
Products			
Training			
Informal networks			
Formal networks			

Outreach and education programs will be delivered on both a regional and sub-regional basis.

Regional outreach coordinator: A regional outreach coordinator will be hired to work directly with state outreach and education teams to insure that efforts are carried out in an efficient, effective and timely manner. The coordinator will work directly with the outreach workgroup and SEA-COOS researchers to continue and expand the Year 1 outreach program. The coordinator will serve as the principal regional connection between users and the project workgroups.

Develop close working relationships with partners in each state. We will establish a SEA-COOS team of researchers and user-group partners for identifying information needs and determining the best methods of information delivery.

Information sharing between SEA-COOS network and partners. Information will be disseminated in a range of ways, e.g., by posting state pilot projects on SEA-COOS web and

providing progress updates; networking with other regional ocean observing efforts; and producing an annual report of SEA-COOS outreach efforts and impacts. The electronic and traditional products will be distributed to other regions to assist their OE efforts.

State and sub-regional projects. In addition to regional efforts, state and sub-regional pilot projects will be conducted in year 2. The purpose of these efforts is to enable SEA-COOS researchers to understand the information product needs for a diversity of user groups in different geographic and cultural areas of the region. In North Carolina the “Wind and Wave Boater Information” project will provide better information and determine the most effective methods of information access for water-based users of wind and wave data, and the “Rip Current Prediction and Warnings” project that will improve rip current forecasts and information dissemination for NC beach users. In South Carolina a Coastal Hazards Outreach Advisory Committee will establish linkages and create dialogue among the South Atlantic Sea Grant Extension program’s existing hazards programs, the SEA-COOS project team and hazards user communities. Georgia Sea Grant will concentrate Year 2 efforts on the Georgia Ports of Savannah and Brunswick and Coastal Hazards, specifically the First Responders to coastal weather events. Florida will conduct information meetings and develop outreach materials. It should be noted that the Florida outreach effort will also tie into an existing NOAA-sponsored project, the Coastal Storms Initiative.

The education objectives are to identify needs and format of SEA-COOS data and processes; disseminate information to educators and students regarding SEA-COOS scientists, technology, data collection and results; and to work with the Data Management workgroup of SEA-COOS and NOAA/CSC in the identification of visualization formats for web based lessons. The SouthEast COSEE (Lundie Spence) will facilitate the development of the education plan for South East Atlantic Coastal Ocean Observing System (SEA-COOS). SouthEast COSEE serves NC, SC and GA. Florida COSEE (PI Paula Coble, University of South Florida) and the Central Gulf of Mexico COSEE (co-PI Mike Spranger, University of Florida) complete the SEA-COOS region.

Develop a regional SEA-COOS educational forum NC, SC, GA, and FL with representatives from the educational and SEA-COOS communities will meet to discuss SEA-COOS in light of educational application. State standards will be identified, as well as existing courses (physical science, physics, chemistry, science, biology) that could apply SEA-COOS data, processes and technology

Electronic newsletter for educators: An electronic newsletter, located on the SouthEast COSEE website, and promoted through educational networks in the region, will track the process of SEA-COOS product and information development. In addition to research news, this newsletter will highlight career and profiles of the scientists, technology used, maintenance and setup of platforms and buoys, and comments from the scientists. This newsletter will also carry other COSEE information and promote COSEE events and collaborations.

Summer Physical Science workshop: A one-week, summer Physical Science workshop will introduce SEACOOS science concepts to secondary teachers and provide them with training and resources needed to use SEACOOS data products in the classroom. Alignment with needs of

teachers and state science standards will be based on feedback from regional forum activity. In addition, a pilot program will be developed by Florida COSEE at USF.

Management and governance

Developing a form of governance that is suitable for the broad coalition of participants in regional ocean observing systems will take time. Few models of interstate organizations that combine academic institutions, federal agencies, state agencies, and private entities exist. We anticipate that the governance of SEA-COOS will evolve over time as we identify the optimum functional framework and establish a working interaction within the broader Regional Association (see below). Our initial effort has therefore focused on implementing a flexible organizational structure that can accommodate anticipated growth in SEA-COOS membership.

The SEA-COOS “Articles of Collaboration” defines our initial governance (Figure 3). It establishes a Board of Directors for SEA-COOS that includes representatives from each of the founding academic institutions, a Sea Grant representative, and an external independent member. A policy for adding new members is established, and an organizational structure, based on Working Groups, provides forums for planning and advancing each of the subsystems. Affiliate Members are organizations with an interest in coastal ocean observing that wish to coordinate activities with those of SEA-COOS or wish to participate in discussions about evolution of the program. Offers of Affiliate Membership will be extended to the existing set of collaborators (see title page), and the Board of Directors will review membership requests from other organizations. Members of the Working Groups can include representatives from Affiliate Members, including other subregional observing systems, which can provide a method to coordinate independently funded activities in the region. The chairs of each of the Working Groups form an Executive Committee that is responsible for the day-to-day operations of SEA-COOS.

The program office is housed at the UNC Office of the President, which provides primary contract and grant coordination and management among the institutional entities that make up the SEA-COOS collaboration. Distribution of funds for the SEA-COOS subsystems and partner institutions is negotiated by the Executive Committee and approved by the Board of Directors. Financial management is governed by a master agreement (http://intranet.northcarolina.edu/docs/aa/research/initiatives/SEA_COOS_Master_Agreement.pdf) signed by all parties.

The Ocean.US “Regional Summit” held in March, 2003, identified Regional Associations as the governing structure that oversee regional observing systems. Among the function of the Regional Associations will be responsibility for allocating funding and prioritizing activities in the region. The Regional Associations are expected to be composed of elected officers from a broad cross-section of information providers and users in the region. The exact form of the Regional Associations, however, is to be self-determined.

