

# SEACOOS Program Management

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## Introduction

In the spring of 2001 a group of institutions in the southeast United States (Table 1) came together to pursue funding to develop a regional-scale coastal ocean observing system. Over the next six years the Southeast Atlantic Coastal Ocean Observing System (SEACOOS) program received significant financial support and undertook an ambitious program of system development and testing and broad-scale community engagement. An initial description of the program by Seim et al. (2003) provided an overview of the organizational structure of SEACOOS; more detailed descriptions of the major components of SEACOOS are conveyed in the companion papers in this volume. In this article the management

## ABSTRACT

The management of the SEACOOS program and its evolution over a five-year period are reviewed. The topics included pertain to the mechanisms used to create a consortium, define its mission, develop and manage its annual budget and tasking cycle; and the history of its focus over a five-year period. The management of SEACOOS was complex and required significant efforts to develop new approaches and collaborative mechanisms. Changes in management were made as weaknesses were identified and to enable a more unified approach to the evaluation, operations, data management and outreach efforts. A number of programmatic lessons learned are summarized that may be of value for future development of regional coastal ocean observing systems.

of SEACOOS and its evolution over time are described.

Another significant regional coastal ocean observing effort underway when SEACOOS began was the Gulf of Maine Ocean Observing System (GoMOOS, www.gomooos.org, Bogden and Richert, 2003). Good communication was established between the SEACOOS and GoMOOS programs, with strong collaboration on data management, but their program management approaches were

quite different. GoMOOS had incorporated as a not-for-profit organization. It was focused on establishing and marketing a buoy-based observing program and viewed itself as a utility. GoMOOS also drew upon a history of regional collaboration that had not been established in the considerably larger four-state SEACOOS domain. Thus, the initial focus for SEACOOS was to foster collaboration between a number of existing sub-regional observing efforts.

**TABLE 1**

Members of SEACOOS (pending affiliates were never formalized but participated in the program).

Founding Members	Affiliates	Pending Affiliates
University of South Carolina	Beaufort TACTS/NSWC/USN	
Skidaway Inst of Oceanography	CO-OPS/NOS/NOAA	SFOMC
University of North Carolina at Chapel Hill	FKNMS/NOAA	Field Research Facility/USACE
University of South Florida	MMAB/EC/NCEP/NWS/NOAA	CLION/DOD
University of Miami	Miami WFO/NWS/NOAA	Jacksonville WFO/NWS/NOAA
NCSU (Sea Grant)	NCDDC/NOAA	NAMOC/USN
University of Georgia (Sea Grant)	NDBC/NOAA	Florida Spaceport
University of Florida (Sea Grant)	SeaKeys/FIO	
South Carolina Sea Grant	Southeast Fisheries Science Center/NMFS/NOAA	
SCDNR	AOML/NOAA	
	FL Fish Wildlife Research Institute	
University of North Carolina	Caro-COOPS	
General Administration	Beaufort, NC Marine Lab/NOAA	
	CORMP	
	SAFMC	
	CSC/NOAA	
	GRNMS/NOAA	
	NRL/USN	

Several aspects of the SEACOOS program made its management challenging. Most significant was that the vision for the Integrated Ocean Observing System (IOOS) as a whole was evolving. When SEACOOS was initiated in 2002, there was a notion of the role of regional efforts in the U.S. coastal ocean network (Lindstrom, 2003), but the more specific descriptions of regional associations (RAs) and the regional coastal ocean observing systems (RCOOSs) to be managed by the RAs would not emerge until two years into the program (Ocean.US, 2003, 2005). SEACOOS began on the premise that it would (and must) tackle all aspects of regional development responsibilities; as a result, a broad range of activities was funded. As the IOOS concept matured, SEACOOS became more focused on addressing the technical aspects of RCOOS development. As the program draws to a close, SEACOOS may be seen as a prototype RCOOS effort. It was thus felt that the program should document its development approach, what was accomplished and, especially, to synthesize lessons learned during this process that may inform future RCOOS development.

A significant challenge faced by SEACOOS, and which appears to be true of many aspects of the IOOS endeavor, was promoting regular and effective communications among the regionally dispersed partners. The distributed nature of a RCOOS forces communications to be electronic. During SEACOOS a number of tools to facilitate communications were explored and tested, but communications within the program remained a task that required constant attention. The personnel requirements for this task are easily underestimated; however, the price of neglect can be high in terms of confused objectives, disenfranchised participants, and mission creep.

Described below are the major components of the program management instituted by SEACOOS. Foundational documents—those that were developed by SEACOOS that define agreements and plans upon which program actions were based—are shown in bold font;

full references are given in the reference section. The description of the program management structure is organized largely chronologically, starting with the inception of the consortium and the documents that define it, next presenting the development of a long-term vision for the program, and describing lastly the annual processes, budgeting and tasking.

