

**REPORT OF THE  
SOUTHEAST-COASTAL OCEAN OBSERVING SYSTEM (SE-COOS)  
PLANNING WORKSHOP**

**27 TO 29 JUNE 2001**

**HOST INSTITUTION:**

**ROSENSTIEL SCHOOL OF MARINE AND ATMOSPHERIC SCIENCE (RSMAS)  
UNIVERSITY OF MIAMI**

**CO-SPONSORS:**

**RSMAS, UNIVERSITY OF MIAMI**

**AND**

**UNIVERSITY OF NORTH CAROLINA-CHAPEL HILL**

**Convenor:** Chris Mooers, RSMAS

**Co-Convenors:** Harvey Seim, UNC (Chapel Hill) and Mark Luther, USF

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# EXECUTIVE SUMMARY

## SE-COOS PLANNING WORKSHOP

27 TO 29 JUNE 2001

Venue: Auditorium, RSMAS  
University of Miami

Convenor: Christopher N.K.Mooers, University of Miami  
Co-Convenors: Harvey Seim, University of North Carolina  
Mark Luther, University of South Florida

**Background.** Consistent with the growing national and international effort to improve the network of regular ocean observations, 45 scientists and engineers concerned with developing SE-COOS, a coastal ocean observing system for the Southeast USA; viz., North Carolina, South Carolina, Georgia, and (all of) Florida, met for the first time to initiate plans for a regional approach. Prior national and international scale generic designs for the Coastal – Global Ocean Observing System (C-GOOS) provided guiding principles and societal application motivations. The SE-COOS Planning Workshop was organized as a follow-up to the 1999 SURA (Southeastern University Research Association) Coastal Ocean Observing System Workshop, whose geographic scope extended from Louisiana through Delaware at that time, and which created a vision appropriate to the academic institutions of the Southeast. And the SE-COOS Planning Workshop was organized as an almost immediate preparatory prelude to the Southeastern Coastal Ocean Observing Program (COOP) Workshop organized by SURA, whose geographic scope has been expanded in the past year to include Texas among others.

The Workshop was organized by a Scientific Steering Committee (SSC) composed of a multidisciplinary group of nineteen (19) ocean scientists and engineers from the four states and affiliated with fifteen (15) academic institutions and one (1) state agency. The SSC developed the Workshop program, suggested invitees, and promoted the Workshop among colleagues. The nine (9) SSC members able to attend also assumed leadership roles during the Workshop. The workshop was designed, in the spirit of SURA's openness policy, to be open to all interested scientists and engineers in the regional universities and other interested parties.

The forty five (45) workshop attendees included four (4) from North Carolina, two (2) South Carolina, five (5) Georgia, and thirty one (31) Florida, plus three (3) guests from outside the region. The attendees included thirty-six (36) from SURA institutions and seven (7) from federal and two (2) from state agencies. Their disciplinary composition was four (4) biologists, ten (10) engineers, six (6) generalists, two (2) meteorologists, and twenty-three (23) physical oceanographers. Also, in the spirit of SURA "no-host" policy, workshop participation was "dutch treat". However, RSMAS provided funds for

workshop facilitation and underwrote local logistics (e.g., coffee breaks, hors d'oeuvres for two no-host social hours, and hotel van service) so a registration fee was not charged, and, importantly, UNC-Chapel Hill provided travel support for non-Floridians.

### **Summary.**

The workshop was set by a series of plenary overviews addressing national and regional COOS developments, describing existing SE-observing systems and SE-modeling systems, and summarizing other planning factors. The main business of the workshop was accomplished through 12 working groups, which fell into a temporal and logical sequence of three categories: (3) regional-disciplinary, (5) subregional-multidisciplinary, and (4) infrastructural. The final plenary deliberations seeded the SE-COOS Vision Statement which follows, including the need for specific standing working groups.

### **Recommendations.**

**General.** There was a strong consensus to form quickly, and circulate broadly, a Vision Statement for SE-COOS (see below).

A set of standing committees needs to be formed to advance the planning for SE-COOS.

A careful and thorough design effort is required to develop needed interfaces to various governmental agencies, most especially NOAA but also U.S. Navy, so that SE-COOS can participate in the evolution of the combined operational and research COOS for the SE.

As a central organizing activity, it is proposed to conduct a Coastal Ocean Data Assimilation Experiment (CODAE) in phases over the next decade, with a focus on the response to storms of the physical system and marine ecosystems, including the physical transports of nutrients, biota, etc.

In parallel, sensor technology development and testing, especially for biology and chemistry, should be accelerated and conducted as part of a national effort.

As a long-term project, communications with various user groups; e.g., state environmental and emergency managers, need to be developed; the relevant experience of State Climatologists may prove invaluable for this purpose.

For the above activities, an academic SE-COOS consortium may offer the most effective approach, which could then connect to governmental agency and inter-agency groups.

Satellite and other remote sensing systems need to be well integrated with the direct sensing and modeling systems.

Coastal meteorological and hydrological communities need to be integrated into SE-COOS.

The challenges faced by those concerned with the inner shelf, estuaries, and coastal lagoons, and those concerned with the outer shelf, continental slope, and boundary currents, have considerable overlap yet significant differences (e.g., spatial and temporal scales and relative dominance of physics and biology), too; thus, there is a need to provide separately, but in a coordinated way because of their interdependence, for the Coastal Zone (CZ) and the Exclusive Economic Zone (EEZ) communities.

**Specific.** There are several large coastal or bottom topographic anomalies in the region that have major impact on the circulation, ecology, fisheries, and other marine resources that warrant special attention; for example, DeSoto Canyon, Cape San Blas, Dry Tortugas Is., Cay Sal Bank, Cape Canaveral, Charleston Bump, and Cape Hatteras.

For societal relevance, there is value in focusing on major seaports, Marine Protected Areas, and other special environments.

There are new, synergistic opportunities presented by the emerging operational prediction products being offered by NCEP/NWS and CoOPS/NOS for the SE coastal ocean.

**Initial Actions.** High priorities for initiating SE-COOS, which build upon existing strengths, include

- establishment of a regional coastal HF radar network for mapping synoptically surface currents, and possibly winds and waves, on a continuing basis
- extension of the existing ad hoc network of moored buoy and tower platform real-time observing system elements, and enhancement of their sensor suites
- implementation of a suite of regional and subregional nowcast/forecast systems, both to develop prototype information products and to guide and assess the evolving observing system
- connection of the several distributed observing systems and modeling systems through an expandable Web-based information management system for the benefit of the SE-community
- development of plans for SE storm response studies and CODAE
- initiation of periodic communications for the SE-COOS science and related (e.g., operational and user) communities

## SE-COOS VISION STATEMENT

The coastal oceans of Florida (see Footnote 1), Georgia, South Carolina, and North Carolina share a number of important features. The Gulf Stream and buoyancy-driven coastal currents strongly influence, and link, these coastal regions, and each strongly interacts with the passage of summertime tropical cyclones and hurricanes and wintertime extratropical cyclones and cold fronts. To a large extent, the southeastern coastal regions also share a common biogeography. The rapid population growth of the Southeast (SE) is driving the increasing need for improved coastal ocean environmental stewardship and coastal emergency management, and for expanded coastal ocean environmental information to support tourism, other coastal industries, offshore operations, water quality monitoring, fisheries management, sustainability of marine ecosystems, and marine biodiversity. By building upon numerous research projects and several monitoring systems in this region, the Southeast Coastal Ocean Observing System (SE-COOS (see Footnote 2)) will initiate a regional, operational oceanography effort to help meet these needs. It is presently unclear how, and by whom, operational oceanography will ultimately be implemented for the USA coastal ocean. However, it is clear that the SE academic community, together with the resource management agencies, has critical roles to play in creating a regional COOS, conducting relevant research, developing the infrastructure required to support the system, and educating the future workforce and general public.

The scope of this activity is broad. It involves basic research issues associated with regional (Exclusive Economic Zone (EEZ)) and local (Coastal Zone (CZ)) scale aspects of Earth System Science, which forms the substantive and conceptual basis for environmental management; e.g., the role of the broad West Florida Shelf (WFS) and South Atlantic Bight (SAB) in biogeochemical processes and fluxes associated with the global carbon cycle, and the role of the Straits of Florida/Florida Current complex in linking the WFS and SAB. Are these coastal ocean regions sources or sinks for carbon? What will be the impact of climate and global change on the coastal ocean of the Southeast, and vice versa? How accurately can numerical circulation models be used to estimate diagnostically the alongshore variability in cross-shore transports of materials? Scientific issues that underpin coastal ocean environmental management must also be addressed, including predicting the physical and ecological responses of the coastal ocean to storms, the spatial extent and temporal duration of harmful algal blooms, and the effects of climate variability on the coastal ocean, and designing effective and efficient strategies for Marine Protected Areas, beach management, and waste disposal. To address both research and socio-economic issues will require significant interaction between researchers and resource and emergency management communities, significantly enhanced access to the existing observing systems, and an expansion and extension of regional observing systems.

The SE-COOS Planning Workshop, held 27 to 29 June 2001 at RSMAS in Miami, considered these issues and outlined a 10-year, initial-stage implementation plan for SE-COOS. This initial stage would be conducted in three phases. The first phase would link the existing operational observing systems and research observatories to create the

framework of a regional system, and would assess existing modeling systems. In particular, it would focus on the nesting of global and basin-scale (e.g., the emergent NOAA East Coast Forecasting System, its Unified Ocean Forecasting System, and Navy operational ocean models and the research-mode Global Ocean Data Assimilation Experiment (GODAE) models), regional-scale, and local-scale models. It would also examine carefully the efficacious mix of *in situ* and local remote sensing systems together with satellite remote sensing systems, as it appears that virtually all existing and planned satellite ocean remote sensing systems offer value to SE-COOS. With an eye to the future, constituency-building/user-cultivation would commence through formal education and outreach activities. The second phase would consist of a Coastal Ocean Data Assimilation Experiment (CODAE), essentially a testing phase of the regional operational observing system, and of the modeling and data assimilation systems. CODAE would also deploy experimental observing systems to augment the extant observing systems and develop a program for the distribution of experimental, prototype information products. The third phase would focus on assessment of the prototype products from the continuing first-generation prediction system and on consequent upgrades to the observing and modeling systems needed to create a fully comprehensive operational system.

Although it is premature to be fully specific about the *in situ* and local remote sensing systems elements to be employed, the need for several generic components is vividly clear. Coastal HF radars offer compelling opportunities for remote sensing of surface currents, winds, and waves. Offshore USN and USCG towers offer advantageous platforms-of-opportunity. Various vertical profilers and Lagrangian drifters will be needed to address physical transports throughout the region. VOS or AUV/gliders temperature and salinity transects will be needed for model validation and verification. And bottom-mounted pressure gauges and inverted echo-sounders will be needed to monitor the Loop Current/Florida Current/ Gulf Stream for estimation of offshore open boundary conditions. A basic principle to be followed is to provide excess capability in power, data acquisition, and communication systems such that new sensors (chemical, biological, optical, acoustic, and other) can be readily accommodated as they become available for evaluation and regular deployment. In some cases, it may be possible to add to the sensor suites of NWS/NDBC meteorological buoys and C-MAN stations and NOS/CO-OPS NWLON stations, because they have excess data channel capacity, real-time telemetry, and 24 X 7 QC/QA operations. During the 10-year implementation plan there would be parallel efforts for sensor technology development, information system enhancement, and coupled model development (e.g., ocean-atmosphere, wave-current interaction, estuary-shelf exchange, ecosystem and fisheries, and sediment transport-geomorphology). Ultimately, the SE-COOS activity would evolve into an “end-to-end” system that incorporates operational oceanography and research with outreach, education, and user feedback.

The SE-COOS region is both environmentally coherent and of a manageable size for many purposes. However, this effort would also logically benefit from a SURA-coordinated federation; e.g., SCOOP, with Alabama, Mississippi, Louisiana, and Texas to the west and with Virginia, Maryland, and Delaware to the north. Not only would this

provide economies of scale, but within the SURA-wide domain there are strong common interests due to linkages produced by long-range, long-term transports. Because an end-to-end approach is needed (i.e., from an observation acquired by an autonomous sensor to an information product delivered to a user by the Web courier or a marine advisory agent), there are many interfaces to be developed to achieve effective outreach to a range of user groups. This dialog must include: federal, state, and local agencies; coastal communities; the private sector (e.g., environmental consulting companies, environmental valued-added companies, and environmental information-user companies); other disciplines (e.g., coastal meteorology and hydrology, plus information science and technology); and adjacent countries (Mexico, Bahamas, and Cuba). To achieve inclusiveness among academic players, all of the interested SURA institutions must be involved, along with related entities such as the Navy and NOAA labs and facilities within the region. It is absolutely essential to develop appropriate and durable “partnerships” with relevant federal and state agencies, in particular with those actively involved in acquiring ocean observations and generating prediction products. These include numerous NOAA components from all five-line offices (see Footnote 3); however, it now appears that NWS will play the leading role for the EEZ and NOS for the CZ. At the federal level, ONR, NMOC, USGS, MMS, EPA, USCG, USACOE, and others contribute as well; at the state level, there is a large variance between individual states in the nature and level of their ocean observing system activity. Because many initiatives are presently in play (including NORLC, NOPP, US.OCEAN, National Ocean Commission, Pew Ocean Commission, IOOS, and USA Coastal-GOOS), the present programmatic milieu is highly fluid. The SE-COOS community is concerned with establishing its appropriate role and arranging robust support for a sustained campaign.

Hence, the SE-COOS community perceives a strong need to proceed deliberately with its organizational development, business plan creation, and strategic planning, and it aims to engage public relation services, management consultants, and technical advisors from operational meteorology and other complementary disciplines to evolve its infrastructure. On an interim basis, it is planned to establish several working groups:

**Organization and Strategy:** Develop interfaces with NOAA, USN, and other; federal, state, and local agencies; advance planning effort; arrange further communications for SE-COOS science community; develop governance mechanisms

**EEZ Observing and Modeling Systems:** Build a regional network of observationalists and modelers concerned with an effective observing/modeling strategy for the full EEZ of the SAB, SOF, and WFS, and the overall SE

**CZ Observing and Modeling Systems:** Build a regional network of observationalists and modelers concerned with an effective observing/modeling strategy for the CZ through out the SE

**Information Management Systems:** Develop mechanisms for effective, real-time, multidisciplinary data exchange and archival within SE region; link to SURA and national and international scale systems

**Sensor and Other Technology Development:** Evaluate and apply existing technologies; develop and/or assess new technologies, especially in chemistry and biology

**Outreach and Formal Education:** Develop liaison with various user communities, including State Climatologists, environmental and emergency managers, and value-added environmental industries; facilitate educational and training programs

## **Footnotes**

1. The SE-COOS community is concerned that Florida not be split as proposed in certain national plans; in fact, it is logical that all of Florida be included in both the Gulf of Mexico region and in the Southeast region to allow for constructive overlap. The concerns are based on the politically obvious disadvantage of splitting the state and, thus, creating “divided interests” within Florida. (Similar concerns exist for the proposed split of North Carolina at Cape Hatteras.) Even more fundamentally, Florida cannot be divided geologically and hydrologically because it does not have an elevated spine that divides it neatly into watersheds; instead, it is bowl-like and, hence, has a hydrological system that inextricably links the state to the ocean and must be managed as a unit.
2. “SE-COOS” is used variously here to mean a region, a community, an activity, and the regional coastal ocean observing system *per se*. Eventually, the semantics (and acronyms) need to be settled and presumably a consortium established.
3. For example, NCEP, NDBC, WFOs, RFOs, and NTPC of the National Weather Service (NWS); NODC, NCDDC, NCDC, NGDC, and CoastWATCH of the National Environmental Satellite Data and Information Service (NESDIS); CSDL, CO-OPS, CSC, NGS, NEERs, COP, FKNMS, and CZM of the National Ocean Service (NOS); AOML, GFDL, FSL, ETL, NURP, and Sea Grant of the Office of Oceanic and Atmospheric Research (OAR); and the SEFSC and Regional Fisheries Management Councils of the National Marine Fisheries Service (NMFS) are all actual or potential players.