SEA-COOS Organizational Structure

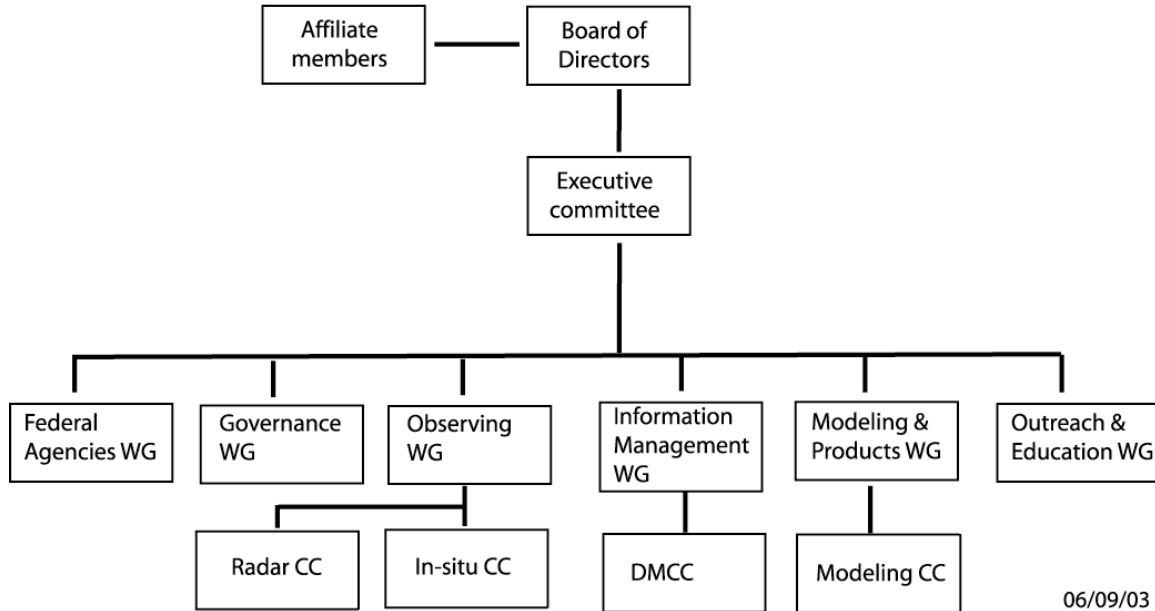


Figure 3 - The organizational structure of SEA-COOS as defined in the Articles of Collaboration. Working Group is abbreviated “WG” and Coordinating Committee is abbreviated “CC”.

SEA-COOS is participating in a proposal to form a Regional Association for the southeast being led by the South Carolina Sea Grant consortium. The spring 2003 SEA-COOS workshop, held in Jacksonville, FL, May 28-29, 2003, focused on introducing state agencies to regional observing systems in general and SEA-COOS in particular, and was intended to promote the engagement of a broader community in the development of the regional observing system. If funded, the proposed Regional Association development program will explore models of governance with the help of external consultants and will host workshops to identify the model most consistent with the needs and desires of the southeast community.

In Year 2 the role of the program office, hosted by the UNC Office of the President, will increase. The SEA-COOS website will be funded from the program office and enlist the help of the Office of Arts and Sciences Information Services division (OASIS) at UNC-CH. The program office will also fund a products coordinator to orchestrate day-to-day activities by working closely with the executive committee.

Summary

SEA-COOS has made significant progress towards its goal of creating a coastal ocean observing system for the southeast in the short time since its creation. An organizational structure has been implemented that has enabled each of the components of the observing system to identify critical

areas of emphasis and to take action to address these issues. The initiation of this process with a relatively small group of academic institutions has permitted rapid development.

In year two the emphasis will be on increasing participation in SEA-COOS by state agencies. This necessitates an increasing presence observationally in the nearshore and is reflected in greater investment in nearshore observational capabilities. Information management efforts will expand to include geospatially-referenced databases and displays that are of significant interest to the management community. Coordination of the selection of data management tools with groups along the eastern seaboard through participation in SURA SCOOP will help ensure ready exchange of data and information products among the nascent regional observing systems. Modeling efforts will emphasize baroclinic simulations and be supported by increased observations of shelf hydrography. Outreach efforts will be increasingly focused on specific users groups to identify target audiences for SEA-COOS products, and a K-12 education thrust will be initiated in collaboration with two regional COSEEs. Governance for SEA-COOS will continue to evolve in response to input from the broader community of data providers and users.

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Budget Justification

The following justification is broken down by subsystem largely following the NOPP investment areas.

Observations (includes operational, observatory, and technique development categories)

UNC

- *Financial and administrative oversight:* The University of North Carolina will provide financial and administrative oversight for the project including compliance monitoring, budget management, and project coordination for governance. In year 2, systems will be developed for tracking periodic progress against project milestones. Budget management systems will also be upgraded to allow more comprehensive analysis and monitoring of the project budget and subawards.
- *Project management services:* through a subcontract to OASIS/UNC-CH provide staffing and office services support for SEACOOS Project Investigator (PI). These services would include: gathering information and creating status reports; handling day-to-day management details for the SEACOOS P.I.; coordinating conferences, meetings; facilitating partner communications; managing day-to-day office tasks (filing, answering/making calls, etc.); and expediting project-level goals and specific tasks.

The University of North Carolina Office of the President serves as the awardee institution for SEA-COOS. UNC administers all project funds in accordance with ONR terms and conditions and the terms and conditions of the SEA-COOS Master Agreement, which was executed in August 2002. Parties to the SEA-COOS Master Agreement are: UNC, UNC-CH, NCSU, MCNC, USC, SC DNR, SC Sea Grant, Skidaway Institute of Oceanography, UGA, UFL, USF and Miami.

Dr. Russ Lea, the project coordinator will devote 12% effort and the Contracts and Grants Manager will devote 15% effort to SEA-COOS. Fringe benefits are calculated at 23% of salaries and wages.

UNC will administer funds for programmatic support including the recruitment of a project manager, who will oversee the day-to-day operations of the project and the continued development and enhancement of the SEA-COOS web portal.

F&A is calculated at 21.7% on base of salaries and wages.

UNC-CH

Fixed platform – P.I. Harvey Seim, UNC-CH

- *Complete instrumentation of towers off GA and NC and maintain system.* It is likely that instrumentation of the NC tower will occur in year 2 due to development and legal delays. The two systems (at SABSOON and off NC) will be maintained and assessed for reliability and servicing needs.
- *Develop and deploy a buoy/mooring-based in-situ measurement system off Cape Lookout.* To be done in collaboration with Fort Macon, NC Coast Guard station. Instrumentation will include a full meteorological suite, surface and bottom water temperature and salinity sensors, and a current profiler with directional wave capability. Primary responsibility for the mooring will lie with Dr. Rick Luetlich of the Institute of Marine Sciences, UNC-CH in Morehead City, NC.

Technique development (HF radar, telemetry, glider) – P.I. Harvey Seim, UNC-CH

- *Maintain and assess NC radar system.* We will evaluate the reliability of the HF radar system as an operational system in year 2. This will include assessment of downtime, variations in range, variations in beam pattern, and limited calibration tests (against in-situ observations).
- *Telemetry Testing.* Continue software development and testing of Iridium satellite communication technology.
- *Purchase and test a Slocum coastal glider for use in the SAB.* Initial testing will occur at SABSOON and be coordinated with survey cruises of the R/V Savannah. Coordinated mapping exercises will be used to test the capabilities of the instrument.