## Inception of the Consortium

SEACOOS as a congressionally mandated program was conceived in early 2001. This approach was the result of interest in pursuing a regional effort in the southeast U.S. that would be consistent with the IOOS vision, and the recognition that no existing agency programs were positioned to fund the kind of effort envisioned. Based on an initial workshop held in Miami, FL, in June 2001, it was clear that there was sufficient interest and expertise in the region to warrant pursuit of significant funding. As the initial group of sub-regional programs began to discuss how to proceed, Dr. Russ Lea of the University of North Carolina-General Administration urged the partners to enter into a contracting model (the **Master Agreement**) prior to receiving any funding. This agreement would ensure that funding, once obtained, could be quickly and efficiently distributed to the partner organizations. The Master Agreement proved to be a robust financial agreement that allowed the program flexibility in funding and autonomy of the partners while ensuring fiscal accountability. The defining attributes of the Master Agreement are that it provided:

- **Uniform treatment of all partners;**
- **Equal credit for principal investigators;**
- **Flow-through contractual terms (from the funding agent), appropriate to the receiving institution;**
- **Negotiated standard legal terms and conditions (e.g., intellectual property, termination) in advance of prime award;**
- **Reduced administrative processing time for specific funding actions (task orders);**
- **The legal framework for managing the**

relationship(s) among partner institutions, and the basis for termination of individual or institutional participants. The Master Agreement successfully served its purpose throughout the lifetime of the program.

The Task Order component of the Master Agreement was especially useful. Task Orders were issued as the funding action under the general terms and conditions of the Master Agreement. A Task Order contains the essential information needed to establish an award to a recipient institution including annual and cumulative funding levels, funding period(s), information on the prime grant agreement including the Catalog of Federal Domestic Assistance (CFDA) number, the identified recipient Principal Investigator (PI), Administrator and Fiscal Officer, established payment terms (invoicing schedule) and reporting requirements and could accommodate special terms and conditions as needed. The recipients' plans of work and the prime grant agreement were included as attachments and the Master Agreement was incorporated by reference. Task Orders were issued to the recipient institutions and include funding for all projects at that institution. The exception was the University of South Florida, which had three different Task Orders, two of which were added in the second year. While negotiating a common agreement among 11 different entities was time consuming, having the advance approval allowed the actual Task Orders to be fully executed within weeks of receiving the formal grant agreement from the funding agent (in this case, the Office of Naval Research). In contrast, the typical turnaround time for sub-agreements among university partners is 1-3 months and can involve lengthy negotiations over legal terms and condition, resulting in delays to project start-up.

In summary, Task Orders defined under the Master Agreement:

- **Provided funding authority;**
- **Incorporated approved budgets/scopes of work;**
- **Defined invoicing and reporting requirements;**

- Could be issued within days of receiving the prime award;
- Were fully executed within weeks of issuance.

## Governance

Beyond the fiscal arrangements, the SEACOOS program quickly recognized a need to implement a form of self-governance. The program at inception had identified 1-3 PIs from each partner institution,

and the management of the program was undertaken by the collection of the PIs. However, within the first year additional PIs were engaged as gaps in the program's expertise were identified, and the number of PIs grew from 10 to more than 20 (Table 2). For the first 1-2 years of the program, videoconferencing was used as a way to manage travel costs while making the regular monthly PI-meetings more face-to-face and productive. However, by the second

year the large number of PIs and co-PIs, and the number and complexity of issues being addressed, made teleconferencing difficult. It was obvious that another model for program governance was needed.

There was also concern about conflict of interest. The PIs who originally conceived the program were also the individuals promoting the program with the Congress and making funding decisions for the program as a whole. It was difficult to argue that this one group alone could objectively develop and approve budgets for the entire program. There was also a need to clarify the roles and responsibilities of the partners in the program. Hence a governance document was developed that articulated how the partners would work together to operate the system being built.

The **Articles of Collaboration** were drafted in January 2003 to address the concerns raised above. These instituted an agreed-upon organizational structure, some of which was defined by the de facto breakdown of responsibilities and some by new efforts. To address the (then pressing) issue of conflict of interest, the Articles called for the formation of a SEACOOS Board of Directors, composed largely of senior administrators from the partner institutions, but with some external representation as well (Table 3). The Articles were considered a "constitution" of the community participating in SEACOOS and clarified the roles and responsibilities of the participants. These also formalized policies for SEACOOS concerning information sharing (free and open access to the data collected, but requiring recognition of source), publicity and publication (a generic attribution of funding), organizational conflict of interest and resolution of disputes.

The Articles defined the following roles with their attendant responsibilities (Figure 1):

- **Board of Directors** – impartial representatives who approve program direction, the budgeting process and are the forum for dispute resolution;
- **Working Groups** – the functional organizational units of the program

**TABLE 2**

SEACOOS Investigators involved with the program over its lifetime.