# GALLERY

NOTE: THE BELOW IS A GUIDE TO THE TEN PAGES OF FIGURES WHICH FOLLOW

## **OBSERVING SYSTEM: NETWORK, ELEMENTS, & COMPONENTS**

- SE-COOS *de facto, ad hoc* Real-time Observing System
- COMPS Components
- SABSOON Elements
- NOAA NDBC Buoys & CMAN Stations

## **ERGO: A NASCENT, de facto COMBINED OPERATIONAL AND RESEARCH OBSERVING SYSTEM EXISTS FOR SE-COOS**

## **RESPONSE TO ATMOSPHERIC COLD FRONT PASSAGE (16 TO 26 MAR 01)**

- WFS: COMP (AT USF BUOY NA26)
  - measurements of air-sea surface variables
  - consequent calculated surface fluxes
  - subtidal winds, sea level, and time-depth current response
- SAB: SABSOON (AT TOWERS M2 & R2)
  - winds, surface wave height, and tidal residual response
  - time-depth current and backscatter response
  - fluorescence, raw beam transmission, and surface wave height

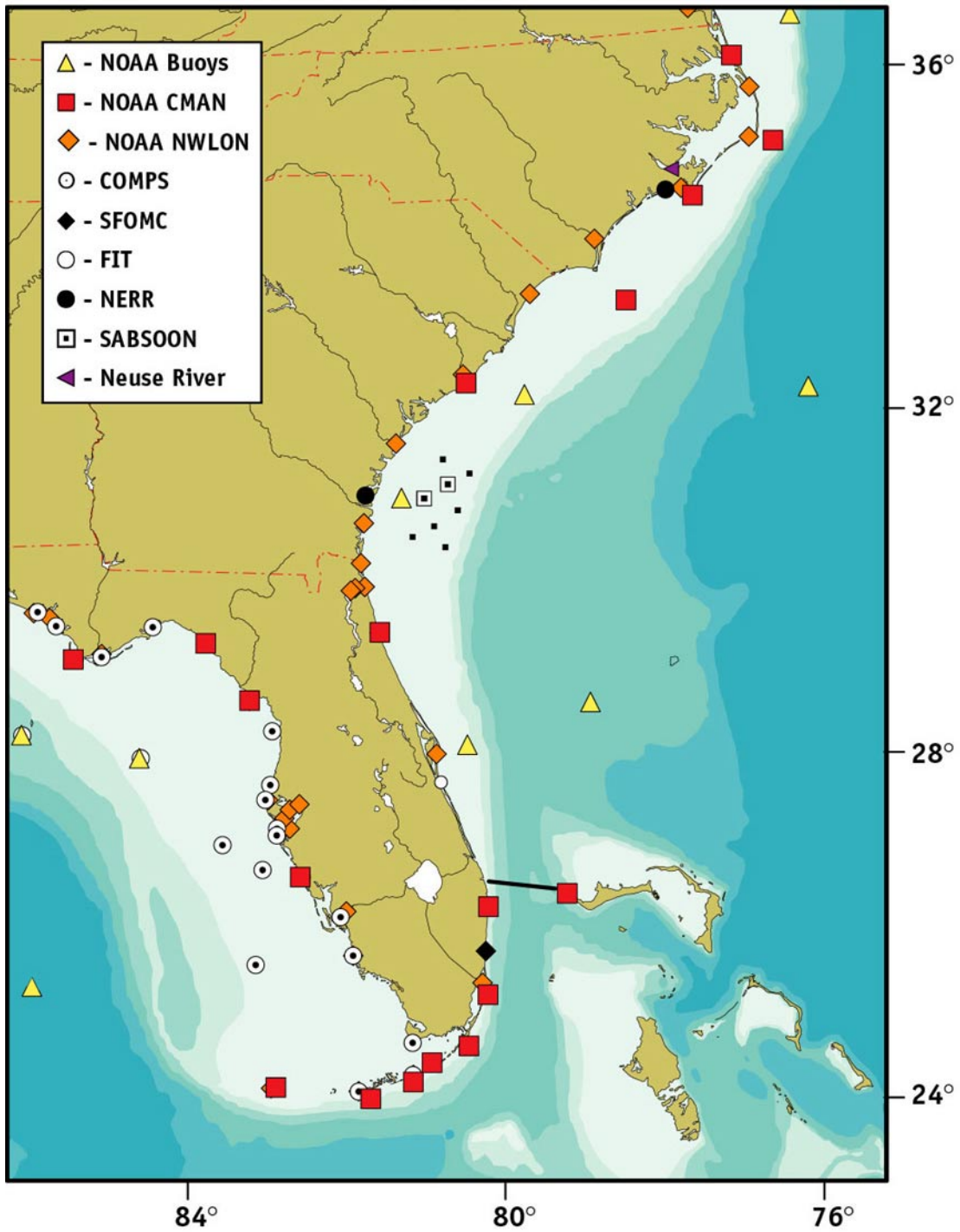
**ERGO: COMP & SABSOON DETECTED THE (STRIKINGLY OBVIOUS) RESPONSE TO THE SAME COLD FRONT PASSAGE FOR WFS & SAB, RESPECTIVELY; SIMILAR RESPONSES OCCUR FOR OBSERVED VARIABLES COMMON TO COMP & SABSOON; AND COMP & SABSOON SAMPLE SOME VARIABLES NOT IN COMMON WITH EACH OTHER THAT DOCUMENT IMPORTANT ASPECTS OF THE RESPONSE, AND THEY USE DIFFERENT ANALYSES & GRAPHICAL FORMATS AND STANDARDS**

## **HENCE, A BASIS HAS BEEN ESTABLISHED FOR**

- **DESIGNING AN UPGRADED OBSERVING SYSTEM FOR SE-COOS**
- **EXAMINING THE SE REGIONAL RESPONSE TO WEATHER EVENTS**
- **INVESTIGATING THE BIO-OPTICAL AND BIO-ACOUSTICAL RESPONSE AS WELL AS THE PHYSICAL RESPONSE TO SUCH EVENTS**

# SECOOS Region - West Florida Shelf - Straits of Florida - South Atlantic Bight

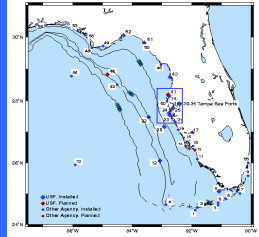
Real Time Observations - Coastal/Offshore Stations



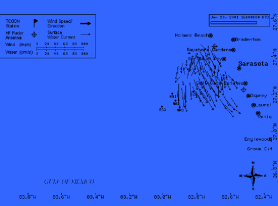
<http://comps.marine.usf.edu>



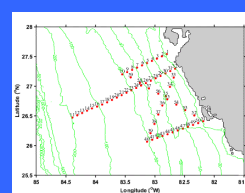
### Real Time Moored Array



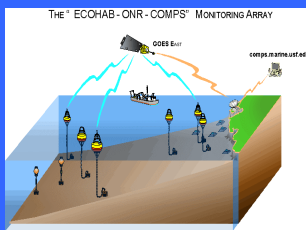
### Surface Currents by Radar



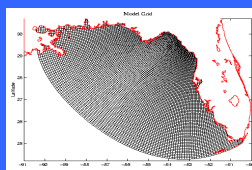
### Hydrography



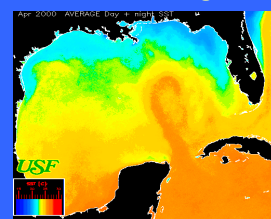
### Process Experimentation

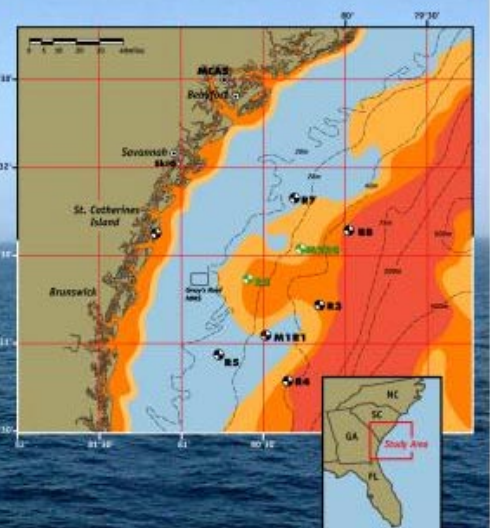
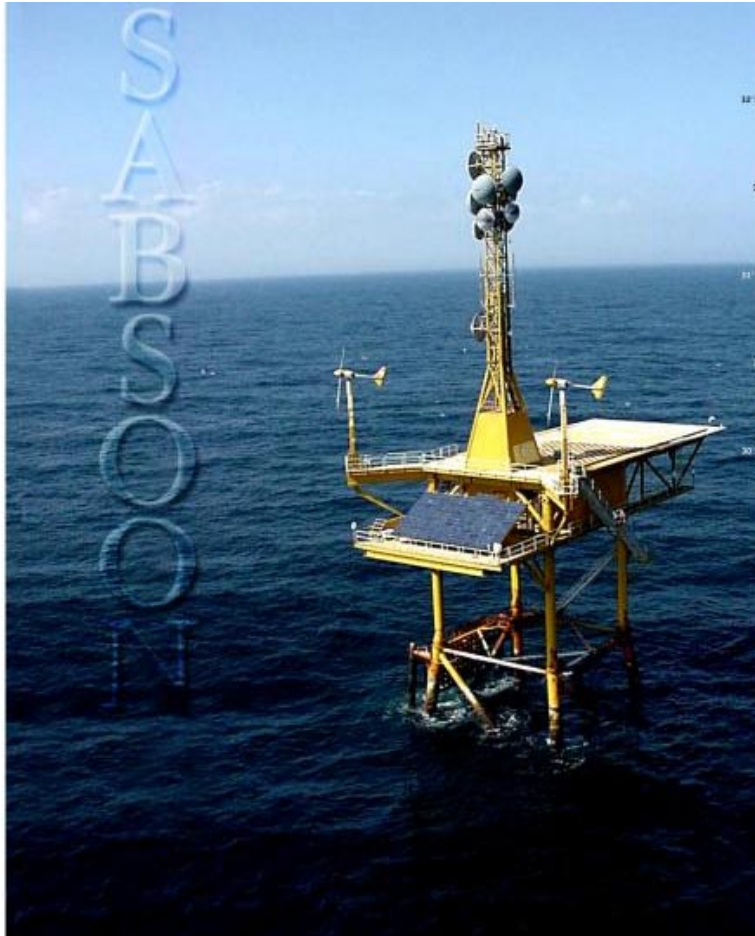


### Nowcast/Forecast Model



### Remote Sensing



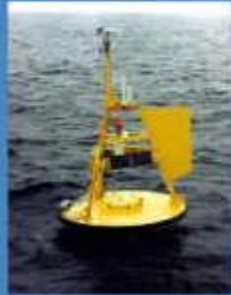


**South Atlantic Bight  
Synoptic Offshore  
Observational Network -  
SABSOON**

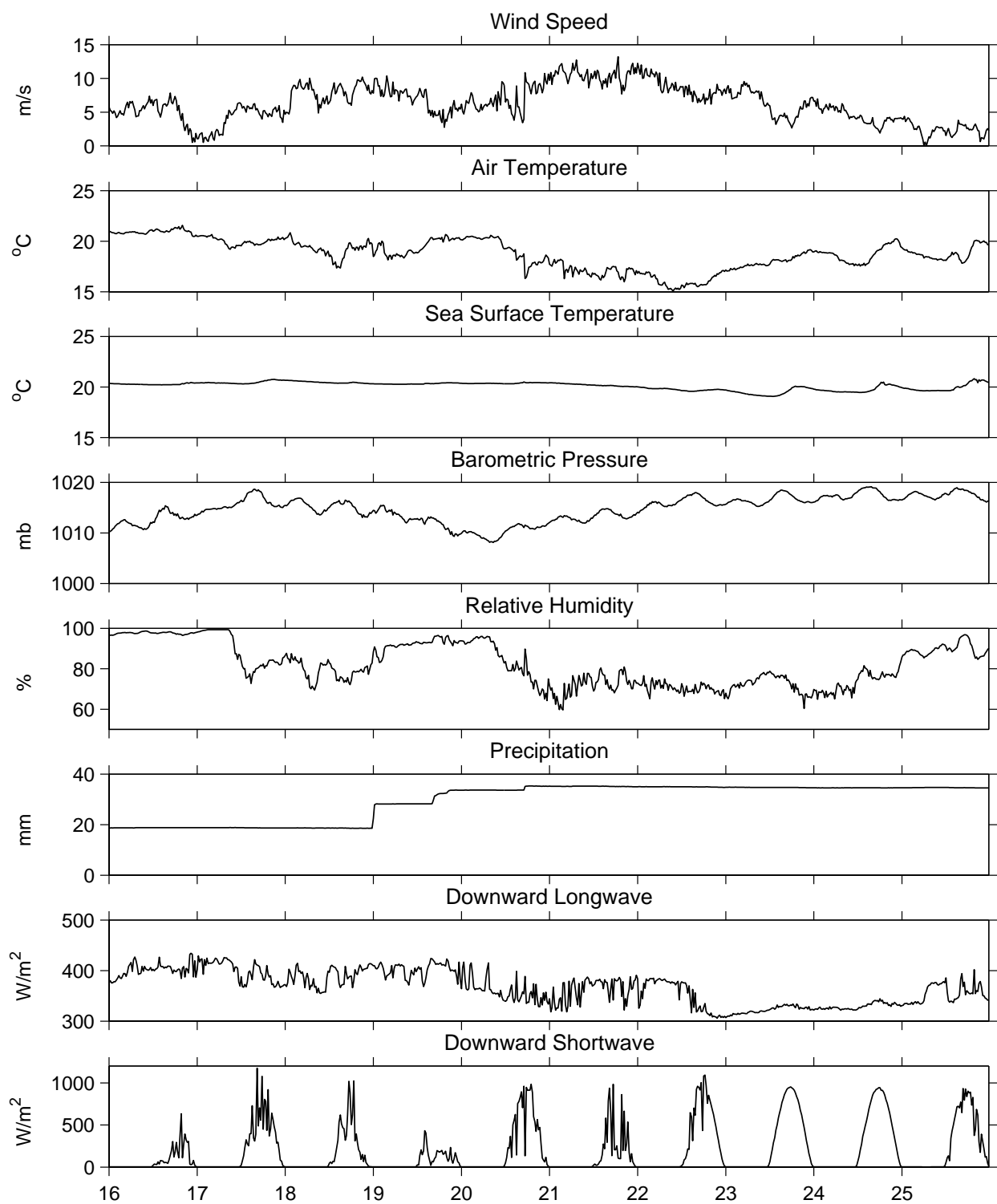
*A real-time observing system covering  
6,000 km<sup>2</sup> of the mid to outer SAB shelf.*