Budget Justification: The observing subsystem includes 2 months of summer support for Seim, two-months support for Sara Haines to assist with programming data telemetry procedures, six months support for Mike Muglia to maintain field equipment, and three months support is summer graduate (Catherine Edwards) support of field. Travel funds for these people are \$10,000, and annual computer maintenance contracts for each person is included (\$4,000). To ensure timely communications with all staff, communications costs include an allowance for cable modems for each supported employee, as well as the purchase of a dedicated cell phone for the project. Partial defrayment of moving expenses (to Manteo) for Mike Muglia (\$1000) are included. Mr. Muglia's relocation to Manteo will facilitate operations and oversight of the systems installed on the coast. The cost of monthly travel to all field sites from the UNC-CH campus would be well in excess of the \$1000 requested. We estimate that this is the most efficient and cost-effective use of agency funds.

Additional expenses are associated with instrumentation and their deployment. Two new fixed platforms will be developed, requiring full instrumentation. Included under permanent equipment are an ADCP with directional wave measurement capabilities (at \$33,000 apiece),

Eppley IR and visible light radiometers (approximately \$6000 apiece for a total of \$24,000), 2 buoys (from GoMOOS for \$75,000), a Remtech sodar wind profiler (\$25,000), two Benthos acoustic modem sets (\$20,000 each) an Edgetech pop-up buoys (\$5500), and 4 Seabird conductivity/temperature sensors (SBE37-IMP, \$6250 apiece, approximately \$25,000 total). Also included is a Slocum coastal glider, at \$80,000, to be used in periodic surveys of shelf hydrography. Supplies include the purchase of meteorological sensors (Rotronics air temperature/humidity sensors, an Aandera visibility sensor, Heise barometric pressure sensors, RM Young anemometers), Seabird inductive modem electronics and coupler, construction of data acquisition systems and associated hardware (\$30,000), and cabling and connectors (\$15,000). We also include \$15,000 in shiptime, and \$15,000 for insuring all instrumentation. Mooring hardware costs are included under miscellaneous charges, as are printer and paper supplies.

University of South Carolina

SC Nearshore Monitoring Stations. - P.I. George Voulgaris, USC

- Deploy and maintain nearshore circulation and wave direction monitoring sites at two locations along the inner-shelf of South Carolina, representing an arcuate strand (Long Bay) and barrier island (Folly Island) type coastline, respectively.
- Provide hourly wave height, direction, period, water temperature, wind speed and direction, surface, mid-depth and bottom current through via Web.
- Process and analyze incoming data and establish joint wave, wind and current climate for each location.
- Evaluate validity of Wave Information System (WIS) data with actual monitored data and suggest modifications for use by coastal managers and engineers.
- Study the relationship between nearshore hydrodynamics and coastline response at a regional level.

Budget Justification: Salary is included for the P.I. (1.5 months), one technician (12 months), and a graduate student(12 months), to design and perform the station installation and handle the data retrieval. The student will be involved also in carrying out some of the planned data analysis and processing. Equipment and supply costs include the purchase of two ADCPs with the waves ® options, two met stations and two CTDs together with the associated underwater armored cable and the base station (IP telemetry). Contractual services expenses include the installation of IP addresses by the base stations, diver assistance, boat for laying underwater cable and freight services. Travel is included for the technician and other personnel to maintain and service the stations. Other costs include student's tuition fees. Indirect costs are charged at 45.5% on everything except capital equipment and student tuition.

Near real time data communications – P.I. Madilyn Fletcher, USC.

- Upgrade 5 offshore moorings for near real time data communications for use in testing and evaluation of data transmission methodologies, especially Iridium.
- Test and implement communications through the Caro-COOPS program headquartered at USC and partnering with North Carolina State University and University of North Carolina Wilmington.

Budget Justification: Caro-COOPS is purchasing the equipment to inductively couple all of the instrumentation on the moorings to modems in the subsurface/surface buoys. Costs are estimated at \$30,000 for each of the five stations to be deployed in the 2nd project year.

South Carolina Department of Natural Resources

Fisheries Management Observations – P.I. Charles Barans, SC DNR

- Continue to maintain and upgrade the hardware and software of the present underwater/ microwave video system.
- Evaluate several fisheries video data logger prototypes for long-term deployments with oceanographic buoy systems.
- Investigate modification of the MBRI Video Information System for application to the acquisition of large data sets from all project video systems.

Budget Justification: Salary support is included for the P.I. for one month. The modification and training of the MBRI neural network system to the project's fisheries video will be subcontracted and include the cost of travel to MBRI. Video data loggers will be tested, evaluated and their hardware and software modified to the project's specifications.

Skidaway Institute of Oceanography

Maintenance and upgrades of SABSOON - P.I.s Jim Nelson, Rick Jahnke

- Continue maintenance of existing SABSOON/SEA-COOS offshore systems at R2, M2 and R8 platforms.
- Upgrade components of instrument, power and communications systems.
- Coordinate data management with SEA-COOS Data Management Working Group.
- Coordinate Georgia Outreach/Education efforts with Outreach Working Group.
- Analyses of existing SABSOON data in coordination with SAB modeling.
- Target installations at M1 (southern Master) and R4 (SE remote).
- Upgrade UW camera system (cameras, data acquisition, data processing) and consider a deeper deployment site.
- Develop near-shore directional wave/current measurement and wireless communications system off Tybee Beach, GA (with partner Paul Work, GIT, Savannah campus).
- Prepare for HF radar installations in Georgia (site surveys, initiate permitting).

Budget Justification: Salary support for Project Co-P.I.s is 3 months for Nelson and 1 month for Jahnke. Nelson will work with SkIO staff to manage the SABSOON systems, including system designs and planning field operations (deployments, maintenance, ship surveys). Nelson and Jahnke will coordinate with SEA-COOS Working Groups and will serve as the primary contacts for SEA-COOS in Georgia. Staff salary support for Engineering and shop services includes Project Engineer (4 mon), Engineering Technician (12 mon), machinist (3 mon) and Field Tech (4 mon). Partial salary support is included for 3-4 members of the SkIO Research Staff (19 mon total) who will manage data communications, data processing and the SABSOON web site, coordinate with SEA-COOS data management for formatting, metadata, etc., and analyze SABSOON, ship and satellite data. SkIO Research personnel will also be involved in diving operations, ship and small vessel work, laboratory analyses and assist in maintenance operations.

The major categories for permanent equipment are for power and communications, data acquisition systems, and instruments. An adequate inventory of spare components and instruments is required to minimize downtime and save on helicopter flight time. The basic maintenance for SABSOON instruments systems is about \$3,500 per platform per year. The SkIO budget will also include maintenance for the SC DNR underwater camera system. Additional safety equipment for SkIO personnel, particularly for cold-weather helicopter operations, will be purchased (flight/immersion suits, helmets) as needed for additional personnel. Other expenses include replacements of worn components, and travel for P.I.s and project personnel to SEA-COOS project and Working Group meeting and to workshops; SkIO computer services, and telecommunications (T1 line for SABSOON).