Institution	Investigators
University of North Carolina at Chapel Hill	Harvey Seim Cisco Werner Rick Luettich
North Carolina Sea Grant	Jack Thigpen Ron Hodson
University of South Carolina	Madilyn Fletcher Dwayne Porter Richard Styles (Yr 2-5) George Voulgaris (Yr 2-5)
South Carolina Department of Natural Resources	Charlie Barans (Yr 1-3) George Sedberry (Yr 4-5) Mike Arendt (Yr 5)
South Carolina Sea Grant Consortium/ Center for Ocean Science Education Excellence Southeast	Robert Bacon Lundie Spence
Skidaway Institute of Oceanography	Jim Nelson Rick Jahnke Dana Savidge
Georgia Institute of Technology	Paul Work
University of Georgia	Randy Walker (Yr 3-5)
Georgia Sea Grant	Mac Rawson (Yr 1-2) David Gates (Yr 1-2) David Stooksberry (Yr 2-3)
University of South Florida	Robert Weisberg Mark Luther Frank Muller-Karger (Yr 2-4)
Center for Ocean Science Education Excellence Florida	Barbara Spector Paula Coble (Yr 1)
Florida Sea Grant	Mike Spranger Jim Cato (Yr 1-2)
University of Miami	Christopher Mooers L.K. (Nick) Shay Bill Johns Ed Kearns (Yr 1-3) Rod Zika (Yr 4-5)

**TABLE 3**

SEACOOS Board of Directors.

James G. Sanders (chair)	Director, Skidaway Institute of Oceanography
Peter R. Betzer	Dean, University of South Florida College of Marine Science
Otis Brown	Dean, University of Miami, Rosenstiel School of Marine and Atmospheric Science
M. Richard DeVoe	Director, South Carolina Sea Grant Consortium
Russ Lea (ex-officio)	Vice-President for Research, University of North Carolina General Administration
Harris Pastides	Vice Chancellor for Research, University of South Carolina
Paul Sandifer (until 2005)	NOAA National Centers for Coastal Ocean Science
Harvey Seim (ex-officio)	Professor, University of North Carolina at Chapel Hill
Tony Waldrop	Vice Chancellor for Research, University of North Carolina at Chapel Hill

that include the observing, modeling, information management, and extension and education working groups;

- **Coordinating Committees – subgroups** of the working groups focused on specific topics that engage technical staff within the program;
- **Principal Investigators—the funded, institutionally authorized participants** in the program who bear responsibility for developing and executing the work tasks;
- **The Executive Committee (Table 4)**—made up of the chairs of the working groups, the program PI (as named by

the funding agent, also known as the chief operating officer) and the project coordinator (the chief fiscal agent), responsible for the day-to-day management along with program direction, development and implementation;

- **Federal agency affiliates—representatives** of agencies based in the region that have pertinent assets and/or interest in the development and operation of the RCOOS;
- **Affiliate members—independently funded** observing programs in the regions with whom the SEACOOS program collaborated.

Overall the Articles of Collaboration worked well and allowed SEACOOS to successfully operate as a program for the remaining funding period. However, a number of issues persisted and are worthy of further discussion.

A primary issue for the organizational structure was maintaining institutional balance in representation among the primary institutions versus representation based on programmatic structure. Representation based on programmatic structure was preferable from an operational standpoint, but the political realities of functioning as a congressionally mandated activity (an “earmark”) meant that the key institutions required active participation of their organization as a condition for continued support. This tension will likely not be unique to congressionally mandated efforts. For example, for the developing RAs, maintaining balanced geographic representation throughout the various components of the organization will likely prove challenging. The approach used by SEACOOS allocated funds to distributed institutions across the region, but did not evenly distribute support for different program components on a geographic basis (that is, support for some partners could be primarily for observing activities, others for

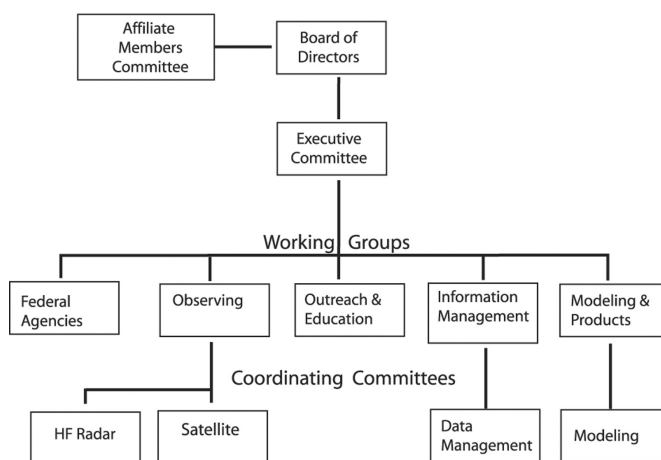
**TABLE 4**

SEACOOS Executive Committee.

Name	Working Group	Affiliation
Madilyn Fletcher	Data Management (DM)	USC
Christopher Mooers	Federal affiliates	UM, RSMAS
Jim Nelson	Observing (co-chair)	SKIO
Harvey Seim	Chief Operating Officer	UNC-CH
Robert Weisberg	Observing (co-chair)	USF
Francisco Werner	Modeling	UNC-CH
Jack Thigpen	Extension & Education (E&E) Yr 1-2	NC Sea Grant
Robert Bacon	E&E Yr 3	SCSGC
Lundie Spence	E&E Yr 4-5	SCSGC, COSEE SE

**FIGURE 1**

An organizational chart of SEACOOS.



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modeling, data management, or extension and education). This approach is likely to be reproduced and seems to be a reasonable compromise for a diverse regional partnership. The principal cost is vulnerability to the potential loss of leadership in key functional areas when expertise is concentrated within one or a limited number of entities in the regional organization.