*Sited at a grid of eight towers in 25 -  
45 m water depths.*

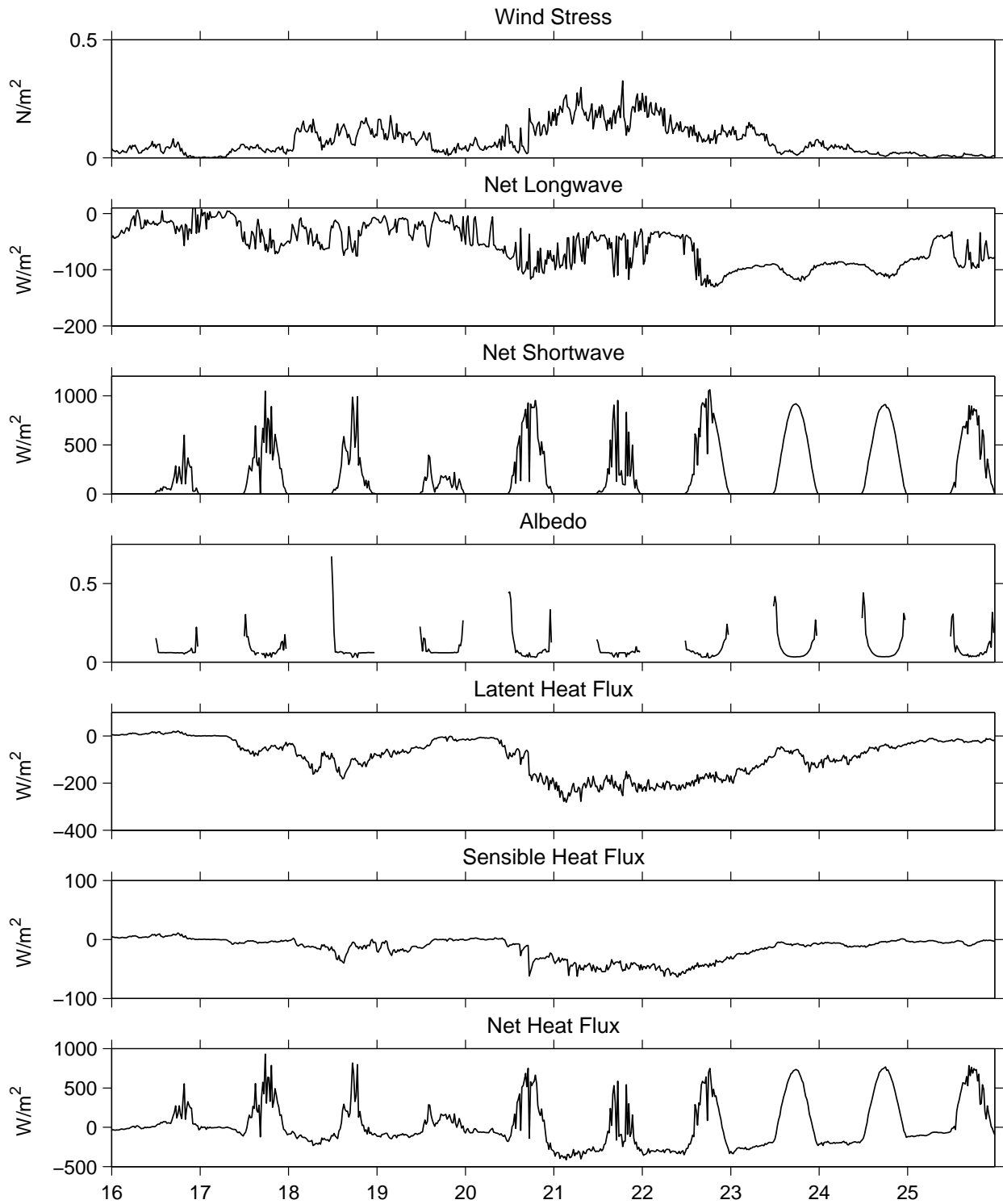
*NOAA NDBC - Buoys, CMAN stations*

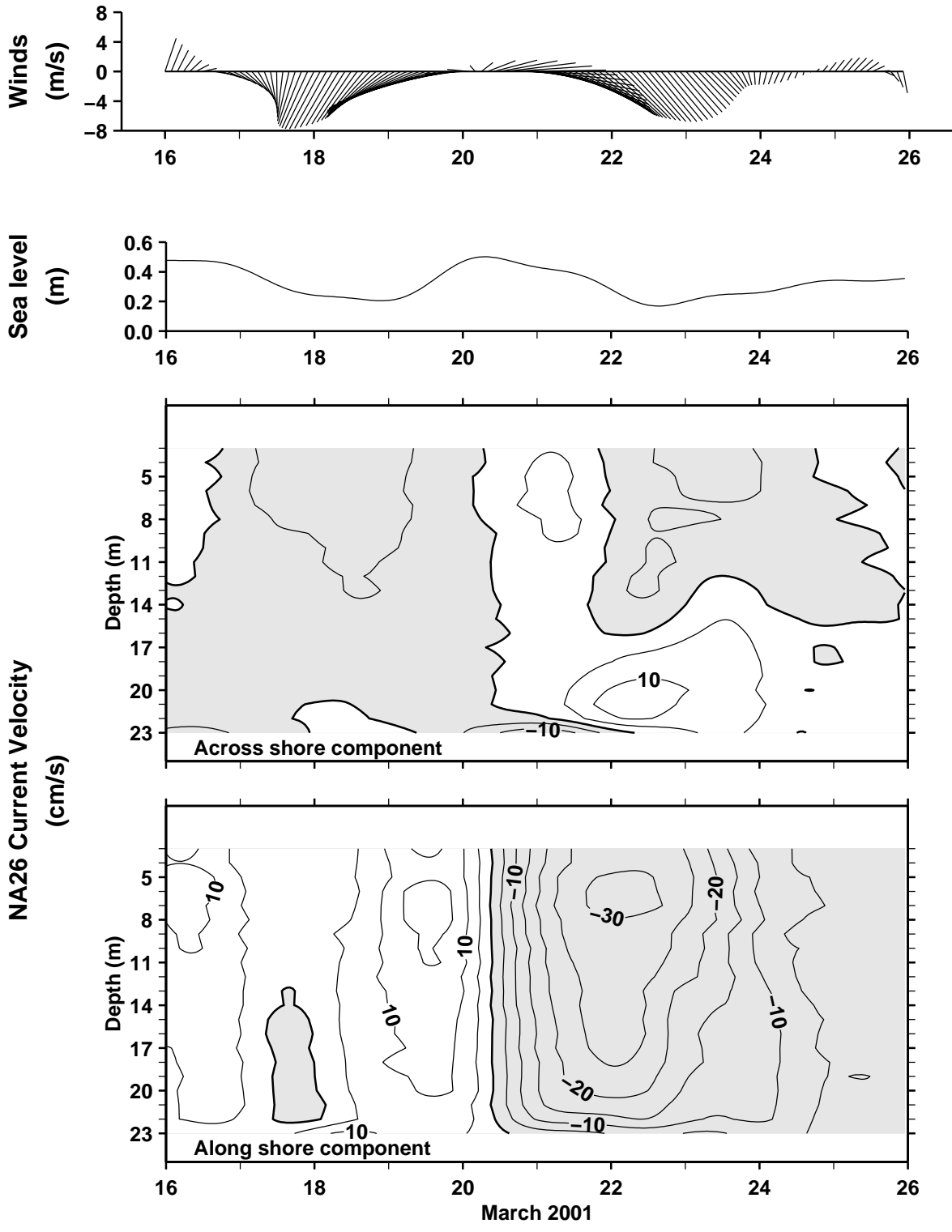


# Measurements at NA26: March 2001



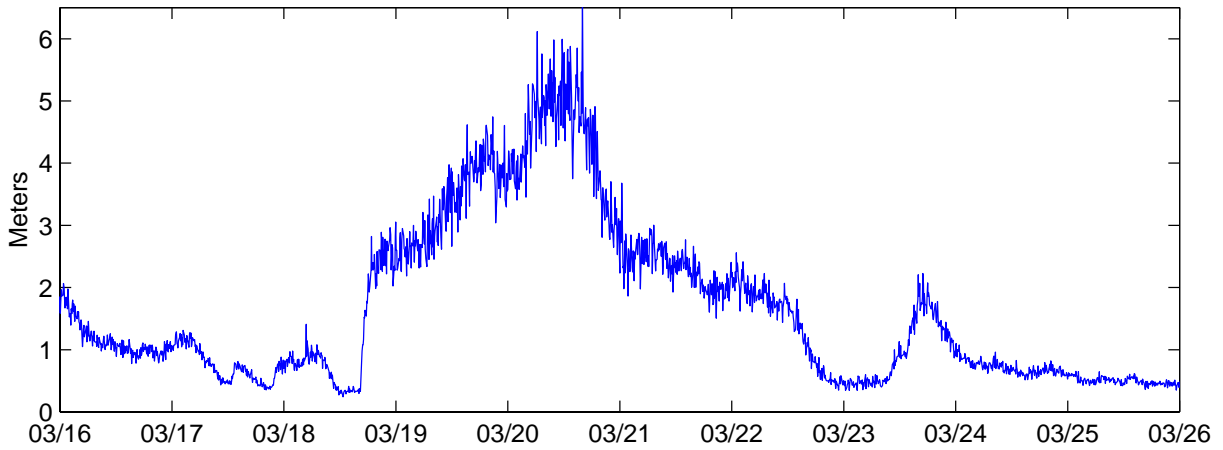
# Surface Fluxes at NA26: March 2001



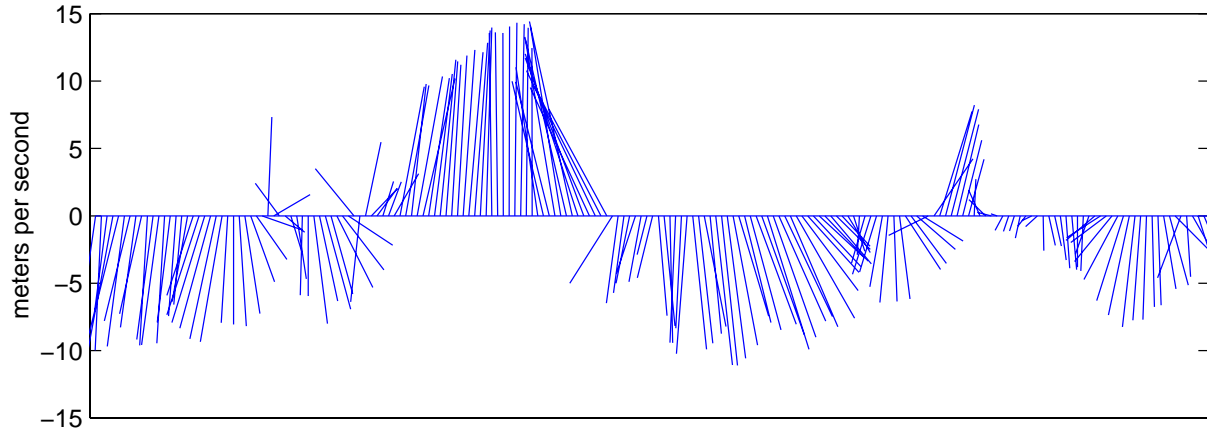


March 2001 isotachs of across shore and alongshore components of currents measured at USF buoy NA26 and time series of sea level measured at St. Petersburg. The winds were measured at NOAA buoy 42036. All series were 36-hour low-pass filtered.