Transportation costs for support of SABSOON systems includes helicopter flight time and ship time. Basic servicing for 3 towers will require about 4-5 hours helicopter flight time per month at a cost of about \$1000 per hour flight time (plus additional ferry charges and pilot per diem). Ten days ship time is requested for the R/V Savannah (estimated rate of \$5,000 per day) for use in instrument deployments and maintenance and for survey work in support of SAB modeling.

A subcontract to Paul Work, Georgia Tech Regional Engineering Program (GTREP, Savannah, GA), will develop capabilities for long-term, real-time wave, current and tide data collection in the near-shore environment off Georgia. The proposed site is near Tybee Island; a commercially and recreationally important beach that has ongoing beach erosion problems and has been a site of beach “nourishment” operations in recent years. Salary support includes one month support for Work, 0.5 mon support for Randy Abler (GTREP, Electrical and Computer Engineering, who will assist in development of wireless real-time communications) and 6 months support of a GTREP student for data processing and analyses. The requested personnel support totals \$38,000 (including fringe and 50% indirect costs) and the total subcontract with equipment and materials costs is \$99,000.

RSMAS

Radar Test Bed for the East Florida Shelf - P.I., Lynn K. Shay, MPO, RSMAS

- Process and analyze radar-derived surface currents and compare these data to moored ADCP data over the West Florida Shelf from the ~2-month deployment in July/August 03;
- Deploy and maintain surface current radar sites along the EFS in establishing a radar testbed (RTB) in a regime with large gradients that occur over short-time scale (compare to ADCP transect data from the Explorer of the Seas);
- Provide hourly estimates of surface current maps via the Web; and
- Add a third radar station along the EFS (probably in the vicinity of Port Everglades) in support of RTB.

Budget Justification: Salary support is planned for Drs. L.K. Shay and B. Haus (3 months each), Tom Cook (6 months), and Jorge Martinez (12 months). Shay will oversee and direct the project, play a leading role in the analysis of the WFS analyses, and procure the hardware, Haus will direct logistical support on the WFS/EFS, Cook is responsible for data processing and will assist Haus, and Martinez and Cook will maintain the HF radar sites. All personnel will be involved in the HF radar set up on the WFS and EFS. The cost function used here is based on three Dania Beach Deployments. The approximate cost per month, including salary support (with indirect cost recovery), was approximately \$23.5K. Direct costs include telephone lines and electricity at the sites, travel to and from the sites, expendable supplies; such as, disks/CDs to store data, computing services (i.e., Internet connections at the sites such as DSL). The WERA (~\$140K) will be a 16-channel system to link into two systems currently on order. A new trailer is requested for the radar system. Shipping costs and customs fees are \$6K.

Real-time Oceanographic Profiling Stations Along the East Florida Shelf - P.I., Bill Johns, MPO/RSMAS

- Begin deployments of in-situ, real-time oceanographic profiling systems within the HF Radar Testbed on the East Florida Shelf. {The systems, referred to as SWAMP (Shallow Water Autonomous Moored Profiler) systems, have been developed independently from SEA-COOS with ONR DURIP and ONR program funding. These systems contain an upward-looking ADCP and a buoyant CTD probe that is periodically released to the surface and winched back to the bottom.}
- Data will be telemetered, presently by short-range radio mode but a change to Iridium or some other cell communication system is planned. {The entire unit is housed in an acoustically recoverable, trawl-resistant bottom platform. The purpose of these units is to provide a capability for acquiring and transmitting velocity and water property (e.g., temperature and salinity) profile data from shallow environments (<100 m) without the need for vulnerable and maintenance-intensive surface buoys.}
- Two SWAMP systems will be deployed early 2004 in the EFS HF-Radar Testbed, nominally off Carysfort Reef in the Florida Keys and off the northern end of Elliott Key. Both units would be deployed in ~35 m depth. The data will be transmitted to RSMAS and incorporated into the EFS Radar Testbed, EFSIS evaluation, and the SEA-COOS real-time data stream.

{Final pre-operational testing of the systems will be accomplished this summer with existing funding.} In operational mode, we anticipate collecting hourly current profiles and 6-hourly CTD profiles that are transmitted once per day.

Budget Justification: Salary is included for the P.I., two technicians, and a research associate to perform the deployments and handle the data retrieval and quality control. Four days on the R/V Walton Smith will be needed for SWAMP deployment and servicing operations. Equipment and supply costs include provision for upgrading the telemetry system to Iridium from the present HF radio telemetry electronics, a new dedicated PC for a telemetry server, and other operational supplies (instrument batteries, etc.). Travel is included for the P.I. to participate in SEA-COOS meetings.

USF

Observational subprogram – P.I.s Robert Weisberg (WFS), Mark Luther (Coastal stations and Tampa Bay), USF

- *Moorings and coastal stations:* By the end of the SEA-COOS year 1 we anticipate having the following WFS observing system resources in place:

Surface Buoys

5 with real-time surface meteorology, water column currents, and T/S;

1 with real time water column currents and T/S

Bottom Moorings

2 (non-real time) with water column currents and bottom T/S.

One of the surface moorings is directly funded by SEA-COOS along with partial support for other array maintenance.

For year 2 we will continue to maintain the offshore array, assisted by SEA-COOS, providing all real-time data to the general public via the COMPS and SEA-COOS Internet sites as well as providing these data to NCEP via the NDBC Internet site and the GTS. Together with the offshore moorings COMPS will also maintain a set of coastal observations (<http://comps.marine.usf.edu>).

- *HF Radar:* 3 Long Range Seasonde (CODAR) antennas (including 1 from Rutgers Univ.) will be deployed, and we will engage in a HF radar test (WERA and CODAR) with SEA-COOS colleagues this summer over the array of moored buoys.

For year 2 we will continue to maintain the CODAR measurements providing data in near real time.

- *Profilers:* Along with the moorings our BSOP (profiler) developments are progressing under separate funding, and we anticipate limited operational deployments beginning this summer.
- *Data analyses:* Analyses will be aimed at understanding the synoptic, seasonal and inter-annual variations on the WFS, both for the ocean circulation and ocean-atmosphere interactions and for the biological ramifications of these. New analyses will derive from the joint HF radar experiments and from the continuation of the operational CODAR measurements.

Budget Justification: For Year 2 activities we have budgeted a replacement surface mooring, a CODAR antenna, and two meteorological sensor suites. Of the 5 moorings with real time meteorological sensors the goal is to maintain at least 2 with a full complement of air-sea interaction sensors including long and short wave radiation (WHOI-designed ASIMET sensors) and the remainder with less expensive Coastal Climate Weatherpaks, or equivalent (without radiation). For increased reliability and for maintaining QA/QC we need spares so that entire systems may be swapped out with freshly calibrated and tested sensors. Personnel support includes 12, 3, and 6 months for two mooring technicians and a radar technician, respectively, plus 1 month for engineering support, and 6 months for data editing/analysis.