A second major issue associated with the organization of SEACOOS was the somewhat isolating nature of the working group structure. Once the decision was made to organize participation in SEACOOS along working group lines, the annual proposal development, with its associated work tasks and reporting requirements, generated a significant amount of communications within working groups. Even so, there often were concerns over sufficient engagement of all the funded groups. The most obvious reason for this concern was the part-time nature of SEACOOS funding for most partners. Most of the staff associated with SEACOOS were engaged in multi-tasking, and, at times, the combined communication demands were overwhelming. Given this setting, it is not surprising that we found it hard to promote dialogue on topics that cut across working groups. Similar to notions of matrix management, cross-cutting themes were pursued (e.g., search and rescue, fisheries) that required participation and dialogue among all the working groups. Although these themes proved useful and popular in workshop settings, we were not able to sustain significant activity in them

outside of the workshops. It may be that it is simply not possible to sustain this level of fine-grained management with part-time participation. The implication is that dedicated staff will likely be required to sustain a healthy level of interaction among the functional elements of the RCOOS.

### Defining the Mission: Long-term Program Direction

As stated above, there was not a clear vision of how IOOS was to be created or operated when the SEACOOS program began. Thus, there was very little guidance from the national level on the scope of the regional program, the roles and responsibilities of its participants, or how it should develop over time. Given this, the program began (at Dr. Chris Mooers' persistent urging) to author a set of more formal planning documents. Participation of a broad cross-section of the program participants was deemed critical to ensure input and buy-in to the directions chosen.

A **Strategic Plan** was produced first. Due to multiple revisions, this took nearly a year to complete, but the effort greatly clarified the long-term purpose and vision for the program. As stated in the Strategic Plan, the main objectives of the SEACOOS program were to:

- Deploy, operate and evaluate *in situ* measurement and remote sensing systems;
- Evaluate emerging observational technologies in field operations;

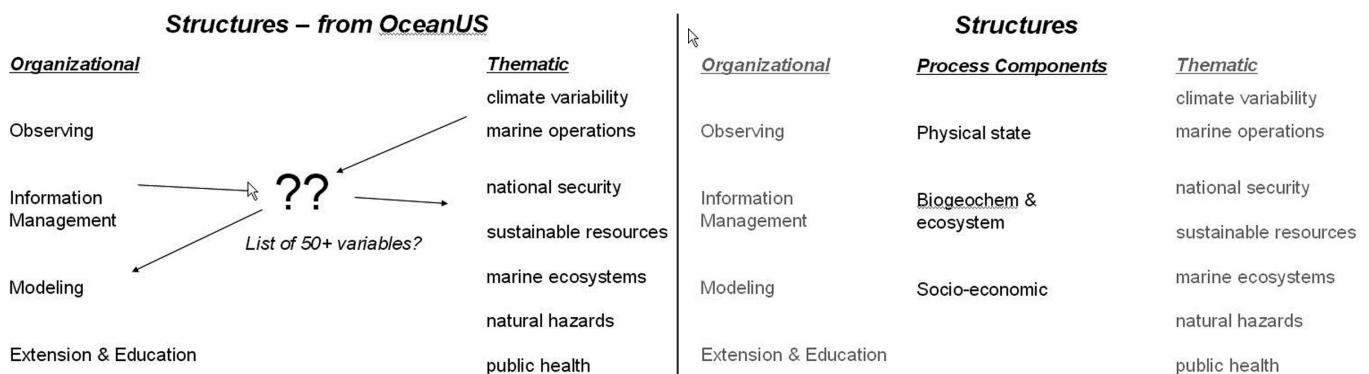
- Develop, implement, and evaluate numerical modeling systems for research and operational forecasting applications;
- Generate and distribute information products in near real-time that combine observational data and model output and are based on up-to-date oceanographic knowledge;
- Develop a regional information management system to access, distribute and archive data, metadata, and visualization products, and to ensure data formats and delivery systems are coordinated, interoperable, and compliant with national systems and standards;
- Coordinate with governmental agencies and the private and public sectors to enhance the development and efficiency of the observing system and to expand the economic opportunities that it provides;
- Promote the use of coastal information by decision-makers, educators and the general public through outreach and education activities.

The Strategic Plan also defined the roles of the four working groups in more detail than conveyed in the Articles of Collaboration and presented views on products, product development, and governance.

While the Strategic Plan defined the core mission elements for the program, it did not define how these objectives would be accomplished. To provide the framework for a more detailed development plan within the overall strategic vision, an **Implementation Plan** was produced.

**FIGURE 2**

Role of process components in Implementation Plan in bridging the existing notional structures from Ocean.US of the IOOS.



As part of this process, a two-day meeting of the funded investigators was held near the beginning of Year 2 that was dedicated to discussion of the path forward. There were two significant outcomes from this meeting. One related to identification of the audiences (user groups) that could be realistically engaged in the near term (see below). The second related to the issue of how the organizational structure described in IOOS planning documents (e.g., Ocean.US, 2002), and adopted by SEACOOS, could effectively address the major societal goals (the thematic structure) proposed for IOOS (Figure 2). Three broad process components were identified as implementation areas that provided a link between the organizational structure and societal themes proposed for the IOOS: 1) physical state estimation; 2) biogeochemical/ecosystem; and, 3) socio-economic. The three process components were proposed as logical units around which to coordinate program activities. This approach acknowledged differences in the relative maturity of sensors (for components (1) and (2)) and modeling systems, and thus could help define priorities for implementation on the basis of what could be realistically addressed with the available resources. The central role of modeling in the technical development of the system was recognized, and specifically, how models can be tested for adequacy, both in terms of the ability to resolve adequately and predict accurately key ocean features, and to serve the information needs of specific application areas. Establishing the best overlay of components, coastal themes, and scientific processes to study is challenging but vital, and is one of the main purposes of the Implementation Plan.