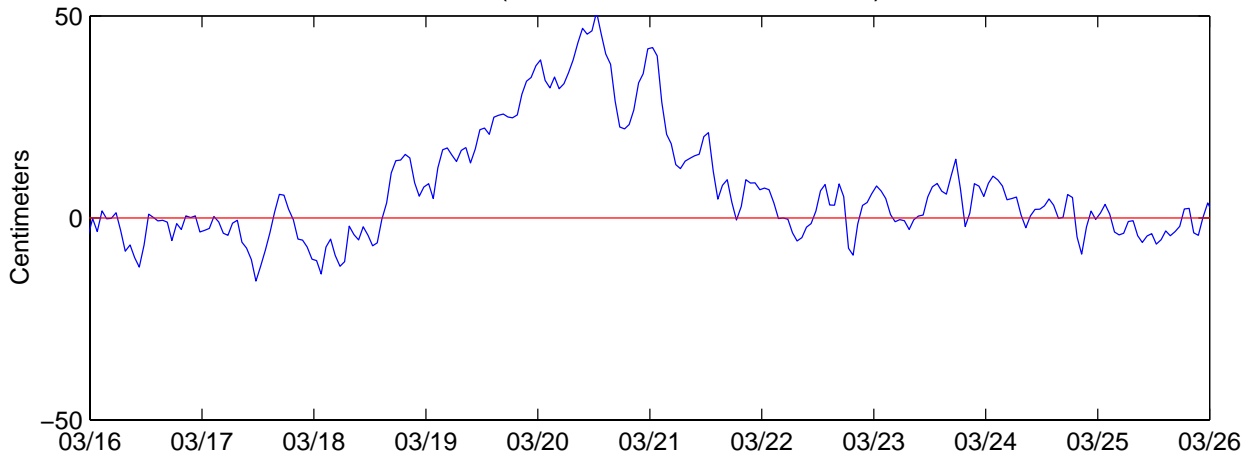
R2 Wave Height March 2001

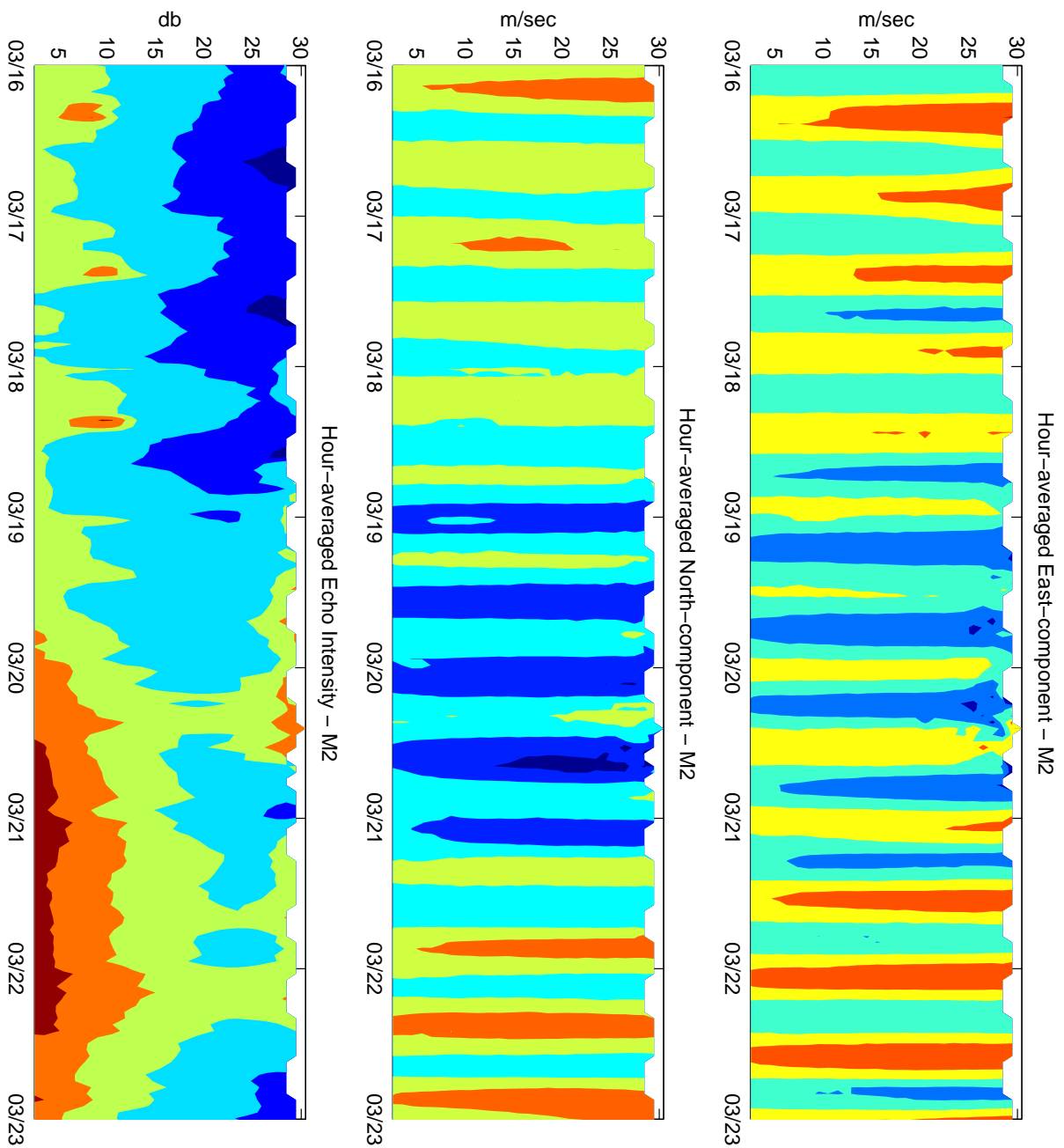


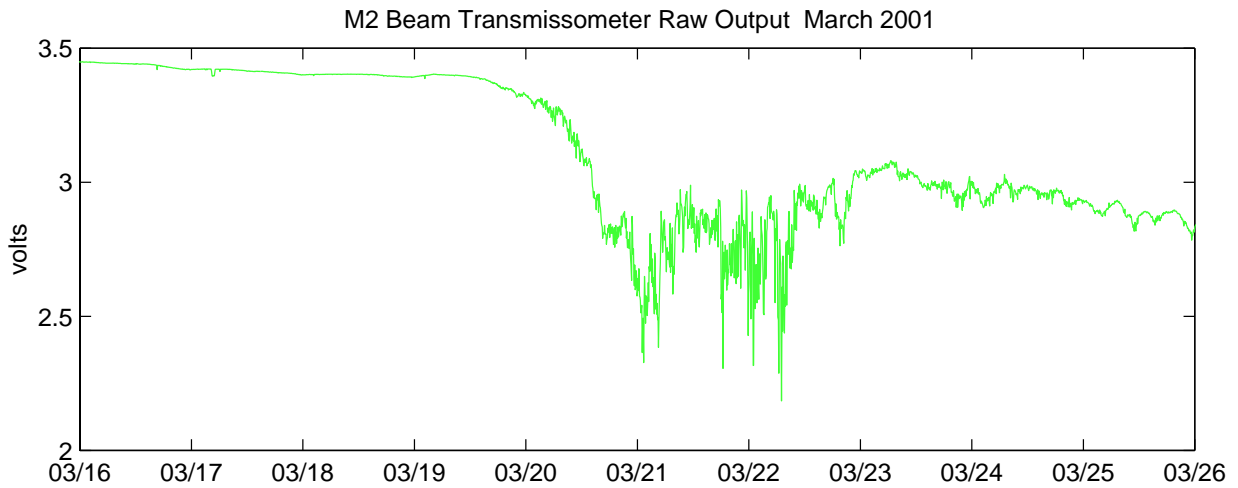
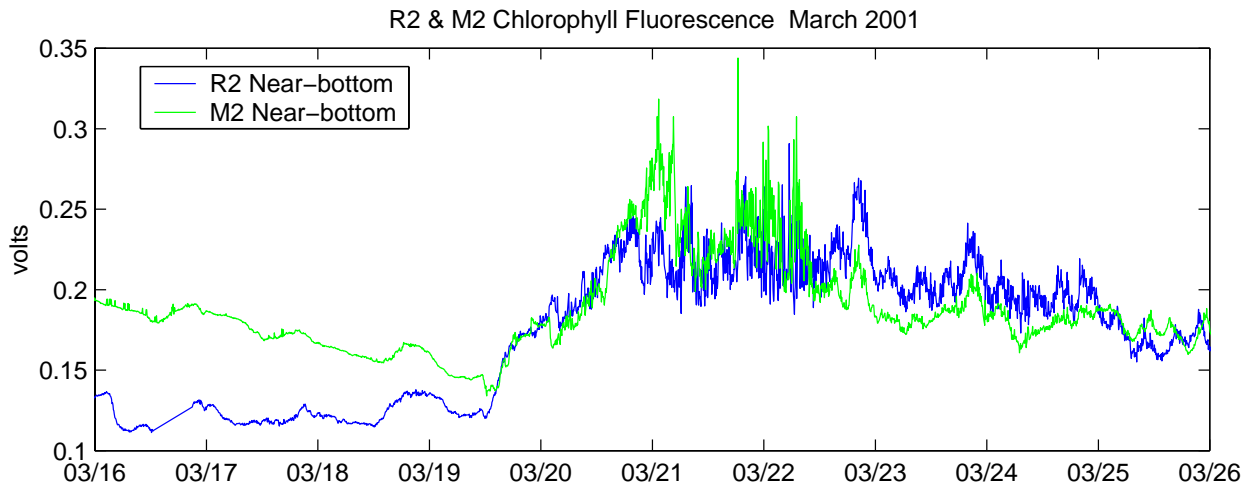
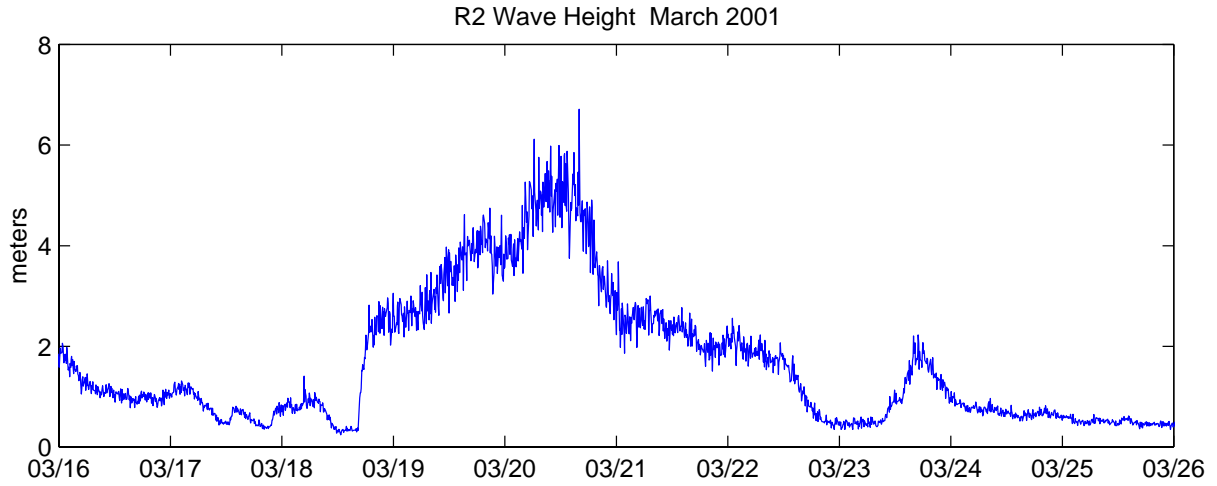
R2 Wind Speed/Direction March 2001



R2 Tidal Residual (Observed - Predicted Tides) March 2001







## BRIEF SUMMARY OF PLENARY PRESENTATIONS

### 1. INTRODUCTION

**CHAIR: CHRIS MOOERS, RSMAS**

**RAPPORTEUR: JIM NELSON, SKIO**

#### **Chris Mooers (UM/RSMAS), Launching the Workshop:**

Chris Mooers convened the workshop and provided an overview of the workshop agenda: on Wednesday afternoon, background information; on Thursday, Working Group sessions and reports; on Friday, bringing together the Working Group summaries and developing a plan of action. It was emphasized that there were no “foregone conclusions.” The objective being to develop the basis for a 10-year plan of action that balances science and societal needs, and to be in a position to take advantage of technological opportunities. The short-term target for the workshop reports was to have draft reports circulating within 2 weeks so that SE-COOS input would be available for the SURA SCOOP Workshop (St. Petersburg) in early August.

Logistical support: Travel funds for non-Florida participants was provided by Harvey Seim (UNC-CH). On-site refreshments, etc. were supported by RSMAS.

#### **Otis Brown (UM/RSMAS), Welcoming Remarks:**

Otis Brown welcomed the participants, emphasizing the regional model for SE-COOS; What can be done better together than can be done separately? He noted that the SE-COOS region is a piece of the SURA domain, and that the workshop will serve as a lead-in to the SCOOP Workshop.

#### **Don Wright (VIMS), The SURA Initiative:**

Background for the SE Coastal Ocean Observing Program (SCOOP) initiative was described, starting with some background on SURA.

The SURA domain extends from Delaware through Mexico. The “SURANET” endowment provides the basis to support three major initiative areas for SURA: 1) high energy physics (Jefferson Lab); 2) IT (having developed SURAnet, SURA has a strong IT track record); and 3) the Coastal Observing Initiative.

SURA’s IT goal is “infinite bandwidth at no cost.” SURA seeks to facilitate development of an open-access net of distributed sensor systems and linked computer models, and support national efforts to establish an integrated and sustained observational presence in the coastal regions. Providing optical fiber connectivity to the coasts is one aspect of SURA’s planned approach.

The SURA domain encompasses a large area of the U.S., including five Navy ports, many commercial shipping ports, with the coasts projected to be a region of high future population growth.

SURA's goal for the Coastal Observing Initiative is to enable reliable, accurate and timely predictions for the coastal regions and support cutting edge science. Prior SURA discussions of scientific topics include:

- 1) How do the ocean and atmosphere interact on synoptic scales during storm events? (e.g., SEVEER program, FSU).
- 2) How do coastal sub-regions link?
- 3) How do river-supplied buoyancy, nutrients, sediments and toxins impact or modulate the physics, chemistry, biology and geology of the coastal systems?

With the size of the composite drainage basin for the SE coastal regions (encompassing most of the area of the southern and mid-western states) considered, these questions are potential unifying themes for a regional program, with broad national implications.

SURA's involvement in the evolution of the U.S. plan for an integrated ocean observing system was described. A 1999 workshop (Charleston) followed the progression from CORE, NOPP, and NORLC that produced the "Nowlin/Malone report". Spinoffs from the latter include the "Frosch report" and the creation of "Ocean.US." SURA's objective is to facilitate science-based predictions, modeling capabilities, and supporting the systems that are in place, helping to implement, link and sustain these systems. There is a SURA focus on the IT component and the vision of "a distributed laboratory" with simultaneous measurements, and data availability in real-time.

The Navy's strong complementary interest in modeling the "littoral" zone is noteworthy.

For SCOOP, SURA is presently seeking \$15M to launch initiatives. The overall plan would encompass partnerships to develop and test sensors and implementation of related infrastructure subsystems. A total project on the order of \$1B is envisioned, at ~\$100M per year. SURA's role would be as a community "force"; to provide IT expertise, "seed" investments (up to \$100K, typically less), and to facilitate partnerships including (in addition to the SURA institutions), the states and industry. Interested parties were asked to contact [elawson@sura.org](mailto:elawson@sura.org) for more information concerning the SCOOP Workshop in St. Petersburg.

***Follow-up discussion:***

Otis Brown: Noted a growing national awareness of a priority need to improve observation/modeling capabilities. He emphasized that SURA's involvement and interest, coming from outside the oceanographic community, is very important to recognize. That is, there is real substance to this. The SCOOP initiative represents the decision of ca. 60 university presidents to make this a priority. The important thing for the oceanographic community: What is the plan?

Interest in coastal ocean observing systems has been expressed by CORE, the Interagency Working Group of NOPP, and Ocean US. The Navy is interested in

improved forecasting models for the coastal ocean. The Navy is willing to contribute to the effort.

But, this requires a coherent plan, with common goals. In many ways, this represents a different approach for the oceanographic community. Several key questions were posed. What is the management structure? What are the possible operational pieces? How to facilitate coordination of separate institutions as a regional group? Such a plan could be a pilot/example for rest of country.

***Other discussion:***

A question concerning clarification of SURA role (Fred Bingham, UNC-W).

What is the role of the research scientist in this? (Mark Luther, USF).

**Harvey Seim (UNC) and Chris Mooers (UM, RSMAS): Conceptual SE-COOS**

The following topics were addressed: 1) SE-COOS –Where are we now?; 2) the C-GOOS model; 3) a plan for the SE.

The prior funding for coastal observatories and prototype observing systems has come from short-term sources (e.g., NOPP), “plus-ups”, and oil royalties (Texas, Alaska). GOMOOS (Gulf of Maine Ocean Observing System) has been pursuing an alternative, legislative route (i.e., line-item funding). Broad bipartisan support for such an effort has recently developed.

There is draft legislation circulating in Washington, D.C. concerning C-GOOS. Much of the terminology is based on prior U.S. GOOS planning documents (Malone, Nowlin) and includes the distinction between “observatories” (not necessarily linked entities) and “observing systems”. The draft legislation specifies characteristics of the latter, including that the “observing systems” should be:

- “end-to-end”;
- “cost-effective”;
- “sustained and integrated”;
- “responsive to the needs of user groups”;
- and “integrated with more intensive observing programs in the regions”.

The C-GOOS model specifies seven regions in the U.S. coastal ocean. This model partitions both North Carolina and Florida; separating North Carolina north of Cape Hatteras, and splitting the Florida peninsula along its N-S axis.

Three “subsystems” of the overall Observing System are defined in the draft legislation: 1) Observational; 2) Communications/networking; 3) Data analysis and applications. It is also emphasized in the draft that “users” would define the products for the Observing System.

The draft legislation states that national coordination would be through NOPP/NORLC, and possibly through NOAA, and it envisions \$10M p.a. per region; i.e., ~\$100M p.a. for a national coastal system.

In addition to the three “subsystem” organization, the draft legislation calls for:

- an acceptable “business plan”; (i.e., identifying who are the “customers” with documented acceptance of the plan by parties of interest);
- incorporation of existing observatories, then filling the “holes” in regional coverage;
- a plan that is responsive to “user needs”;
- 24 hr per day operation;
- free and open access to data.

Needs for SE-COOS were noted:

- a distributed observing system—with regional geographic sub-regions represented. (Requires technical support centers for infrastructure.)
- nested data management and data dissemination systems. (Requires IT/network infrastructure).
- nested modeling subsystems. (Requires coordination, definition of domains of interest)

Pressing issues:

- consensus on the important, regional issues.
- greater community involvement (academic and federal entities, but also state and local representatives).
- making sure that all the regional “observatories” are identified and made aware of the effort.
- \* for the Working Groups, preparations for the SCOOP Workshop.