COMMONS

UNC

Website maintenance and development, subcontract to OASIS, UNC-CH

- *Dynamic web portal development:* Application development services in support of the design, implementation, support and on-going extension of a dynamic web-based portal to meet the data dissemination needs of the SEA-COOS project will be provided.
- Continued goals for the portal are to: integrate data from distributed partner collection sites; and explore and implement additional dynamic capabilities such as GIS and related technologies.
- *Ongoing Celoxis project management/design training:* OASIS will continue to manage Celoxis-based project management services and training for SEA-COOS users. These services include: task tracking; reporting; email notifications; document sharing; document versioning (check-in, check-out); user and group security; client platform neutrality (Netscape/Linux must be supported).
- *Web portal maintenance and content update:* OASIS will continue to maintain the SEACOOS portal's application infrastructure.
- *Software consulting services:* OASIS will continue to provide data integration, systems analysis, and consulting to Marine Sciences in support of this project. These services would include: technology investigation; process consulting; SEACOOS partner communications; conference attendance.

Budget justification: Costs include full-time support for a web development programmer and part-time support for a number of personnel within OASIS. Licensing fees for Celoxis (\$1,500) and server maintenance (\$4000) are included, as is \$5000 in travel expenses.

UNC-CH

SAB Modeling – P.I. Francisco Werner, UNC-CH

The tasks for the modeling team are:

- *Analysis of merged model fields:* Using the DODS server and in collaboration with the Data Management Team, in year 1 we will have completed the steps required to merge the present near-real-time barotropic nowcast/forecast fields (e.g., bottom topography, coastlines, sea surface height and depth-averaged currents, etc.) from UNC, USF, and UM. The product will be available on the www.seacoos.org website. In this coming year we will quantify the difference fields in overlap zones and correct/adjust/enhance as needed.
- *Barotropic skill:* using sea-level gauges, ADCP velocity data and drifters, we will develop a quantitative measure of model skill of barotropic (no density) mode.
- *Inclusion of baroclinic structure:* we will study the response of imposing heat fluxes and river discharge on the nowcast/forecast system. Data quality and model response will be assessed. This will allow the study of the formation of tidal fronts during summer, the cooling of nearshore waters and associated water-mass subduction during cold-air outbreaks, as well as the formation of low salinity fronts during wet seasons.
- *Data assimilation:* we will examine the possibility of routine data assimilation into the SEA-COOS modeling sub-regions in collaboration with colleagues from UM and USF. We will build on experiences gained in the SABLAM project. We anticipate that sea level and ADCP data may be available regionally for assimilation during the coming year, and we will also consider assimilation of surface current data from HF radar. The latter is an open research topic requiring development of formal methods and forms part of a community-wide effort.
- *Deep Ocean Model Products:* over the next years, GODAE anticipates providing basin-scale model products. We have formally established a collaboration with the HYCOM/GODAE team led by Prof. Eric Chassignet (UM) and will test their forecast products to force our limited area models. Initial forcing will include initially the open boundary sea surface elevation. Based on recent findings on the seasonality of the variations on Gulf Stream transport and its effect on the sea level on the continental shelf, inclusion of offshore forced solutions should improve our forecasts.
- *Applications:* we will collaborate with Dr. Jon Hare of the National Marine Fisheries Service to study and quantify the transport of larvae (of selected species) on the SAB shelf. This effort has already begun and results of this study will be assessed in relation to their impact on the design of Marine Protected Areas (MPAs). A second application we anticipate is that of sediment transport. In this coming year we will explore availability (and capabilities) of models of high-frequency waves. Inclusion of these models may enable a better forecast of bottom stress and thus a more quantitative statement on sediment transport processes.

- *Publications*: we expect to submit three papers for publication in the peer reviewed literature on: (i) operational regional models, (ii) barotropic skill including data assimilation, and (iii) applications related to larval transport/MPAs.

Budget justification: This includes 2 months of summer support for Werner, 10 months of support for a postdoc (Brian Blanton), and full support for two graduate students already in place (K. Pehrson and A. Aretxabaleta). Travel funds for the modeling team are \$10,000, and annual computer maintenance contracts are included at \$4,000. A terabyte storage system (\$28,000) is included under permanent equipment to support ongoing computing needs at UNC-CH. Supplies are budgeted at \$20,000. To ensure timely communications with all staff, communications costs include an allowance for cable modems for each supported employee. Tuition for each student will also be supported.

UNC-CH Data management – P.I. Harvey Seim, UNC-CH

- *DODS Evaluation*: We will continue to evaluate the use of DODS Servers for near, real-time data dissemination. This also includes participating in a workshop hosted by Peter Cornillion (University of Rhode Island) scheduled for Fall of 2003 on NVOODS to provide feedback about OPeNDAP protocol and software.
- *Data Integration*: Collaboration with SEA-COOS data management personnel to develop and implement processes to aggregate external data streams for modeling and outreach products. These external data streams are from federal data providers such as NBDC, NWS, and USGS.
- *Data Quality and Control*: We will participate in the identification, design, and documentation of QA/QC practices to be used by SEA-COOS data partners. We will implement QA/QC practices as identified by SEA-COOS partners. This includes procedures for near, real-time observational data, as well as, after-the-fact. This also includes participating in a workshop with NDBC on real-time QA/QC practices.
- *Establish metadata and data structure for NC observations*: We will assist in identifying SEA-COOS minimums for data structure and metadata needs for HF radar and in-situ measurements. These will be made available in a manner that are consistent with those throughout SEA-COOS.
- *Operational data streams*: Scripts and programs will be developed to automate the processes of converting, calibrating, and aggregating data as they are received from remote sites and pushed to data servers for Internet access. These automated processes will need to be sensitive to when sensors and equipment are brought online and offline or when there is a telemetry failure. Also, these scripts will need to access information about changes in calibrations and maintenance.
- *Design relational equipment database*: A relational database will be designed to hold information about field equipment and sensors, history of maintenance, calibration data and threshold standards. This will improve the communication of very detailed and pertinent information between the field personnel and data management personnel. This database will be updated by field personnel and used by operational scripts and programs—a crucial step towards operational function.

Budget justification: This component includes partial support for a technician, a \$5000 travel allotment, \$5000 in supplies and \$2000 in computer support contracts. Four months of support is for Sara Haines. Luke Stearns will participate in these activities at no cost to the project.

To ensure timely communications with all staff, communications costs include an allowance for cable modems for each supported employee.

F&A is calculated at 46% on a modified total direct cost base.