The Implementation Plan identified two short-term (1-5 year) phases of development, both of which focus on creation of the physical state estimation component.

Phase 1: a) Produce circulation fields and 3-dimensional Lagrangian/particle trajectories for use in Search & Rescue, spill response, nowcasts and forecasts of pollutant dispersal, and harmful algal bloom forecasts. The identified users were

the United States Coast Guard, State and Federal emergency managers, National Oceanic and Atmospheric Administration Hazardous Materials Program, and the National Weather Service Weather Forecast Offices. b) Support Fisheries oceanography with an emphasis on Lagrangian trajectories to assess regional “connectivity” afforded by larval transport and fisheries recruitment. The identified users in part b) are the Southeast Fisheries Science Center, South Atlantic Fisheries Management Council, Gray’s Reef National Marine Sanctuary, Florida Keys National Marine Sanctuary, Florida Fish and Wildlife Resources Institute, South Carolina Department of Natural Resources, and Beaufort Marine Laboratory, NOAA.

The two application areas were chosen for a few reasons. Those in a) were considered quite mature user groups and ideal candidates to quickly and efficiently take advantage of increased dataflow to support their applications. Their preference is for demonstrable predictive capability in the short-term. This preference aligned closely with an interest in SEACOOS in quantifying the uncertainty of the initial nowcast/forecast system. The fisheries application was chosen to demonstrate the importance and utility of physical state estimation to ecosystem-based management, and to engage users whose data needs are more archival and retrospective in nature. Both applications lead to a set of requirements that can help define the characteristics of the observing system.

From an implementation perspective, the introduction of the process components provides a logical basis for defining a set of variables that should be measured simultaneously. For the Phase I development these included, at a minimum, ocean currents (in 3 dimensions and in time), water level, winds, water temperature and salinity. These variables also form a dynamically consistent set for which an assessment of adequacy can be made; e.g., are the measured currents consistent with the observed and/or modeled water level gradients, water density gradients and wind stress? Thus the

introduction of the process components provides a basis for selecting variables on which to focus attention and a means for testing the ability and completeness of the observing system in a scientifically-defensible manner, rather than on an application-by-application basis. While the latter will also need to be demonstrated, by focusing on developing and testing capabilities for addressing a core set of process components, rather than an indefinite number of applications, the implementation scheme for the RCOOS becomes a manageable undertaking.

Phase II focused on enhanced nearshore and inshore capabilities, adding two more targeted applications. These applications were also chosen because of feasibility, but were delayed until Phase II because of the significant development efforts required. The applications are:

- a) Storm surge/inundation—assist in providing high-resolution estimates of surge heights and inundation areas. The identified users are the NWS/Weather Forecasting Offices (WFOs) and Emergency Management groups (Federal, State, and County). The major development required is high resolution topography onshore and high resolution bottom topography in the nearshore/inshore regions.
- b) Surface Waves—to better represent rip currents, bed stress and sediment transport, and to provide validation for wave forecast models. The identified users are NWS/WFOs and state resource managers, and the major development required is a regional directional wave measurement program.

The staging of these two phases of the Implementation Plan was largely dictated by a desire to first integrate existing assets on the open shelf and then grow the system landward. Two important perspectives influenced the development scheme: 1) that SEACOOS could have its greatest impact by demonstrating capabilities in shelf waters where essentially no capabilities existed prior to SEACOOS; and 2) that in shelf water the number of interested parties that should be engaged was relatively small and

manageable, while inshore these increased dramatically.

The Implementation Plan also provided a platform for putting forward ideas on a number of additional topics. These included a rationale for system design (which later led to a separate plan on this topic) driven by geography, oceanography, history, capability and needs; an expression of appropriate roles for the various provider sectors as the system progresses through its development stages; a development process that defines a generic approach to establishing a specific observing capability for the RCOOS (inventory, aggregation, evaluation, augmentation, testing, etc); an explanation of the chosen priorities, based on the rationale/philosophy behind selection of initial efforts; and an attempt at a timeline for implementation, expressed as a chart of development targets.

In retrospect, the Implementation Plan, while a reasonably thorough document, lacks a listing of clear science learning objectives that define the spatial and temporal scales of critical processes relevant to the applications. A regional science plan would be an obvious next step in developing a planning framework for evolution of the RCOOS.

### External Evaluation

In January 2005, roughly 2.5 years after funding began, a mid-term, self-imposed external evaluation was conducted. Two volumes of material were produced for the evaluators, one which described the program and actions to date, augmented with presentations to the evaluators, and a second volume of the proposals and annual and semi-annual reports. The preparation of these volumes was a significant undertaking but did greatly clarify our explanations of SEACOOS. The **External Evaluation and Response** has been made public and includes both reviewers' comments/recommendations and responses from the program. Overall the exercise was important in helping SEACOOS understand its own mission and better explain what it was attempting and accomplishing.