## **2. OVERVIEW OF EXISTING SE-OBSERVING SYSTEMS**

**CHAIR: JOHN MORRISON, NCSU**

**RAPPORTEUR: JOE RAMUS, DUKE U.**

A. Themes which emerged from this session – John Morrison, NCSU and Joe Ramus, Duke U.

1. Most existing efforts are “observatories”, which are project-oriented; true “observing systems” do not yet exist.
2. Sustained funding is a necessity but seldom attained.
3. Disasters often provide short-term support, but the public’s attention quickly wanes.
4. The public doesn’t connect with physical measurements, but rather connects with living resources and human behavior. Therefore it behooves the community of coastal scientists to help the public understand the links between physical properties and the impacts on living resources and human behavior.
5. The maintenance of moored instrument packages is a real challenge.

6. Real time (telemetered data) is a high priority goal.
  7. There is a great need for better predictive models.
- B. South Atlantic Bight – Jim Nelson, SKIO.
1. Observatories in-place include NOAA (NDBC, C-Man, NWLON) and other (SABSOON tower) installations.
  2. Data being acquired from SABSOON towers include meteorological, wave height, SST, surface and subsurface salinity, horizontal and vertical currents.
- C. Straits of Florida – Kevin Leaman, RSMAS.
1. Florida Current measurements are being acquired from submerged cables (voltage-derived current speeds) continuously, but with some disruptions in the last decade due to severed cables.
  2. NOAA/NDBC long-term time series.
  3. Florida Bay moored array, cruises and drifters.
  4. NOAA/NURC is making biological measurements; NOAA/NMFS is conducting fisheries surveys.
  5. Ocean Surface Current Radar (OSCR) is being utilized in the coastal ocean (range to 30 km now and to 300 km in the near future) providing data on surface velocity fields, winds, and waves in real time.
- D. West Florida Shelf – Mark Luther, USF.
1. West Florida Coastal Ocean Monitoring Program (COMP) is near “observation system” status with mooring and stream gauge arrays, and monitoring array data transfer through GOES East. Many agencies and programs participate, including ONR, USGS, NOAA, ECOHAB and USF.
  2. Tampa Bay PORTS, a joint USF & NOAA/NOS effort, provides line-of-sight radio telemetry.
  3. Nowcast and forecast model data are available on the Web through COMP.
  4. Remote sensing efforts underway including AVHRR, SeaWiFs and MODIS.
- E. North Carolina – Joe Ramus, DUKE U.
1. FerryMon program on the Pamlico Sound estuarine system.
  2. Unattended water quality monitoring utilizing NCDOT ferries as platforms.
  3. Provides near real-time data using high-quality, well-maintained, well-operated, high-frequency, long-term, low-cost sampling platforms (ships of opportunity).
- F. Coastal Georgia – Daniela Dilorio, UGA
- UGA’s LTER (Long Term Ecological Research) program is monitoring 10 sites in coastal Georgia including chemical, geological, and physical variables.

**3. OVERVIEW OF SE-MODELING ACTIVITIES**  
**CHAIR: CHRIS MOOERS, RSMAS**  
**RAPPORTEUR: GEORGE MAUL, FIT**

NCEP has a real-time operational coastal ocean forecast system (ECOFS) using the Princeton Ocean Model (POM). Modeling domain shown included the east coast USA south to Cape Canaveral. NCEP needs real-time boundary conditions such as water level data. Several problems with their POM implementation were discussed that are lessening by ingesting SST and SSH data. NCEP has developed a new model (NOFS) with 80 km resolution for the global grid and 8 km for the nested regional grid covering the USA coastal ocean; resolution of both is programmed to increase substantially with scheduled computer upgrades in the next few years. NCEP has a continual requirement for real-time data such as that which SE-COSS will provide.

UGA is evolving ecosystem dynamic models, but these are not now real-time. NCSU has coupled air-sea models applied to hurricane track forecasting, Gulf Stream shelf fronts, storm surge, and estuaries. UNC-CH is modeling circulation in the SABSOON area (Charleston to St. Augustine). The challenge of modeling baroclinic circulation on the shelf was mentioned.

One group at FSU is running a Gulf of Mexico version of the Bryan & Cox model emphasizing the role of the Gulf Loop Current (GLC) on the West Florida Shelf. USF is using POM applied to a similar domain. USF is using NCEP Reanalysis to compare model with observations, and is developing an eastern Gulf nowcast and forecast system. USF is also coupling their model to a biological response model for the West Florida Shelf. Another group at FSU is running NCOM (an NRL model similar to POM) at high resolution for the Gulf of Mexico.

UF is running estuary-scale models of the Indian River Lagoon and along the beaches. Model computes physical variables with applications to hurricane surge effects. UF has installed three monitoring systems offshore of three inlets on the East Florida Shelf and is looking at effects on ecosystem variables; e.g., nutrients, seagrasses, light attenuation, and riverine input.

NCSU has a collocated modeling activity with the local NWS Weather Forecast Office and is in a partnership for improving the forecasts of storm tracks, which has led to awards for the NWS Office.

NRL (Stennis Space Center) is running a 1/16 global ocean model and placing the output on their website in real-time.

FIT has a new sigma-coordinate ocean model that has overcome the numerical instability problem so common with applications of the POM over steep bottom topography. The FIT ocean model is available from Gary Zarillo (zarillo@fit.edu).

RSMAS implemented POM as a real-time nowcast/forecast system for the Straits of Florida several years ago. There are also modeling projects for Florida Bay and Biscayne Bay and the HYCOM (more or less a merger of the RSMAS MICOM and NRL NLOM layered models, with some features from POM) development for the Atlantic Ocean.

#### **4. OVERVIEW OF DATA MANAGEMENT ISSUES**

**CHAIR: MARK LUTHER, USF**

**RAPPORTEUR: PETER SHENG, UF**

Dwayne Porter (USC) reported the NERR (National Estuary Reserve Research) perspective of data management issues. There are 10 NERR sites in the SE-COOS region where a system-wide monitoring program started in 1994. The monitoring includes: (1) estuarine water quality and meteorological monitoring, (2) biodiversity monitoring, and (3) land-use monitoring. The components of the data management programs are: (a) user needs assessment, (b) data collection protocol, (c) QA/QC procedures, (d) program documentation and metadata, and (e) data/information dissemination hub. The OMB's National Spatial Data Infrastructure (NSDI), which aims to ensure that data are made available for sharing, was emphasized. Mark Luther (USF) presented major data management issues including (1) common data/metadata formats, (2) real time QA/QC, (3) centralized access to distributed data sets, (4) integration of biogeochemical data, and (5) serving/archiving model-generated products and satellite-derived products. A SCOOP Website, with open-system architecture and free and complete access, is being developed at USF.

#### **5. SEVERAL PLANNING FACTORS FOR SE-COOS**

**CHAIR: JOE RAMUS, DUKE U.**

**RAPPORTEUR: JOHN MORRISON, NCSU**

Maureen Kenny, CO-OPS/NOS, Major Ports

- 175 water level gauges reporting real-time using NWLON
  - Hourly
  - Storm Surge Mode - 18 Minutes.
  - Data transmitted in near real-time and backed up locally for 60 days.
  - [www.co-ops.nos.noaa.gov/co-ops.html](http://www.co-ops.nos.noaa.gov/co-ops.html)
- Tides On Line
  - 2 days of predicted and actual data
  - [www.tidesonline.nos.noaa.gov](http://www.tidesonline.nos.noaa.gov)
- Physical Oceanography Real-time System (PORTS)
  - Safe navigation, spill response, user needs
  - Uses CORMS (Continuous Operational Real-time Monitoring System)
  - 24 hours monitoring of the PORTS data system for QA/QC
  - Now: Houston/Galveston, San Francisco, Long Beach, Narragansett Bay, New York/New Jersey, Delaware, Tampa Bay
    - Chesapeake Bay when online will be largest implementation.
- ONSTEP (Ocean System Test and Evaluation Program)
- CODAR (Coastal Ocean Dynamics Radar)
- Planned Hydrographic Programs for FY2001 include Pamlico-Albemarle Sounds, North Carolina.
- Coastal Storms Initiative for FY2002
  - Jacksonville and St. John's River

Sandy Vargo, FIO, Marine Protected Areas

- Large number of marine protected areas in the SE-COOS program.
- The Marine Protected Areas, while a large percentage of their support is federal, are run and managed by the states
- Two of largest are Pamlico/Albemarle Sound and Florida Keys National Marine Sanctuary (FKNMS)
- Goal of regular monitoring of physical, chemical, and biological variables, measuring the change in biodiversity, and mapping of bottom habitat

Stewart Glegg, FAU, Hi-Tech Facilities

- South Florida Ocean Measurement Center (SFOMC)
  - Joint venture between SeaTech (FAU) and NSWC (Navy)
    - 2 ADCPs in coastal environment
      - 1 since 1984
      - 1 since 1989
- Data displayed on Web.
- Have over 300 miles of cable on ocean floor for connecting sensors offshore (maintenance problems)
- Developing SMART Acoustic Network Project to connect array in a 2 mi x 3 mi x 15' to 100' grid
- AUV testbed.

## **6. INITIAL DISCUSSION OF A TEN-YEAR PLAN FOR SE-COOS**

**CHAIR: CHRIS MOOERS, RSMAS**

**RAPPORTEUR: JIM NELSON, SKIO**

In preparation for the following day's Working Group breakout sessions, some thoughts on the Ten-Year Plan for SE-COOS were offered. The interests of industry, government, and academia need to be coupled. In addition to serving K-20 students, scientific educational efforts need to target resource and emergency managers and the general public. The SE-COOS plans should be developed in the context of anticipated "permanence"; i.e., establishment of the capability for continuous observations in perpetuity. The challenge for the working groups is to identify what is essential for the observing system, and to outline the developmental phases for this effort.

## **7. FINAL WORKING GROUP SUMMARIES**

**CHAIR: PETER SHENG, UF**

**RAPPORTEURS: HARVEY SEIM, UNC-CH and JIM NELSON, SKIO**

**Group 1: Physical/Geological I (EEZ) Working Group, Presenter: John Morrison, NCSU**

Two major cross-cutting issues were identified:

- 1) Heat distribution / fluxes to the atmosphere.
  - need to account for various scales of processes;

- need models for planning where to make measurements and to determine the range of time/space scales the measurements need to address.
- 2) Along-shelf variability of cross-shelf transport.
- noted large uncertainties in the momentum balance. How to address this? For surface information, could use coastal HF Radar. Subsurface information might utilize AUVs. Also possible application of Lagrangian methods and acoustic arrays (noted the latter are small scale at present).

General needs:

A need to integrate the development of the observing system with modeling efforts was noted. Questions to be addressed include how to formulate regional nested models. This will require scale analysis and simulations. A need for coupled models was also emphasized. For example, including land-sea breeze effects in coastal models and coupling estuarine and hydrologic models.

Other needs:

To better determine heat flux, it was proposed to upgrade the NDBC buoys. These are presently set up for bulk parameterization. It was proposed to add long- and short-wavelength radiation sensors to obtain radiation fluxes (needed at about 3 W/m<sup>2</sup> or better precision). Also heat fluxes in the water column.

*Discussion:*

Chris Mooers noted how diagnostic studies are employed in meteorology to estimate higher order processes that are often very difficult to measure directly.

The question was raised concerning whether the observational approach should be to “densify” the NDBC buoy system or build separate systems around them. It was also noted that the buoy technology is evolving (e.g., lower troposphere profiling instruments are being added in some cases). For instrument additions to the NOAA system, the limitations of GOES bandwidth were noted.

**Group 2: Physical/Geological II (CZ: the near-shore and estuarine zone) Working Group, Presenter: Joe Ramus, DUKE U.**

For the “brown water oceanography” region, six major areas of concern were listed:

- 1) cyclogenesis and dissipation of cyclones;
- 2) material fluxes (e.g., FW, organic C, sediment);
- 3) flooding from storm surges;
- 4) changes in coastal/estuarine morphodynamics before/after storms;
- 5) along-shore and cross-shore scales of coherence;
- 6) the role of estuaries in the trapping or “bypassing” of materials to the coastal zone.

Information needs:

- 1) fine scale spatial and temporal resolution;

- 2) real-time data of various types;
- 3) extended dynamic range and increased “robustness” for various sensors;
- 4) storm surge models that include flooding/drying and wave effects;
- 5) how surface and bottom boundary layers interact;
- 6) buoyancy flux and its influence on air-sea fluxes.

Observing system requirements:

- 1) need to be capable of measuring gradients in the estuaries;
- 2) models to bridge observing system gaps should be developed and applied;
- 3) collaboration is needed to ensure integration of systems;
- 4) need to develop profilers and “adaptive” samplers and enhance flexibility in the spatial range and frequency of sampling.

*Discussion:*

Andy Sheppard noted the importance of the 0-3 mile offshore zone to a range of user groups. There is a need to develop our capabilities for observations and modeling in this critical near-shore region.

**Group 3. Biological and Chemical Working Group, Presenter: Larry Brand, RSMAS.**

The general importance of defining gradients in biological and chemical properties was noted. In comparison of estuarine and offshore systems, there is often more data available inshore. Are we data limited offshore? Also, it is often the “average conditions” that are defined when we are data limited. The importance of measuring the extreme events on biological and chemical systems was emphasized. Major issues identified by the group were:

- 1) Global change predictions, in particular the effects on ecosystems;
- 2) eutrophication in coastal regions, effects on primary production;
- 3) Harmful Algal Blooms (HABs);
- 4) effects of beach renourishment;
- 5) management issues, in particular assessing the “no take zone” strategy;
- 6) changes in Florida Bay and other Florida coastal regions from the planned modifications in S. Florida hydrology (the “replumbing” of the Everglades);
- 7) ground truth of remote sensing products in the coastal zone;
- 8) sensor development for biological/chemical properties. How to reduce maintenance requirements? How to deal with bio-fouling? The need to ensure that observing platforms can accommodate new technologies as these are introduced.

*Discussion:*

It was proposed that biological processes have an important role in setting the morphology of the estuarine zone (e.g., salt marsh structure), while physics dominates offshore. Are there implications for observational/modeling strategies?

**Group 4. South Atlantic Bight Working Group, Presenter: Jim Nelson, SKIO**

Distinguishing features and major issues for the SAB were summarized.

1) Coastal Buoyancy.

A “line source” of buoyancy at the coast, combined with strong tidal mixing sets up a coastal frontal zone. A number of questions are related to this: How continuous is the coastal current? How “connected” are different estuaries? What is the role of the high tidal range in exchange processes and the morphodynamics of the coastal region?

2) The role of the shelf in global carbon and nutrient budgets.

3) Exchange across the offshore, shelf break boundary.

4) Benthic exchange processes. How does tide and wave action influence the biogeochemistry in permeable sands?

5) Specific “regions of interest” within the SAB as sites for focused study.

For example, the Charleston Gyre (its role in outer shelf exchange, retention of planktonic communities) and other potential “hot spots” for cross-shelf exchange.

*Discussion:*

Chris Mooers noted a number of common themes between the SAB and the West Florida Shelf are also common to Earth System Science in general.

**Group 5. The Straits of Florida, Presenter: Kevin Leaman, RSMAS**

Distinguishing features in the Straits of Florida are: a narrow shelf; the Florida Current; small-scale features dominating cross-shelf exchange. Many of the key issues are thus physical. By contrast, in Florida Bay, the biology become far more important, and anthropogenic effects of nutrient loading, toxin inputs are far more critical.