University of South Carolina

Data management and communications – P.I.s Madilyn Fletcher, Dwayne Porter

- OPeNDAP, and possibly other platforms, will be evaluated for supporting non-gridded (e.g. relational) data bases.
- The Web portal will continue to be enhanced for dissemination of data, metadata, and data products, with particular attention paid to various user applications.
- Data integration software and processes will be further developed, including QA/QC procedures and documentation, identification and documentation of metadata standards, and implementation of processes to facilitate metadata documentation.
- Processes will be developed and implemented to handle external data streams for modeling and outreach products.
- The development of geospatially-referenced, web-based products for presentation of data, model outputs, and other data products will be initiated.
- Coordination and assistance will be provided to all SEA-COOS partners to facilitate cooperation, exchange of information, and collective problem solving.

Budget justification: Salaries for University of South Carolina faculty are based on actual pay. Salary for 1 month is requested for Fletcher, and Porter will participate at no cost to the project. Three senior personnel are requested to have responsibility for coordination of data management efforts among the participating institutions. These will be personnel with expertise in systems administration, technology development, and programming. They will be familiar with the data management needs of the individual sites and tasked with providing strategic and technical assistance to all participants.

The duties of the system administrator (Purvis, \$67,000) include hardware setup, installation and configuration of DODS servers and NVOODS components, network and security administration, and planning and management of system backups, including a disaster recovery plan. The system administrator will coordinate with appropriate IT resources at each of the subregional institutions to assure continuity of service and availability of resources for data managers. A data administrator (\$53,000) will provide maintenance, conversion, and programming skills and will also focus on the more common data management activities, including collation and spatial enablement of data sets, migration of data to forms that can be shared, guiding the creation and publication of metadata, and implementing procedures for data quality assurance. The technology development and programmer (\$50,000) includes a number of functions, including creating code for automating common QA/QC procedures, transforming and aggregating data into forms that can be shared, and producing data products focusing on data generated by the

partners in the subregions. These data products will include both integrated data files and data visualization using tools. The programmer will focus on providing tools and resources that enable principal investigators to make use of the integrated regional data and will assist with tools and applications, such as DODS and LAS tools. Fringe benefits at USC were calculated at 19.1% of salaries (\$34,599) plus health insurance (3 @ \$2,665).

Travel includes airfare, ground travel, hotel and per diem, and incidental expenses. The budget estimate includes ground travel and air fare between Columbia, SC, Chapel Hill, NC, SkIO, GA, and St. Petersburg, FL, for data management assistance activities and project reporting meetings. Air travel includes trips by the Principal Investigator (Fletcher) to 1-2 national meetings to report on the project and facilitate coordination with other observing system programs. Considerable effort will be devoted to developing linkages with user groups and other observing systems, as well as identification of additional future applications of SEA-COOS and program development.

Supplies include computer stations (1 @ \$2K), laptops (2 @ \$2K) essential for technical work at partner sites, software and software licenses (\$3K), and supplies (cartridges, etc. \$450). Funds (\$1,000) are requested to cover USC computer support costs.

RSMAS

East Florida Shelf Information System (EFSIS) - P.I., Christopher N. K. Mooers, OPEL/AMP, RSMAS

- Sensitivity, process, and validation studies will be continued with EFS-POM (East Florida Shelf –Princeton Ocean Model).
 - Alternative sources of open ocean boundary conditions will be evaluated.
 - Participation in the initial SEA-COOS storm response analysis and the initial SEA-COOS merged nowcast/forecast study will be continued.
 - Nested modeling for the Dry Tortugas subdomain will be continued, and Lagrangian trajectories will be extended to three-dimensions.
 - EFSIS (East Florida Shelf Information System) will continue to be upgraded with more complete and realistic forcing.
 - Preparations will be made for a nested subdomain in the WERA footprint between Key Largo and Port Everglades. For example, there will be a model validation and verification phase when the WERA surface current data become available, followed by design of a data assimilation and verification phase.
 - Major contributions to the governance and planning of SEA-COOS are intended, especially for the development of federal agency interfaces.

Budget Justification: Salary support is included for the P.I.; the research scientist responsible for the hands-on EFSIS development, testing, and implementation; and the graduate research

assistant responsible for advanced model development and experimentation. An upgrade of computer workstations is planned. Travel for SEA-COOS business and presentations at professional and scientific meetings is included.

Observations from the Explorer of the Seas and Associated Data Systems - P.I., Edward Kearns, MPO/RSMAS

- The Explorer of the Seas will continue to provide daily real-time data from the Straits of Florida and the northern Caribbean Sea.. These observations include ADCP, bulk and skin SST, sea surface chemistry, standard meteorological measurements, incoming radiation, aerosol characterizations, upper air wind profiles, radiosonde profiles, pCO₂, and wave height estimates.
- The Explorer also serves as a testbed for instruments from both the oceanographic and meteorological communities, including a SeaKeepers automated sea surface and meteorological measurement system.
- The Explorer also provides a significant public outreach opportunity to educate and inform passengers about oceanography in general and the SEA-COOS program in particular.
- The Explorer's shore-side real-time data stream and the high-resolution archival data system will integrate the data streams from other Miami SEA-COOS investigators (Mooers-EFSIS, Shay-WERA, Johns-profilers) and the RSMAS Remote Sensing Laboratory (Terra-& Aqua-MODIS ocean color and SST, AVHRR SST). The goal is to both conserve computer and personnel resources and to provide seamless Internet access to the available real-time and archival observations, model products, and satellite observations from the East Florida Shelf.
- The comprehensive East Florida Shelf data distribution system will also better facilitate the production of a variety of blended and derived products for the SEA-COOS domain, including validation of WERA current velocities and advective nutrient/chlorophyll fluxes from ocean color data. It will thus be a key element of the SEA-COOS distributed data network.

Budget Justification. Base support is provided for the daily Explorer observations as well as the shore-side data management and distribution system activities. The largest portion of these expenditures is salary for 24/7 at-sea tech support. Other lesser salary expenditures are targeted mainly on the shore-side data management activities of the data manager, P.I., and support personnel (including part-time help for compiling the satellite data archive). Modest funds for necessary supplies and hardware to calibrate instruments and maintain the on-board data network are budgeted, as are funds for additional hardware (disk arrays and network equipment) in support of the data management system.