An outgrowth of the external evaluation, the **RCOOS Design** exercise (Seim et al., 2008) sets out a reasonably detailed depiction of an initial RCOOS (Figure 3) and makes an estimate of the cost to maintain it. An important new aspect to the RCOOS design plan that differs from the SEACOOS implementation is recognition of the need for explicit funding of application teams/forecast centers/analysis centers to utilize the information flow to its greatest extent. A secondary but important motivation to develop the RCOOS design document was the need to estimate observing system costs as part of the SECOORA business plan.

The last document authored as a cross-cutting effort within SEACOOS was the **Southeast Coastal Ocean Report**. It consisted of basic characterizations of the atmosphere and coastal ocean in the southeast region, the status of the Southeast RCOOS, and description of several recent coastal ocean "events". It was intended to be an initial report that would subsequently be regularly updated

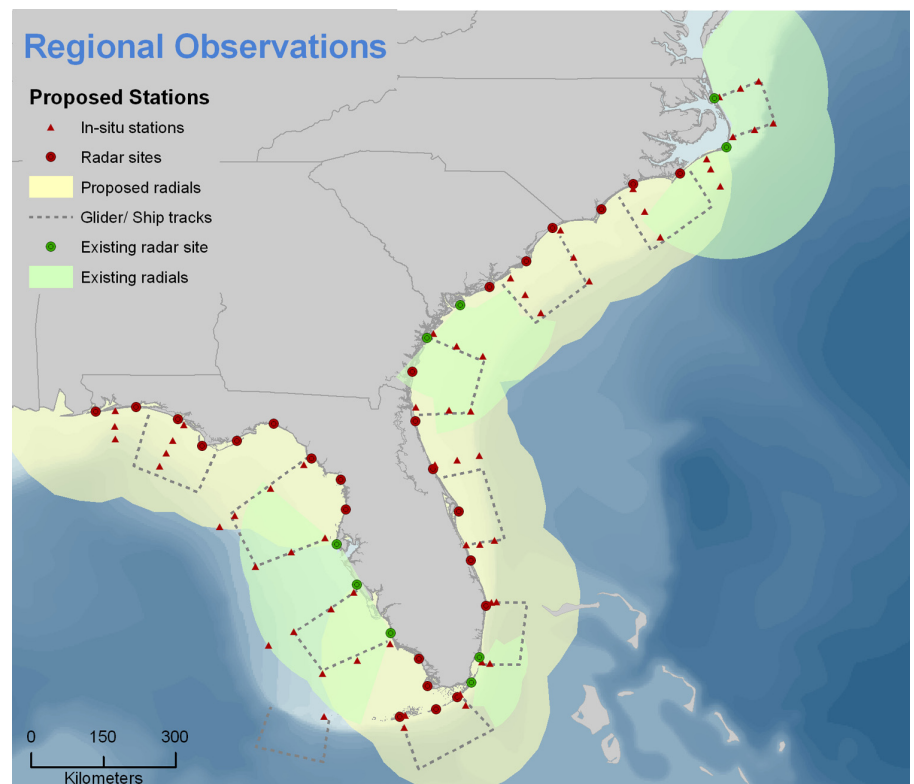
and produced by SECOORA, serving as a record of the evolution of the RCOOS and changing conditions in the SE. Internally, it was hoped that this report could provide a mechanism to encourage review and evaluation among the participants, help link activities across the region, and identify key areas for further investigation. The report was also intended as a model for a document that could be broadly distributed among agencies and program managers, providing a straightforward way to demonstrate progress and discuss key issues related to coastal ocean processes.

### Annual Funding: Developing and Managing the Budget

In addition to providing overall direction for the program, a major undertaking in the management of SEACOOS was development and implementation of an annual funding process. Over the first two years of its existence the program evolved to use the sequence of annual milestones listed in Table 5.

**FIGURE 3**

Conceptual design of the observing assets of the Southeast RCOOS, from Seim et al. (2008).



**TABLE 5**

Annual funding process.

Date	Milestone
Month 2	Annual objectives – present before Fall Workshop
Month 3	Draft working tasks – discuss at Fall Workshop
Month 5	Executive Committee Review of draft work tasks
Month 6	Draft budget, balance against funding
Month 7	Board approval, submission to funding agent
Month 6	Semi-annual report
Month 12	Annual report

The process was long and rather involved, but did allow sufficient time for everyone to participate at some level. Given the uncertainty in funding levels that the program would be receiving each year, the process had to be flexible. As could be expected, the process was never simple nor without difficulty, but it did prove to be reasonably effective.