Needs:

The importance of linking offshore and inshore models in this region was emphasized. Defining the offshore boundary conditions are critical. Definition of the fine-scale structure at the inshore edge of the Florida Current was noted as one critical area of information need. Thus sensor systems that will enhance this are of particular value. These could include:

- bottom-mounted sensors for sea level pressure;
- inverted echo sounders for temperature structure and defining boundary conditions such as the GS position;
- improved biological/chemical sensors (e.g., nutrients);

Strategy:

1) It was proposed to make better use of existing systems, such as the NDBC buoys. Augmenting these and examining acoustic telemetry (with possible relay nodes) as a means of enhancing the bandwidth available from the NDBC system.

2) Use of HF coastal radar, at least at critical points, to measure the fine-scale structure of the Florida Current at the shelf margin. (The difficulty in long-term maintenance of HF radar systems was noted. Thus, perhaps some critical regions for coverage need to be defined.)

- 3) Larger scale, a need for collaboration with the U.S. neighbors, such as the Bahamas, was seen as necessary. However, the limited infrastructure and research community in some countries must be recognized.

*Discussion:*

With regard to international cooperation, George Voulgaris reported that Mexico (through PEMEX) would be deploying three-to-four real-time moorings in the Gulf of Mexico.

**Group 6. Coastal Lagoons and Estuaries Working Group, Presenter: Gary Hitchcock, RSMAS**

It was pointed out that these are highly dynamic environments, with greater importance of short time and space scales relative to offshore environments. Key issues include:

- What are the ecological/trophodynamic responses to natural and anthropogenic perturbations?
- Responses to various “loadings” to the system?
- How do perturbations change the structure of the ecosystem?

Addressing such topics requires an integrated approach, with multiple-scale observation and sampling strategies.

The question of using prior observations to enhance the overall spatial/temporal database in the estuarine zones and provide the basis for comparative studies was raised. A challenge here is ensuring adequate and consistent QA/QC standards for the historical datasets.

Observational challenges for the estuarine region include turbidity (e.g., high attenuation and multiple scattering effects for optical sensors) and the critical issue of bio-fouling of sensors. The latter must be addressed and it was suggested that the community continue to make this clear to the instrument manufacturers.

*Discussion:*

The issue of atmospheric deposition of nutrients to the estuaries was raised, and that there is an EPA monitoring program to address this nationally. Joe Ramus emphasized that key sensor needs are for robust nutrient and dissolved oxygen systems.

**Group 7. West Florida Shelf Working Group, Presenter: Mark Luther, USF**

Distinguishing features of the WFS include: a very wide continental shelf; the proximity of the Loop Current; the fact that it is “upstream” of the rest of the SE-COOS region, and thus can be a “source region” in regional material exchange and advection of biota. The Florida Bay area is distinguished by a high surface area to volume ratio, which strongly influences the carbon cycle in that area (e.g., response to increased nutrient loading, changes in hydrology). Subsurface freshwater flow can have important local effects, especially in the Big Bend region. HABs, local or advective in origin, are an important

issue, affecting many interests. The low slope in onshore topography combined with a broad shelf makes the region highly susceptible to storm surge and sea level change associated with global warming. Tourism is an important part of the regional economy; hence, the importance of issues such as water use and offshore oil leases.

Primary needs for further information:

- documentation of freshwater input, including improved stream gages (presently set above head of tide), subsurface stream flow (e.g., side-looking ADCPs), and groundwater data;
- improved resolution of optical properties, especially as relates to HABs and suspended sediment loads;
- better characterization of wind and current driven upwelling at the shelf break;
- better air-sea flux measurements.

Given the present observing systems, the WFS would be a good site for further pilot work for a regional observing system, particularly on air-sea fluxes. The general popular interest in manatees might be capitalized on, as a species impacted by a variety of environmental issues.

It was also noted that inner, middle and outer shelf regimes are distinct but coupled. Thus, it will be important to consider observational strategies in developing regional models.

*Discussion:*

The question of use of vessels of opportunity came up. Kevin Leaman noted that some, such as the cruise lines, are very restricted in terms of ocean “litter”, thus might not be available for some applications (e.g., XBTs). Further emphasis on remote sensing may be required.

**Group 8. Regional Scale Modeling and Satellite Remote Sensing Working Group, Presenter: Chris Mooers, RSMAS**

Key issues for regional modeling were identified as:

- domain selection;
- gridding schemes;
- the open boundary conditions.

The prospect of NCEP’s operational ocean prediction systems is promising, but they need to be further assessed. There is also considerable work needed for the development of coupled air-sea, wave-circulation and physical-biogeochemical models on a regional scale. The basic information needs entail marshalling all available observations, exploiting what exists or will exist, and ensuring that these data are made available in a “model-friendly” format.

Three phases are envisioned for the development of regional models.

Phase I. Assessment of what is available, including assessment of existing observational and modeling capabilities, evaluation of alternate open boundary conditions.

Phase II. "CODAE" (i.e., a Coastal Ocean Data Assimilation Experiment); a "test bed" investigation for data assimilation strategies in the SE-COOS domain. This would include deployment of experimental observational arrays and an attempt to "over sample" in order to determine what should be continued long-term. Experimental products would need "disclaimers."

Phase III. Dissemination of prototype products for user evaluation; further develop the information management system; update systems designs based on user feedback to develop the next generation of observation and modeling systems.

Of the various disciplines, it was thought that this could be accomplished for the physical field in the next 10 years. Other truly multi-disciplinary regional modeling efforts may take longer.

*Discussion:*

John Van Leer suggested that the RUC model ("rapid update cycle" model used for forecasting weather for the airlines) might be worth exploring. Mike Crane also noted the Forecast Systems Lab is doing high-resolution (< 4 km) data assimilation research for Cape Canaveral.

**Group 9. Information Technology and Information Management Systems Working Group, Presenter: Mark Luther, USF**

Communications: Present options for communications have both range and bandwidth limitations (e.g., 40-50 km range for cell phones, 400 bytes/hr for GOES). New satellite options may be coming on-line, but there are issues of cost and power draw.

Key issues for data management:

- how to ingest data in readily accessible formats;
- making sure that raw as well as processed data is archived (note, this can be an issue with larger data sets such as HF Radar);
- real time, "on-the-fly" QA/QC (a difficult problem);
- redundancy of data sets (e.g., mirrored sites);
- developing a hub/node architecture to provide access to data, allow the "provider" to do QA/QC, but with a centralized access site. (Related issues include the need for standardized formats, search protocols, bandwidth requirements).
- use of "open architecture" software (freeware) for ease of access;
- all data open and free;
- data collection must be routine and sustained, 24 hr per day;
- inclusion of non-real time data (e.g., those requiring lab analyses);
- capability for high bandwidth applications.

Sustained, high bandwidth operations will require solid financial support.

**Group 10. Sensor and Other Technology Development Working Group, Presenter: John Van Leer, RSMAS**

Development of new sensor technologies and deployment strategies is most critical for biological and chemical sensors.

Among the sensor needs are:

- “sustainability” in the field (reduced maintenance requirements and bio-fouling effects);
- observing systems capable of accepting new sensors as these become available;
- exploring the augmentation of existing observing platforms (e.g., NDBC buoys and CMAN stations);
- vertical profiling systems;
- further development of the supporting infrastructure for sensor systems, including AUVs, and UW mate-able connectors and docking systems.

It was also emphasized that SE-COOS should play a role in the development of new sensors.

**Group 11. Education and Outreach Working Group, Presenter: David Stooksbury, UGA**

It was emphasized that effective outreach is an iterative process.

- Product needs of the public and private (and research) sectors must first be defined.
- The scientific community (also product users) then generates a number of possible products.
- Some become “no use” products, with respect to the private/public sectors, others are used, evaluated and subsequently modified as the definition of user needs are refined.

The potential public/private users often don’t know what the possibilities are, and it is often the case that the best contact within public/private organizations is not apparent to researchers. Finding the appropriate contact person is critical. Consequently, developing a productive dialog often takes time and a certain degree of persistence.

David Stooksbury, the State Climatologist for Georgia, suggested contacting other regional State Climatologists for potential outreach connections, since this is an area where the climate community has considerable experience. It was suggested that a SE-COOS Advisory Board be established to facilitate outreach and education, and that this be a broadly inclusive organization. Also important to outreach are a Website and logo.

*Discussion:*

Chris Mooers noted that outreach would have to be integral to “Phase I” of the three-phase sequence (outlined above).

Pursuing links to several organizations that have outreach and education missions was suggested. These include the National Marine Educators Association, the state Sea Grant organizations, and the International Association of Aquatic and Marine Libraries and Information Centers (IAMSLIC), the regional Southern Association of IAMSLIC Libraries (SAIL), and (NAML) National Association of Marine Laboratories.

**Group 12. Organization, Communication, Technical Personnel, and Finances,  
Presenter: John Morrison, NCSU**

The various organizational models considered included an academic consortium to run an operational facility at one extreme, and the formation of a non-profit corporation to run it at the other extreme.

Then it was recognized that federal and state agencies are involved in operational activities germane to the concerns of SE-COOS. Furthermore, they already provide a basic (though sparse and incomplete) set of coastal ocean networks, and SE-COOS needs may be met by complementing and supplementing the sensors and sensing systems presently offered by governmental agencies.

Hence, it may be most logical and successful to develop a “partnership” with NOAA, USN, and others for enhancing the system of extant observing system networks. In this mode, SE-COOS could assume a regional stewardship role for the SE coastal ocean, for which a formal academic consortium would be useful. Such a consortium could also operate in the experimental mode to organize pilot studies, to conduct new sensor testing, etc. that would help design, assess, and otherwise evolve the operational system.

**8. REVISED CONCEPTUAL SE-COOS  
CO-CHAIRS: MARK LUTHER AND JIM NELSON  
RAPPORTEUR: GARY HITCHCOCK**

Revised Conceptual SE-COOS

- Have sensed a need for parallel, coordinated, and inter-dependent efforts for the CZ and EEZ
- Have recognized the need to remain flexible until the direction of USA-COOS becomes transparent
- Have identified better the texture of the SE coastal ocean and the issues that pertain to it
- Have recognized the potential synergies that could be achieved if we can learn to work together on regional science

- \* Have realized the essentiality of partnering with NOAA, USN, et al., but it is very unclear as to how that may be done in a robust, sustainable fashion; however, rallying around a major, multi-year experiment may be the most productive arrangement
- \* Have identified a potential initial unifying theme of developing CODAE for the SE which, of necessity, would foster linking observing and modeling systems through data assimilation

### **SE-COOS ORGANIZATIONAL STRUCTURE**

- Explore alternative governance and management models, which depend upon the nature, scope, and duration of the SE-COOS activity that cannot be fully defined yet
- \* Establish initial working groups (see SE-COOS VISION STATEMENT above)
- \* Derive Mission Statement from the SE-COOS Vision Statement  
(given above)

## APPENDICES

### ACHIEVED PROGRAM FOR THE SE-COOS PLANNING WORKSHOP, 27 to 29 JUNE 2001

#### WED/27 JUN 01

1300 – Introduction (**Chair, Chris Mooers, RSMAS; Rapporteur, Jim Nelson, SKIO**)

Welcoming remarks – **Otis Brown, RSMAS**

National developments and Roles of SURA and SCOOP – **Otis Brown, RSMAS, and Don Wright, VIMS**

Conceptual SE-COOS– **Harvey Seim, UNC (Chapel Hill) and Chris Mooers, RSMAS**

1345 – Overview of Existing SE-Observing Systems (**Chair, John Morrison, NCSU; Rapporteur, Joe Ramus, DUKE**)

South Atlantic Bight – **Jim Nelson, SKIO**

Straits of Florida – **Kevin Leaman, RSMAS**

West Florida Shelf – **Mark Luther, USF**

1445 – COFFEE BREAK

1515 – Overview of Existing SE-Modeling Systems (**Chair, Chris Mooers, RSMAS; Rapporteur, George Maul, FIT**)

NOAA Ocean Forecasting System – **D.B. Rao, NCEP**

South Atlantic Bight – **Harvey Seim, UNC (Chapel Hill)**

West Florida Shelf – **Phil Hsueh, FSU and Ruoying He, USF**

Estuaries & Beaches– **Peter Sheng, UF**

1615 – Overview of Data Management Issues (**Chair, Mark Luther, USF; Rapporteur, Peter Sheng, UF**)

- NERRS perspective –**Dwayne Porter, USC**

- SCOOP perspective – **Mark Luther, USF**

1720 – Several planning factors for SE-COOS (**Chair, Joe Ramus, DUKE U.; John Morrison, NCSU**)

- major ports – **Maureen Kenney, CO-OPS/NOS**

- major marine protected areas – **Sandy Vargo, FIO**

- hitech field facilities (“observatories”) – **Stewart Glegg, FAU**
  - o DUCK
  - o SABSOON
  - o SEATECH
  - o COMP
  - o Etc

1830 – Initial discussion of a ten-year plan for SE-COOS (**Chair, Chris Mooers, RSMAS; Rapporteur, Jim Nelson, SKIO**)

1845 – ADJOURN//NO-HOST RECEPTION & POSTERS

## **THURS/28 JUN**

0800 – COFFEE, ETC.