- *Baroclinic hindcasts.* We are presently using 3 different models, depending on application. The primary vehicle is the POM (Blumberg and Mellor, 1987), which we are using for baroclinic hindcasts and for barotropic nowcast/forecasts. Our baroclinic hindcasts are all quantitatively gauged against data. On this basis we are attempting to determine model limitations and corrections. Surface forcing appears to be the primary limitation (as contrasted with model physics). While overly simplified, surface heat flux is limiting on seasonal scales and surface momentum flux is limiting on synoptic scales. Given adequate forcing functions we can do reasonably well on integrations of several-months duration, and comparisons between independently derived momentum balances from the data and the model demonstrate that the model performance is correct. We are using optimal interpolation (O/I) techniques to 1) composite SST fields from different satellites (AVHRR and TMI) to produce cloud-free daily images (He et al., 2003) for surface heat flux relaxation and 2) composite surface wind fields from EDAS (model) and buoy and coastal observations for improved surface momentum flux forcing. The ocean model results from these O/I fields are demonstrably better than from the nominal EDAS fields alone (He, Liu, and Weisberg, 2003). From this we may conclude that the most effective way of improving ocean state specification by models is to improve the coastal marine weather forecasts used to drive the coastal ocean models. This quantitative finding underscores the importance of coastal ocean observing systems. These O/I techniques may be considered as our first steps toward data assimilation.
- *Nowcast/forecast.* Our barotropic nowcast/forecast uses EDAS nowcast/forecast winds to drive the WFS POM, inclusive of tidal forcing at the open boundary. For year 2 we will implement baroclinicity now that we have an SST product for surface heat flux relaxation.
- *SEA-COOS domain model.* For the purposes of improving the open boundary condition specifications for the WFS regional model we also implemented a larger SEA-COOS domain grid. Initial experiments were with tides forced at the open boundaries along with climatology for surface dynamic height and subsurface hydrography adjusted for total transport. Coupling of the regional coastal ocean models with larger scale deep-ocean models will be explored in collaboration with our SEA-COOS colleagues and other modeling groups. A formal relationship through NOPP now exists between USF and the HYCOM/GODAE team of E. Chassignet, RSMAS.
- *Estuarine applications.* In use for estuarine applications is the ECOM3D-si (Blumberg, 1993). Along with the Tampa Bay PORTS applications of M. Luther, we have applied this to the Charlotte Harbor estuary (Weisberg and Zheng, 2003 and Zheng and Weisberg, 2003).

- *Linking the estuaries with the shelf.* For the purposes of achieving high resolution without nesting, and thereby being able to directly link the estuaries with the continental shelf, we are using the FVM of Chen et al. (2003). Two applications each with direct outreach implications have been performed. The first is a set of hurricane storm surge simulations for which we translate prototypical category 2 and 4 hurricanes into the Tampa Bay region, making landfall at several locations, from several directions, and with several approach speeds. By combining the flooding/drying capabilities of the model with the most recent merged NOAA/USGS bathymetric/topographic data we have a high-resolution simulation with important emergency management implications. The second is an application the FVM to the Pinellas Co. Inter-Coastal Waterway (ICW). Starting sufficiently offshore to properly force the tides we pare down to 40 m resolution within the ICW to look at its time varying flow fields and how the various inlets exchange water with the coastal ocean. Year 2 activities will include FVM simulations in fully baroclinic mode to study the evolution of salinity fronts by the coalescence of estuarine and shelf processes. We will also continue our local outreach activities.

Budget Justification. Half time support for a research associate and two months support for the P.I. are requested along with computer maintenance. USF is providing matching support for computer hardware.

USF Data management-P.I. Mark Luther, USF

- We are participating in all areas of data management integrating efforts with colleagues at USC, UNC and RSMAS. Data are being served at the COMPS, NDBC, and SEA-COOS websites.

Budget Justification. Two months support is budgeted for the P.I. and for a data manager.

Outreach and Education

North Carolina Sea Grant Outreach – P.I. Jack Thigpen, NCSG

- *Explain SEA-COOS capabilities to potential NC users.* Establish a rapport with coastal resource management groups, emergency management agencies, recreational boating associations, ports and harbors, recreational and commercial fishing associations, commercial shipping and barge operators. Attend scheduled meetings of probable user groups and present information about the system and its capabilities.
- *Determine Local Needs for CODAR information and products:* As HF radar system situated on the northern Outer Banks come on-line, work with local commercial fishermen and recreational boaters to identify useful products and methods of delivery.
- *Evaluate information delivery scheme for Cape Lookout buoy measurement system:* determine the information needs and delivery methods of a real-time wind and wave monitoring system that would improve the safety for recreational boaters, anglers, commercial fishermen, commercial and recreational underwater divers, and wind

powered sailors in the central NC coastal region (Morehead City). Establish user preference for combinations of web-based, radio and telephone delivery methods.

- *Develop outreach brochure and publication.* A tri-fold color brochure and an eight-page color brochure will be designed and produced. These materials will serve as an introduction to SEA-COOS and coastal ocean observing and will be distributed to potential users.
- *Assessing regional impacts of coastal observing:* The known literature covering the economic and social impacts of coastal observing for the southeast region will be reviewed and compiled. Additional research will be conducted in areas of weakness.
- *Partner with OCEAN.US on national workshop on outreach methods for regional ocean observing projects.* To advance outreach and education methodologies, a workshop for all regional observing efforts is planned to enable the cross-fertilization of practices.

Budget Justification: This includes .10 of annual support for Jack Thigpen and full support and tuition for one graduate student to attend meetings, develop and conduct focus groups, work with data management and other SEA-COOS workgroups to identify and refine information delivery methods. Travel funds total \$6,000 and will be used to gather information from user groups, work with other SEA-COOS partners and to present findings at regional and national observing systems meetings. A total of \$29,000 will be used to design and print the brochure and publication. \$10,000 will be allocated for the partnering with the national outreach workshop and \$40,000 for the impact analysis review and research.

Florida Sea Grant Outreach – P.I.s Mike Spranger and Jim Cato(FLSG)

- *Regional outreach coordinator.* A regional outreach coordinator will be hired to work directly with state outreach and education teams in the states of Florida, Georgia, South Carolina and North Carolina to insure efforts are carried out in an efficient, effective and timely manner. The coordinator will work directly with outreach workgroups and SEA-COOS researchers to continue and expand the Year 1 outreach program. The coordinator will serve as the principal regional connection between users and the project workgroups.
- *Florida Information meetings and development of outreach materials.* Informational meetings will be held to gain an understanding of capabilities of the observation system, focus on potential uses and to identify targeted user groups. In addition, convene at least 3 in-state meetings with local community user groups and project scientists to better design the observing systems, data collection and product development to optimize usefulness to local interests and needs
- *Determine the needs and requirements of a real-time wind, tide, and current monitoring system.* Determine needs and wants of clientele groups on application of real-time observational systems in their daily activities, monitoring and communication equipment, and support personnel that might be needed to implement real-time systems. Investigate pilot project sites.