The drafting of work tasks for each component of the program provided a relatively simple and straightforward way to set performance objectives at the investigator level and to track progress over the funding cycle. For essentially all those involved, projecting what they would accomplish in one year in a specific task list format was a significant departure from the multi-year research proposal model. It is worth noting that investigators almost always overstated what could be accomplished in a year, and that even by the end of the program, it was still difficult to project what could be accomplished in a year. Due in part to the difficulty in realistically scoping annual work tasks, and due in part to the nature of the year-to-year funding of the program, a formal review and evaluation process at the investigator level was never implemented as part of the annual process. Carrying out such review and evaluation could be a valuable component of the annual process. One drawback to the review procedure that was utilized was the lack of a place to capture

**TABLE 6**

Annual Tasking Cycle: Developing and managing project goals.

**Year 1 Objectives (from Oct. 2002 workshop)**

- More sites reporting real-time observations
- Critically evaluate key technologies in field deployments
- Use and refine data assimilative modeling techniques
- Produce nowcasts and forecasts from circulation models
- Implement a regional data management system
- Develop mechanisms of information exchange between SEACOOS and non-research users
- Engage the SE research and management community to plan for further development of the system
- Develop a working partnership with federal operational and research entities to link to national infrastructure
- Establish a flexible governance system

**Year 2 Objectives (from Nov. 2003 workshop)**

Continue Year 1 activities and include:

- A pilot effort to observe surface waves (enhance relevance to nearshore)
- Work with the Centers for Ocean Science Education Excellence (COSEEs)
- Support development of the Southeast Regional Association (SERA)
  - clarifies SEACOOS role as a pilot study in developing a coastal ocean observing system
- Explicit inclusion of satellite remote sensed observations

**Primary Year 3 Target: ocean response to weather forcing (from Nov. 2004 workshop)**

- HF radar, highest priority instrument pilot project effort
- Fixed, moving, and remotely sensed observations to be merged
- Modeling will work towards nowcasts/forecasts including the full density field
- Outreach and education centered around derived products

**Secondary Year 3 efforts**

- Surface waves
- Fisheries
- Biogeochemical indicators
- GIS coastal databases

**Year 3 Possible Road-blocks and solutions**

- Communications – need to promote more dialogue between working groups.
  - Steps: develop Implementation Plan; establish cross-cut teams; revisit project management software
- Budget process – uncertain lines of authority
  - Steps: develop internal governance document; establish more formal budget process
- Central office personnel – too light, cannot service all requests
  - Steps: suggest consideration of PhD-level project manager

**Year 4 targeted activities**

- Refinement of ocean circulation, emphasizing baroclinic processes and associated applications: search and rescue, spill response, and fisheries management
- Design and begin implementing a directional wave observations system and storm surge observations and prediction system, in support of emergency management, resource management and safe navigation
- Design a coastal ocean data assimilation experiment (CODAE) to test ocean circulation observations and modeling based on lessons learned

**Year 5 – focus on documentation, maintain a skeleton crew for the RCOOS as is feasible**

and report activities undertaken during the year that were not part of the initial proposed work tasks. For example, it would have been useful to provide a mechanism to record how the SEACOOS investment was

leveraged by partners during each year to enhance opportunities for basic and applied research in the region.

The annual objectives developed in each year of the program that guided the

annual proposal process are listed in Table 6. As can be seen, the scope of the objectives changed significantly over time, as did the way in which they were cast. In general, as the program matured the objectives became more specific and the scope of activities more focused.

## Workshops

SEACOOS hosted ten regional workshops over the five-year timeframe of the program. After some initial adjustments, the program settled into holding a Spring Workshop that was open to the community and intended to foster interactions among all interested parties in the region, and a Fall Workshop that was used for program planning and review (see annual process above). The Spring Workshops initially sought to provide a venue for information exchange between SEACOOS, other COOS activities, and federal activities in the region. As SEACOOS developed a clearer notion of how the RCOOS effort should be implemented, the Spring Workshops evolved into discussion forums for specific aspects of RCOOS development. The workshops were quite popular with attendance exceeding 100 participants in 2004 and 2005. The Fall Workshops were dedicated to internal communications and program development and were venues for discussion of long-range planning documents and the annual budgeting process. Time was also set aside in breakout for the working groups to interact, review progress to date and consider necessary re-orientation of objectives.

Several aspects of the workshops are worth noting. First and foremost they proved to be a wonderful venue for collective planning and frank dialogue among all the interested parties in the region. It was the one and only time that we witnessed participation by state, federal, academic and private sectors in planning regional efforts. Of particular note were the development of a waves program for the SE (see Voulgaris et al., this issue) and an ecosystem-based fisheries observation program. There is great potential for follow-on activities that should include further planning and joint execution of regional implementation of RCOOS components. This positive aspect of the workshops was partially offset by the difficulty in maintaining coordination on projects after workshops. Also, the scope of the workshops failed to include a focus on science issues. Though some of the earlier spring workshops did foster dialogue on regional scientific issues, this topic deserves more attention now that there is a vision for how a science plan can be linked to the implementation plan. As those with experience in organizing workshops will know, planning and executing these relatively large workshops is a major undertaking and requires a significant time commitment by a program committee and a workshop reporting team. The number of simultaneous documentation efforts undertaken by SEACOOS was large; the workshop reports proved difficult to complete as a result. It can be hard to balance the need for numerous workshops against the time commitment required to make them worthwhile.