0815 – Working Group Organization (**Chair, Chris Mooers, RSMAS**)

0830 - **Disciplinary Working Groups**

Physical & geological I – **Chair, Nick Shay, RSMAS**

Physical & geological II – **Chair, Peter Sheng, UF**

Biological & chemical – **Chair, Larry Brand, RSMAS**

1000 – COFFEE BREAK

1030 – Plenary (Disciplinary Working Group Summaries) (**Chair, Gary Hitchcock, RSMAS; Rapporteur, Joe Ramus, DUKE U.**)

1100 – **Multidisciplinary-Subregional and Cross-cutting Working Groups**

South Atlantic Bight – **Chair, Harvey Seim, UNC (Chapel Hill)**

Straits of Florida – **Chair, George Maul, FIT**

Coastal Lagoons and Estuaries (e.g., Florida Bay and Keys, Indian River Lagoon, and Pamlico Sound) - **Chair, Peter Sheng, UF**

West Florida Shelf – **Chair, Phil Hsueh, FSU**

Regional Scale Modeling and Satellite Remote Sensing – **Chris Mooers, RSMAS**

1230 – NO-HOST LUNCH

1330 – Plenary (Multidisciplinary-Subregional and Cross-Cutting Working Group Summaries) (**Chair, Phil Hsueh, FSU; Rapporteur, Jim Nelson, SKIO**)

1400 – **Infrastructural Working Groups**

Information Technology & Information Management Systems – **Co-Chairs, Mark Luther, USF and Dwayne Porter, USC**

Sensor and Other Technology Development\* – **Co-Chairs, John Van Leer, RSMAS and Jim Nelson, SKIO**

\*Includes mooring technologies and power/communications

Education and Outreach – **Co-Chairs, Phil Hsueh, FSU and George Maul, FIT**

Organization, Technical Personnel, and Finances – **Chair, John Morrison, NCSU**

- 1530 – COFFEE BREAK  
1600 – Plenary (Infrastructural Working Group Summaries) (**Chair, Chris Mooers, RSMAS; Rapporteur, Sandy Vargo, FIO**)  
1630 – WORKING GROUP CHAIRS, RAPPORTEURS, & OTHERS: DRAFT REPORTS  
1800 – ADJOURN/NO-HOST RECEPTION & POSTERS

**FRI/29 JUN**

- 0800 – COFFEE, ETC.  
0830 – Plenary (Final Working Group Summaries) (**Chair, Peter Sheng, UF; Rapporteur, Harvey Seim, UNC (Chapel Hill)**)  
1000 – COFFEE BREAK  
1030 – Revised Conceptual SE-COOS (**Co-Chairs, Mark Luther, USF and Jim Nelson, SKIO; Rapporteur, Gary Hitchcock, RSMAS**)  
1100 – Recommended Objectives for FL, GA, SC, & NC in SCOOP Workshop & Beyond (**Chair, John Morrison, NCSU; Rapporteur, Mark Luther, USF**)

NOTE: for example, establishment of standing work groups (e.g., coastal HF radars, tower systems, drifting systems, moored systems, bio-optic sensors, satellite remote sensing, numerical modeling); design and conduct of pilot studies; enhancement of IMS capabilities

- 1145 – Plans for producing the workshop report (**Chair, Chris Mooers, RSMAS**)  
NOON – ADJOURN  
1230 – Working Lunch for SSC  
1400 – FINAL ADJOURN

# ORGANIZATION OF, AND GUIDANCE FOR, WORKING GROUPS

## DISCIPLINARY WORKING GROUPS

### **CHARGE:**

*FOR THE NEXT DECADE, WHAT ARE THE LEADING SE-COOS/REGIONAL SCALE BASIC AND APPLIED RESEARCH ISSUES (QUESTIONS) FOR YOUR DISCIPLINES?*

*WHAT INFORMATION IS NEEDED TO ADDRESS THESE ISSUES (QUESTIONS)?*

*WHAT ARE THE PROMISING OBSERVING SYSTEM STRATEGIES IN PROSPECT FOR OBTAINING THE NEEDED INFORMATION?*

### **PHYSICAL & GEOLOGICAL I (EEZ)**

CHAIR, NICK SHAY

RAPPORTEUR, JOHN MORRISON

#### MEMBERS:

GEORGE MAUL

HARVEY SEIM

PHIL HSUEH

STEVE MOREY

ALEXANDER SOLOVIEV

STEVEN WONG

JUAQUIN TRINANES

FREDERICK BINGHAM

RUOYING HE

### **PHYSICAL & GEOLOGICAL II (CZ)**

CHAIR, PETER SHENG

RAPPORTEUR, JOE RAMUS

#### MEMBERS:

CLIFF MERZ

DWAYNE PORTER

JOHN VAN LEER

DAVID STOOKSBURY

MAUREEN KENNY

MIKE CRANE

GEORGE VOULGARIS

RICK DRISCOLL

SIDNEY SCHOFIELD

BILL VENEZIA

DON WRIGHT

JYOTIKA VIRMANI

MARK LUTHER

DANIELA DI IRORIO

### **BIOLOGICAL & CHEMICAL**

CHAIR, LARRY BRAND

RAPPORTEUR, SANDY VARGO

MEMBERS:

BRUCE UPCHURCH                      DANIELA DI IORIO                      GARY HITCHCOCK  
RYAN SMITH                              JIM NELSON

**MULTIDISCIPLINARY-SUBREGIONAL, AND CROSS-CUTTING WORKING GROUPS**

**CHARGE:**

*FOR THE NEXT DECADE, WHAT ARE THE LEADING SCIENTIFIC ISSUES (QUESTIONS) ON A MULTIDISCIPLINARY/SUBREGIONAL OR CROSS-CUTTING BASIS?*

*WHAT INFORMATION IS NEEDED TO ADDRESS THESE ISSUES (QUESTIONS)?*

*WHAT TYPES AND DISTRIBUTIONS OF SENSOR ARRAYS ARE REQUIRED TO OBTAIN THIS INFORMATION?*

**SOUTH ATLANTIC BIGHT**

CHAIR, HARVEY SEIM                      RAPPORTEUR, JIM NELSON

MEMBERS:

FREDERICK BINGHAM      GEORGE VOULGARIS                      BRUCE UPCHURCH

**STRAITS OF FLORIDA**

CHAIR, GEORGE MAUL                      RAPPORTEUR, KEVIN LEAMAN

MEMBERS:

JOHN VAN LEER                      NICK SHAY                              RICK DRISCOLL  
ALEXANDER SOLOVIEV

**COASTAL LAGOONS AND ESTUARIES**

CHAIR, PETER SHENG                      RAPPORTEUR, SANDY VARGO

MEMBERS:

DANIELA DI IORIO                      DWAYNE PORTER                      RYAN SMITH  
JOE RAMUS                              LARRY BRAND                          MAUREEN KENNY  
MIKE CRANE                              MARCELO CAVALCANTE              STEVEN WONG

SIDNEY SCHOFIELD

DAVID STOOKSBURY

JUAQUIN TRIANES

**WEST FLORIDA SHELF**

CHAIR, PHIL HSUEH

RAPPORTEUR, MARK LUTHER

MEMBERS:

CLIFF MERZ

SANDY VARGO

DON WRIGHT

**REGIONAL SCALE MODELING AND SATELLITE REMOTE SENSING**

CHAIR, CHRIS MOOERS

RAPPORTEUR, STEVEN MOREY

MEMBERS:

AJOY KUMAR  
RUOYING HE

D.B.RAO

JYOTIKA VIRMANI

**INFRASTRUCTURAL WORKING GROUPS**

**CHARGE:**

*GIVEN THE SCIENTIFIC ISSUES (QUESTIONS), INFORMATION REQUIREMENTS, AND OBSERVING SYSTEM DESIGN CONSIDERATIONS OUTLINED BY THE DISCIPLINARY AND MULT-DISCIPLINARY/SUBREGIONAL WORKING GROUPS,*

*WHAT ARE THE REQUIREMENTS (AND OPPORTUNITIES) FOR, AND APPROACHES TO:*

*SUPPORTING IT AND IMS INFRASTRUCTURE?*

*SENSOR AND OTHER TECHNOLOGY DEVELOPMENTS?*

*EDUCATION AND OUTREACH TO PUBLIC AND PRIVATE SECTOR?*

*ORGANIZATION, TECHNICAL PERSONNEL, AND FINANCES?*

**INFORMATION TECHNOLOGY & INFORMATION MANAGEMENT SYSTEMS**

CO-CHAIRS, MARK LUTHER AND DWAYNE PORTER  
RAPPORTEUR, MIKE CRANE

MEMBERS:

AJOY KUMAR                      FREDERICK BINGHAM                      D.B.RAO  
LIBBY JOHNS                      JOE RAMUS                      MIKE CRANE  
MARCELO CAVALCANTE                      STEVE MOREY                      ANDY SHEPARD  
JUAQUIN TRIANES                      RUOYING HE

**SENSOR AND OTHER TECHNOLOGY DEVELOPMENT**

CO-CHAIRS, JOHN VAN LEER AND JIM NELSON  
RAPPORTEUR, CLIFF MERZ

MEMBERS:

BRIAN HAUS                      BRUCE UPCHURCH                      CLIFF MERZ  
DANIELLA DI IORIO                      GARY HITCHCOCK                      STEWART GLEGG  
JOHN VAN LEER                      KEVIN LEAMAN                      LARRY BRAND  
JIM NELSON                      NICK SHAY                      RICK DRISCOLL  
RYAN SMITH                      SILVIA GREMES                      SIDNEY SCHOFIELD  
ALEXANDER SOLOVIEV                      STEVEN WONG                      DAVID STOOKSBURY  
BILL VENEZIA

**EDUCATION AND OUTREACH TO PUBLIC AND PRIVATE SECTOR**

CO-CHAIRS, PHIL HSUEH AND GEORGE MAUL  
RAPPORTEUR, DAVID STOOKSBURY

MEMBERS:

DWAYNE PORTER                      MAUREEN KENNY                      JYOTIKA VIRMANI

**ORGANIZATION, COMMUNICATION, TECHNICAL PERSONNEL, AND FINANCES**

CO-CHAIRS, JOHN MORRISON  
RAPPORTEUR, HARVEY SEIM

MEMBERS:

PETER SHENG                      SANDY VARGO                      DON WRIGHT  
CHRIS MOOERS

# **WORKING GROUP REPORTS**

## **DISCIPLINARY WORKING GROUP SUMMARIES**

**CHAIR: GARY HITCHCOCK**

**RAPPORTEUR: JOE RAMUS**

### **Physical and Geological I (EEZ), Presenter: Nick Shay, RSMAS**

#### Science Goals:

- Heat Distribution and Fluxes to Atmosphere
  - Effects of transients to climate scale
  - Models to define where we need measurements
  - Define strategic points for measurements in our system using inverse modeling.
  - Need to define the cut off wave number for phenomena of interest.
- Along-shelf variability of cross-shelf pathways of transport
- Momentum balance is what is least understood
- Need to resolve long-shelf scales in very important if we are to understand the cross-shelf transports.
- Continuous along-shelf measurements of the surface velocity field (using HF and Offshore Radar)
- Need subsurface measurement of diffusion:
  - Monitoring using Lagrangian measurements
  - Acoustic process oriented experiments.
  - Use AUV to map the cross-shelf direction.
- Provide information to managers in useable format.
- Regional Nested Model of Region.
  - Need air-sea coupled model
    - Needed to look at a variety of problems such as land/sea breeze effects.
  - Need air-sea flux moorings to implement.
  - Climate to short transient scales
  - Research needs to be carried out to identify the region needed to address the science concerns of SE-COOS
  - Need to get the mixed layer correct: need to worry about  
Advection - Vertical Shear - Surface Fluxes.

## **Physical & Geological II (CZ), Presenter: Peter Sheng, UF**

- A. Characteristics of the shallow, inshore region (estuaries and inner continental shelf), which distinguishes it from the offshore region (outer continental shelf - Physical & Geological I).
  - 1. Steep spatial and temporal gradients.
  - 2. Interaction between the surface and bottom boundary layers.
  - 3. Widespread input of freshwater from rivers.
  
- B. Improvements needed in existing models, which are currently inadequate to describe processes in the nearshore, shallow water environment.
  - 1. Models for the atmosphere, nearshore, estuary and coastal ocean need to be linked and integrated.
  - 2. Models which describe atmosphere-ocean interactions, particularly cyclogenesis.
  
- C. Specific areas, which require scientific inquiry.
  - 1. Cyclogenesis and dissipation.
  - 2. Material fluxes into the coastal zone, especially fresh water, carbon and sediments.
  - 3. Flooding during storm surges.
  - 4. Morphodynamics over the entire coastal zone during storms and between storms.
  - 5. Long-shore / cross-shore coherence scales.
  - 6. The role of estuaries in trapping or bypassing materials.
  
- D. Specific information needs.
  - 1. Finer spatial and temporal resolution for data and models.
  - 2. Real-time data, especially waves and currents, temperature and salinity, total suspended solids, and meteorological data. Priorities among these variables also need to be established.
  - 3. Robust sensors with resettable dynamic ranges are needed to capture both baseline conditions and extreme events.
  - 4. Storm surge models need to be improved, to include flooding and drying cycles and wave effects.
  - 5. The interactions between surface and bottom boundary layers.
  - 6. Buoyancy flux and its impact on the air-sea flux.
  
- E. Observing system strategies.
  - 1. Data acquisition to measure the steep temporal and spatial gradients in the nearshore environment.
  - 2. The use of models to bridge data gaps.
  - 3. Instrument packages like “adaptive samplers”, autonomous underwater vehicles (AUVs) and Cyclesonde vertical profilers.
  - 4. Collaboration among federal and state agencies with universities to share data and ensure integration and sustainability of monitoring programs.
  - 5. Unified basic data formats (metadata) and unified QA/QC.

6. Produce data and modeling products, which are useful to environmental management activity.

### **Biological & Chemical, Presenter: Larry Brand, RSMAS**

#### **Hypotheses to be addressed**

- For the flux of water, carbon, nutrients, and species, in many cases the net flux is from inshore to offshore because of the concentration gradient, but in some cases the flux from offshore can be significant or even greater. There tends to be a bias towards examining the inshore inputs not only because of the concentration gradient but also because of the greater amount of data inshore. This bias needs to be corrected with more offshore data, which can be best addressed with remote sensors.
- Global change in physical parameters such as temperature and sea level can be predicted with some degree of certainty. This is not the case with most biological and chemical parameters. Spatially and temporally dense baseline data are needed to begin documenting changes that result from global change that are beyond “normal” variability.
- It is hypothesized that rare extreme events may have greater, longer-lasting effects on ecosystems than normal environmental variation. This can be best tested with spatially and temporally dense data that is collected with remote sensors that are operating when unpredictable extreme events occur and sensors with can withstand such extreme events.
- Eutrophication of coastal waters continues to increase, as do harmful algal blooms. Eutrophication is often not noticed until there is a catastrophic change in the ecosystem or a harmful algal bloom develops. Long-term data with remote sensors are needed to provide early-warning signals of eutrophication. Comparative studies in different ecosystems are needed to be able to predict the levels of nutrient loading that are sustainable before catastrophic ecological changes occur.
- Increasing numbers of fish stocks and other marine life are being overharvested. Such changes at the top of the food web can be expected to have significant effects on the remainder of the ecosystem. Spatially and temporally dense data are needed to examine this, which can best be done with remote sensors. Remote platforms may also be useful in monitoring vessels that are causing the overharvesting of marine life.
- Beach renourishment by offshore mining of sediments is thought to be causing significant damage to benthic communities both as a result of the mining activity and the subsequent massive deposition of sediments when storms wash away the

beaches again. Remote sensors are probably the best way to determine the extent of this damage.

- Increasingly, “no take zones” are being used to ameliorate the effects of the overharvesting of marine life. Spatially and temporally dense data from remote sensors may be the best way of testing the effectiveness of these zones.
- The largest ecosystem restoration project ever attempted will be conducted in South Florida. This will result in a large change in where and when freshwater enters the coastal waters of South Florida. Remote sensors will be needed to document the effects of these changes in these coastal ecosystems. Similarly, changes in land use and hydrology will certainly be occurring throughout the southeast United States, so ecosystem changes can be expected all along the coastline, and should be monitored with remote sensors.
- Remote sensors can play an important role for ground truthing satellite-derived data. They are intermediate between the satellites and actual data collected from ships.

### **Sensors**

1. Temperature
2. Salinity
3. Oxygen
4. Turbidity
5. CDOM
6. Nutrients
7. Trace metals
8. Pollutants
9. Chlorophyll fluorescence
10. Particle size spectra (particle counters, flow cytometers)
11. Acoustic instruments for zooplankton and fish
12. Imaging systems for phytoplankton, zooplankton and fish
13. Molecular probes for microbial species and HABs

Many of these sensors are in various stages of development. It is extremely important that any new platforms be designed to be flexible and be able to handle new sensors as they become available.

Most of these biological and chemical sensors require a high degree of maintenance. Biofouling is a particularly difficult problem.

### **Sensor distribution**

- Fixed vs. mobile platforms
- Placement should be based upon our prior knowledge of the area
- Placement should be based upon discussions between biological and physical oceanographers and from their different perspectives.

Input from modellers is important so that the gridwork of sensors is useful for their models.