- *Contact first responders, inform them of SEA-COOS objectives and potential and ask them to list services that would be the most useful from a real-time coastal observing system:* Meet with the emergency managers in Florida's coastal counties brief them on SEA-COOS efforts and potential assistance in their operations, obtain a comprehensive list of their needs, transform the list of needs to a practical plan of instruments and personnel to implement those needs, and develop a projected budget and time-line to implement the Emergency Management component of SEA-COOS.

Florida Sea Grant Education – P.I. Paula Coble (USF)

- *Summer Physical Science workshop:* A one-week, summer Physical Science workshop will introduce SEACOOS science concepts to secondary teachers and provide them with training and resources needed to use SEACOOS data products in the classroom. Alignment with needs of teachers and state science standards will be based on feedback from regional forum activity. In addition, Florida COSEE at USF will develop a pilot program.

Budget Justification: Salary and fringe benefits for Regional Project Coordinator (1.0 FTE) and part-time Florida Sea Grant staff (0.20 FTE) to assist in the identification of state and regional user groups, organization meetings, interaction with regional Sea Grant partners in the generation of materials and other related duties total \$83,965. Unemployment insurance totals \$470. Permanent equipment (computer) total \$4,500. For organizing meetings, facilities rental and reports, \$11,023 is budgeted. Travel support for coordinator, Sea Grant staff and user group participants is budgeted at \$21,625. \$25,000 is allocated to FL-COSEE for the summer physical science workshop. An indirect cost at rate of 20% of modified total direct cost is \$28,417. Total budget amount request is \$175,000 (\$146,583 direct + \$28,417 indirect).

South Carolina Sea Grant Outreach – P.I. Robert Bacon, SCSGC

- *Coastal hazards extension education and technology transfer program:* recruit and hire a Coastal Hazards (CH) specialist. Under the leadership of the CH Specialist, a SCSGEP/SEA-COOS Coastal Hazards Outreach Advisory Committee will be formed to oversee a coastal hazards/ocean observing system outreach needs assessment, extension and communications products, and research in subsequent SEA-COOS project years.

South Carolina Sea Grant Education – P.I. Lundie Spence, SCSGC

- *Develop a regional SEACOOS educational forum.* SouthEast COSEE (NC, SC, GA) and FL with representatives from the educational and SEACOOS communities will meet to discuss SEACOOS in light of educational application. State standards will be identified and existing courses (physical science, physics, chemistry, science, biology)

that could apply SEACOOS data, processes and technology. Additional “satellite” workshops will result.

- *Electronic newsletter for educators:* An electronic newsletter, located on the SouthEast COSEE website, and promoted through educational networks in the region, will track the process of SEACOOS product and information development and highlight career and profiles of the scientists, technology used, maintenance and setup of platforms and buoys.
- *Project Oceanography Program poster.* A poster will be designed and produced to introduce educators and students to oceanography and the SEA-COOS project as a tool for teaching science principles.

Budget Justification: The CH position and associated fringe benefits will account for \$31,500. Publication costs, travel and other costs will total \$18,500. The education (SE-COSEE) regional education forum will cost \$24,000 and the related satellite workshops will add an additional \$12,000. Costs associated with the electronic newsletter will total \$18,000 and poster and travel costs account for \$5,000 and \$1,000 respectively.

Georgia Sea Grant Outreach – P.I. Keith Gates, GASG

- *Georgia Ports and Coastal Hazards.* A SEA-COOS Advisory Panel will be formed to provide technical and programmatic direction for the Georgia outreach initiative and help determine the needs and requirements of a real-time wind, tide, and current monitoring system that would greatly improve the safety and profitability of the Savannah and Brunswick Ports. The specific needs of Brunswick and Savannah Port clients for a real-time observational system will be determined.
- *First Responder and Weather Hazard Decision Makers:* The GA outreach team will meet with the emergency managers of the eleven coastal zone management counties and with Georgia Emergency Management Agency (GEMA) officials to brief the officials on SEA-COOS efforts and potential assistance to their offices and agencies; obtain a comprehensive list of their needs, and transform the list of needs to a practical plan of instruments and personnel to implement those needs. Then a projected budget and timeline to implement the Emergency Management component of SEA-COOS will be developed.
- *SEA-COOS Targeted Training Workshops:* Based on interviews and survey results, Georgia Outreach will conduct two SEA-COOS workshops for the Georgia target user groups, Georgia Port Operations and the first responders to coastal weather hazards.
- *Georgia Will Develop a Coordinated State SEA-COOS Website:* The site will display all training materials and any available real-time data that will be provided free to the public or in a password protected area for information potentially restricted to subscribers.

- *Assess the Predictive Models Needed to Implement the Real-Time Coastal Needs:* Base the proposed products on interview and survey results from the two coastal SEA-COOS workshops attended by target coastal client groups seeking SEA-COOS products.

Georgia Sea Grant Education – P.I. Keith Gates, GASG

- *Continue Funding for an Educational Program Specialist:* As of June 1, 2003, MAREX, with GA MAS support, hired Ms. Margaret Olsen as an Educational Program Specialist and the SECOSEE educator.
- *Develop and Produce Educational Materials Aimed at K-12 Students and Teachers:* The training materials will including brochures, CD-ROM presentations, and static displays depicting current and future SEA-COOS capabilities and anticipated products for Georgia coastal user groups.
- *Develop and Produce Educational Materials for the Public:* The training materials will be based on the K-12 materials and in many instances, will be identical, including brochures, CD-ROM presentations, and static displays depicting current and future SEA-COOS capabilities and anticipated products for Georgia coastal user groups.

Budget Justification: The Georgia PI requests funds to support one month of his salary and two-months of technical support from Robert Overman, Marine Resources Specialist II. The requested salary for the two positions is \$11,722.83 with fringe benefits of \$3,047.94 totaling \$14,770.77. The PI and the Marine Resources Specialist will organize and arrange at least two meetings of the Georgia SEA-COOS Advisory Panel. SEA-COOS funding will support committee member travel to the panel meetings. All funds from last year were designated ‘travel funds’ by the SEA-COOS Program. We request that \$3,000 from last year’s travel funds be held over to support travel in the budget we are submitting for SEA-COOS Year II.

Requested extended MAREX travel funds will also support coastal client end-user surveys concentrating on individual interviews on port and first responder leaders to assess long and short-term SEA-COOS needs and capabilities, economic analyses of projected SEA-COOS benefits (\$3,000.00), and the development of public and K-12 training materials (\$3,500.00). Specific funding needs include publication of SEA-COOS brochures and CD’s (\$2,700), construction of traveling exhibits (\$2,500), developing the Georgia SEA-COOS website (\$3,000), sponsoring two user oriented training workshops (\$2,348), and researching future predictive modeling needs (\$3,500). Anticipated computer costs for all project needs are \$1,500. Total direct projected project costs are \$36,818.77. Requested extension of travel funds from year one are \$3,000. No matching funds are required for the project.