## Budgets

The annual budget and allocations by working group are shown in Table 7. The funding levels varied widely from year to year, a result of the targeted appropriations process in Congress. Throughout the program the largest investment by working group was made in observing, and in total more than half of the expenditures went towards this one working group. In the first 2 years of the program the observing budget included considerable equipment purchases, but in later years was dominated by personnel support. The majority of funds, by investment category, went towards personnel support (37%). In year 3 of the program, SEACOOS provided nearly 400 person-months of salary support to funded participants; 90% of that funding went toward non-PI personnel. Equipment was the second greatest expense direct expense (17%) and reflects the investment SEACOOS made in growing the observing infrastructure in the SE U.S. Indirect charges (also known as overhead expenses) were 22% of the total budget. This percentage is roughly half of the rates used by most of the institutions and reflects the large equipment budget (on which most institutions do not assess overhead). The third greatest direct expenditure was for travel (7%) which includes ship and helicopter charges. The need for a large travel budget reflects the distributed nature of the program and the necessity of meeting in person to promote communications and joint planning, the remarkable national activity associated with IOOS and the many workshops it has led to, and

**TABLE 7**

Annual budgets, broken down by working group.

	Year 1	Year 2	Year 3	Year 4	Year 5	Total
Observing	2,488,818	3,125,903	3,049,794	2,372,761	616,693	11,653,969
Modeling	484,698	619,049	730,356	652,986	164,727	2,651,816
Information Management	335,482	993,014	1,261,836	1,236,455	613,770	4,440,557
Extension & Education	193,515	478,000	496,875	427,546	117,084	1,713,020
Management	49,487	48,034	226,139	132,252	49,437	505,349
	3,552,000	5,264,000	5,765,000	4,822,000	1,561,711	20,964,711

the travel requirements imposed by the operations and maintenance needs of the observing infrastructure.

## Summary and Lessons Learned

SEACOOS was a complex enterprise that developed new and creative functional relationships among multi-disciplinary components, including observations, modeling, information management, education and public outreach. SEACOOS, and by extension IOOS, has proved to be an extraordinary platform for creating productive collaborations that span the spectrum from collecting basic information to delivering community-based applications. Such a complex endeavor presented many organizational challenges requiring novel solutions. Not surprisingly, during the first two years of the SEACOOS project, most programmatic progress was made in developing an understanding of problems confronting the program. As the program matured and the vision for the IOOS evolved, efforts focused on developing solutions to problems. Key lessons learned during the five-year program include the following:

- **Promoting regular and sustained communications among partners** is a significant challenge. The personnel requirement this task implies is easily underestimated. The price of neglect can be high in terms of confused objectives and disenfranchised participants. Substantial travel budgets are necessary.
- **Providing adequate dialogue within and between working groups** was also a challenge. Cross-cutting thematic areas were explored as a mechanism to promote dialogue and interaction between working groups and were partially successful. The isolating nature of the working groups was exacerbated by the part-time nature of most of the funded effort. The implication is that dedicated staff will likely be required to sustain a healthy level of interaction among the functional elements of the RCOOS.

- **There is great value in having a robust financial agreement** that allows program flexibility in funding and autonomy of the partners while ensuring fiscal accountability. The SEACOOS Master Agreement reduced the turnaround time for funding actions (task orders) and proved of value throughout the lifetime of the program.
- **Implementation of a form of self-governance** is needed to clarify lines of authority, formalize program policies on information sharing, publications, organizational conflict of interest, and on dispute resolution. The SEACOOS Articles of Collaboration were drafted to address these concerns.
- **The political realities of functioning** as an activity supported by legislative appropriations led to challenges for the organizational structure. Specifically, there was tension between maintaining institutional balance in representation versus representation based on programmatic structure. The principal cost of maintaining a balance between these two interests is the potential loss of leadership in a functional area if programmatic skill is concentrated within a limited number of entities.
- **A clearly defined, long-term program vision** is needed for success. In response to little guidance on the scope of the program, the roles and responsibilities of its participants, or a notion of how it should develop over time, SEACOOS developed a Strategic Plan to define what should be done, and an Implementation Plan to define how best to grow the RCOOS. Inclusion of a broad cross-section of the participants was deemed critical in the writing of the plans to ensure buy-in to the directions chosen.
- **One of the main purposes of an Implementation Plan** is to provide a rationale for system design. Establishing the best overlay of components, coastal themes, and scientific processes to study is challenging but vital. Clear science learning objectives that define the spatial and temporal scales of critical processes relevant to the applications need to be articulated.
- **The uncertainty in funding levels** that the program would receive each year caused difficulty in realistically scoping annual work tasks (nearly all investigators overstated what could be accomplished). Projecting what could be accomplished in a year was a significant departure from the grant proposal process of envisioning what could happen over the lifetime of the grant. Careful consideration of appropriate and achievable objectives is a vital first step to defining developmental milestones.
- **In addition to the yearly funding uncertainties**, we learned that the project (as we attempted it) cost a great deal more than the funding we received. Of course there is another way to look at it: we perhaps should have cut back in programmatic scope.
- **The SEACOOS program would have benefited** from a Science Plan and an explicit R&D thrust to enhance the scientific basis for a RCOOS design.
- **A central office staffed with dedicated personnel** is needed to effectively manage a regional project.

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