**MULTIDISCIPLINARY-SUBREGIONAL AND CROSS-CUTTING WORKING GROUP SUMMARIES**

**CHAIR: PHIL HSUEH, FSU**

**RAPPORTEUR: JIM NELSON, SKIO**

**South Atlantic Bight (SAB) Subregional Working Group , Presenter: Harvey Seim**

- 1) An important feature of the SAB is that it has a distributed river input of FW, mixed in the estuarine and near-shore to form a “line source” of buoyancy input to the coastal zone. A number of key regional questions relate to the presence of a coastal buoyancy current. These include: its along-shore continuity; the “connection” between estuaries; and cross-shelf exchange processes when the coastal frontal zone breaks down. Other coastal buoyancy issues include: its role in the variability of mixing rates in the nearshore zone; how stratification sets up in relatively shallow waters; how this influences the response to episodic events.
- 2) Another key feature of the SAB is the continental shelf, 100-120 km in width off SC and GA, that is bordered by the Gulf Stream on its seaward margin. Key scientific topics relating to the continental shelf system include:
  - carbon and nutrient budgets (e.g., is the shelf a net source or sink for organic carbon?);
  - the role of the Charleston Gyre in exchange on the outer shelf;
  - the role of Gulf Stream meanders in exchange along the shelf margin;
  - benthic exchange processes;
  - atmospheric inputs of materials.

Also, where are the “hot spots” for regional exchange processes over the annual cycle?

- 3) A more generic research need for the region is a better understanding of mixing. The total lack of direct field measurements was noted. In particular, the role of surface waves and surface wave interactions with the sea bed in shelf mixing and sediment dynamics were identified as key topic areas, relating to sediment transport, bed stress, and benthic exchange (i.e., advective flux between the water column and the pore waters of the permeable sand sediments that characterize much of the SAB shelf). Key observational needs to address these topics are:
  - nearshore directional waves;
  - the vertical structure of physical, chemical, and biological properties.

Sensor systems that could address these needs include:

- HF coastal radar (for surface waves as well as surface currents);
- vertical profilers for T,S, optical properties, chlorophyll, and other properties;
- possibly emerging AUV technologies.

## **Coastal Lagoons and Estuaries Working Group, Presenter: Gary Hitchcock, RSMAS**

Coastal lagoons and estuaries are highly dynamic regions, often with high productivity, and often with significant anthropogenic influence. Key issues and questions identified were:

- Ecological, tropho-dynamic, and natural responses to perturbations (on the synoptic and global scale, natural and anthropogenic), including storms, changes in land use, and watershed modification.
- What regulates the structure of estuaries? How to develop the basis for comparison between estuaries and for prediction of responses?
- Understanding the fluxes and exchange of materials in coastal lagoons and estuaries.
- What are the effects of nutrient and material (e.g., sediment) loadings?
  - Key observational needs include:
  - Observations on appropriate temporal and spatial scales (in particular, there is a need for fine-scale measurements in estuaries).
  - Exploitation of prior records through conversion of older paper records to digital forms. (The issue of data QA/QC for prior records was noted here).
  - Comparative studies -- can information and conclusions derived from the study of one estuary be “transferred” or applied to another?
    - Other important issues are:
    - The sustainability of time series and comparative studies.
    - How to serve the variety of “user groups” that are interested in the information and conclusions derived from estuarine and near-shore studies.
    - Linking “vertical datasets” through the water column
    - Ensuring appropriate “transfer functions” and proper calibrations during instrument exchanges in extended time series.
    - Education -- How to effectively reach students, agency personnel, and the public.
      - Types and distribution of sensors:
      - Real-time – An issue for many bio-optical, acoustic sensors – how to get real-time capabilities comparable to that available for many physical measurements?
      - Application of a range of remote sensing techniques.
        - Other needs:
        - Cooperation between university, state and federal groups.
        - Data acquisition during storm events.
        - Further sensor development, especially, approaches for sustained operation in highly fouling environments

### ***Questions/discussion:***

Chris Mooers: How many estuaries and lagoons exist in the SE-COOS region? What are the roles of EPA and NOAA programs in the estuaries?

Phil Hsueh: The need for direct measurements during storms raises the issue of the “survivability” of sensors.

**Straits of Florida (and Florida Bay) Working Group, Presenter: Kevin Leaman, RSMAS**

1. For the next decade, what are the leading scientific issues (questions) on a multidisciplinary/subregional or cross-cutting basis?

The overwhelming presence of the Florida Current near the eastern Florida coast has a strong impact on circulations and watermass properties in the inshore coastal region. This may influence currents in the vicinity of important ports such as Miami or Port Everglades, and it may have important effects on not only the physics but the biology of important marine habitats such as the Florida Keys and Florida Bay.

Recent studies have shown that as we are able to look at successively smaller scales of fluid motion in the Straits, we have detected the presence of strong circulations (e.g., speeds of several  $\text{ms}^{-1}$ ) with small time (a few hours) and space (a few kilometers) scales. The existence of this variability, particularly along the edge of the Florida Current, has important implications for the turbulent transfer of not only momentum but nutrients and other properties of biological interest from the open ocean to coastal waters and vice versa.

One of the most important tasks of the coming decade will be to design observing components that will provide information needed to couple offshore, larger-scale models to coastal models with much finer resolution. In locations such as Florida Bay where the biological environment is of extreme importance, such models will also have to take into account the flux of nutrients, etc. through the environment.

2. What information is needed to address these issues (questions)?

For the general problem of coupling offshore and coastal models we need information that will allow us to model the barotropic and baroclinic flow fields in a restricted coastal regime and connect that model to an offshore general circulation model. Such information includes but is not restricted to surface (sea-level) elevation, pressure conditions on the open ocean (current edge) boundary of the Florida Current, density structure at the same location and surface current structure on short time and space scales. The latter is particularly important in determining the interactions of the Florida Current edge with the adjacent coastal waters.

The addition of biological concerns requires that every effort be devoted to expanding the suite of available sensors that can be routinely deployed in an operational mode to include important biological variables such as nutrients, oxygen and light levels. In regions such as Florida Bay where freshwater inflow is important, reliable long-term salinity measurements have an obvious importance.

### 3. What types and distributions of sensor arrays are required to obtain this information?

To develop our capabilities to match inshore and offshore models we will need better observations at the interface of these regimes, most usually the "shelf break". The requirements for pressure and density information could be met by, among others, pressure/inverted echo sounder devices with the addition of acoustic telemetry.

It is clear that we can do a better job in expanding the suite of observations carried by C-MAN/sea level sites. It is possible to include, for example, oxygen, light, nutrients pH and others to such sites. All of these data can be reported in real time. These sites also should include GPS receivers to improve the geodesic information available.

To observe the very important boundary between the Florida Current and the coastal waters at small space and time scales and in real time, the access to data from sites where Ocean Surface Current Radars (OSCR) are deployed should be improved. Emphasis should be placed on locations where either important marine habitats are located, such as Florida Bay, or sites where important human activities such as maritime access to harbors take place.

Finally, it must be remembered that measurements needed to observe the Florida Current, such as transports measured from telephone cables or sea level pressure measured on both sides of the Straits of Florida, will require the cooperation of neighboring countries such as the Bahamas (and, eventually, Cuba). Every effort must be made to include such states in the process of establishment and use of a coastal observing system.

### **West Florida Shelf (and Florida Bay), Presenter: Phil Hsueh, FSU**

#### Major distinguishing factors:

Very wide shelf, low slope

Proximity of Loop Current makes WFS source region for entire SE-COOS region

Large fresh water input from ground water, esp. in Big Bend

#### Cross-cutting issues:

Global Change (both carbon flux and sea level rise)

Cross-shelf exchange

Interannual variability (ENSO, NAO, etc.) changes in rainfall/streamflow, frequency/intensity of winter frontal passages; wild fires (aeolian transport)

Sea grass loss, both on the shelf (particularly in Big Bend) and in estuaries - Sport fishing depends on sea grass beds for spawning etc.

Harmful algal blooms

Nutrient loading from riverine inputs, also from offshore upwelling

Human impacts from water withdrawals, desalination projects (one under construction, another proposed for Tampa Bay region)

Carbon cycling/exchange important part of air-sea flux – especially important of WFS because of large areal extent and high productivity

Nutrient/pollutant loading – esp. Fla Bay – receives runoff from large agricultural areas. Exchange across shelf, through Keys affects offshore and reef tract. Advection by Fla. Current affects entire SE-COOS region. Fla Bay particular “hot spot” for SE-COOS – Marine Protected area as well. Good science, big payoff.

Atmospheric deposition of nutrients important part of nutrient loading

Because of low topographic gradient WFS (esp. Big Bend and Keys) especially susceptible to sea level rise and storm surge

Tourism (beaches, fishing, watersports), marine transportation important to local economy

#### **Information needed to address issues:**

Mapping extent of seagrass beds and changes over time – why? Turbidity, nutrient loading, higher chl, lowered light; boating, fishing/trawling activities, waves, sediment resuspension also contribute – need observations of these

Better measurements of air-sea interactions in nearshore for flux parameterizations – affects cross-shelf flux dynamics

Need measurements of optical properties, hyperspectral satellites can give large areal coverage with minimum number of cal/val in situ observations – same goes for HAB's

Both wind driven and current driven upwelling important on WFS – what is relative contribution of each? What is contribution of advection of organisms/nutrients from Campeche upwelling? Could this be measured with AUV's? Need to combine with moored instrumentation across shelf and into estuary. Biological and chemical sensors needed, also sediment sensors

Monitoring array already in place to some extent – need to augment with better air-sea turbulent flux measurements; ex. Acoustic rain gages, surface boundary layer profilers (above and below interface); lead to better parameterizations of turbulent fluxes for models. WFS is good location for pilot study because of existing infrastructure. Results could be broadly applied to other coastal regions. Also carbon flux needs to be measured – how to do it? WFS has more surface area per unit volume than other shelf areas.

WFS is good place for AUV measurements

Better real-time measurements of fresh water input to coastal ocean. Big rivers – Apalachicola, Suwannee, Hillsborough, Peace, Shark; also large influence of Mississippi River on WFS.

More obs needed on circulation on WFS from Desoto Canyon to Keys – all closely connected, highly correlated. Pressure signals propagate from Keys toward northwest all the way to Mississippi delta as shelf wave which sets up geostrophic flow along shelf. Fla Bay is “source” of signal.

M2 tide is amplified due to width of shelf.

Manatees affected by much of above (boat traffic, heat budget, pollutant loading, etc.) – good selling point.

Shelf break, mid-shelf, and inner shelf distinct yet closely coupled – require special modeling as well as observational considerations

Look to Weather Channel and similar outlets for outreach/education – ocean circulation, SST, HAB animations

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### **Regional Modeling and Remote Sensing Working Group, Presenter: Chris Mooers, RSMAS.**

The key scientific issues discussed were in two general areas: numerical simulation and data assimilation.

Numerical issues:

- outer boundary conditions
- nested grid designs
- telescoping grids
- adaptive grids

Data assimilation:

- assessment of NOFS and other approaches (e.g., Navy models)
- wave-circulation coupling

- ecosystem-biogeochemical coupling
- sediment transport modeling

These issues have not been addressed at the SE-COOS region scale.

Information needs:

- Application of all available satellite products
- Better links to Coast Watch
- Better river discharge data
- Lagrangian data
- High-resolution circulation in special areas; e.g., where topography and circulation are complex and unique habitats exist; for example, topographic anomalies with associated recurrent mesoscale features:
  - DeSoto Canyon
  - Cape San Blas
  - Dry Tortugas Is,
  - Cay Sal Bank
  - Cape Canaveral
  - Charleston Bump
  - Cape Hatteras
- Surface currents
- Air-sea surface fluxes of heat, evaporation minus precipitation
- Outer Boundary Condition “checks” (e.g., profiles of velocity, T, S at boundary)
- VOS transects (e.g., glider AUV?)

Three phases for development of regional models were proposed.

- I. Assess existing observing systems and models. Address the problems in making use of the existing systems. What are the inadequacies? Examples of present models include: NOAA (e.g., NCEP/ECFS & NOFS) and Navy (e.g., NAVO (POM & NCOM) and FNOMC (NLOM & POPS)).
- II. Conduct a “CODAE” (Coastal Ocean Data Assimilation Experiment, i.e., a GODAE analog for the coastal ocean). Test various models and data assimilation schemes and assess operational and experimental observing systems. Generate “experimental” products and evaluate these.
- III. Disseminate prototype prediction products and assess these through feedback from various user groups. Update the observing system to enhance the predictive modeling system. Improve the models.

***Comments/discussion:***

The potential problems that could arise from distributing “experimental” quality products to a broad group of potential users were discussed (e.g., inappropriate application, liability questions). However, Mark Luther also noted some potential advantages in

getting feedback from experimental product availability. There are mechanisms for providing “disclaimers”.

## **INFRASTRUCTURAL WORKING GROUP SUMMARIES**

**CHAIR: CHRIS MOOERS**

**RAPPORTEUR: SANDY VARGO**

### **Information Technology & Information Management Systems, Presenter: Mark Luther, USF**

What are our requirements and opportunities?

1. Instrument communications real time to shore sites - data acquisition servers  
Approaches:  
GOES  
**Spread-spectrum radio**  
Cell phone/CDPD technology  
Iridium satellite  
Other satellite options possible in near future
2. Shore to collecting to computer center or academic institution
3. QA and QC functions
4. Mirror sites
5. DODS is potential data sharing technology
6. Data management procedures must be implemented
7. Data Management Issues
  - Common data/metadata formats
  - Real-time QA/QC
  - Centralized access to distributed data sets (common search engines, etc.)
  - How to integrate biological/geochemical data (not necessarily real-time)
  - How to serve/archive model-generated products, satellite-derived products
  - Modular/Expandable systems
8. Data Management Philosophy
  - Open systems architecture
  - Web-based
  - Free and complete access
  - To be included, data must be routinely collected, sustained, and readily available
9. Accommodate investigators to add new instrumentation/data types
10. Sustainability for 24x7 operations
11. Link to models as an assimilation
12. Accommodate user communities
13. Preserve original data; QA/QC, any editing of data saved as overlays
14. Observational standards to be developed
15. Provide for commercial participation in a partnership
16. Governmental partnerships
17. Staffing by central and local members for data ops must fully funded

18. Should there be competition for data installations and management?

Think big – HD video at numerous sites; HF radar x 20, archiving all spectra; optical sensors; holographic particle counters; etc.

Get estimates from participants of data volume to be generated

### **Senor and other Technology Development , Presenter: John Van Leer, RSMAS**

#### **Desired Measurement Variables:**

1. OCEAN: Temp, Pressure, Conductivity, Velocity, Light, Turbidity, Currents using bottom-mounted up-ward looking and buoy-mounted downward looking ADCP's, acoustic rain gages, Chlorophyll, DOM, pH, DO, pCO<sub>2</sub>, Phosphate, Silicate, and expendable sensors like XBT, XCTD.
2. ATMOSPHERIC: Temperature, Humidity, Wind, Barometric Pressure, UV (Long and Short Wave Radiation), Precipitation, Sulfates, Nitrates, Flux (es) measurement capability.
3. OCEAN SURFACE: Bottom-mounted up-ward looking ADCP's measuring waves, HF phased-array radar (currents, directional spectra), various remote sensing (e.g. Hyper-spectral satellite) methods.
4. GEOMORPHOLOGICAL: Rotating Acoustic Sonar (monitoring bedform migration and bottom-tracking), OBS and LISST (optical suspended sediment, biologics), PC-ADP/ADCP (bottom boundary layer and suspended sediment, biologics via acoustic backscatter).

#### **Needed Sensor Improvements for Long-Term Deployments:**

1. Establishment of SE-COOS-wide sensor specification/guidelines to ensure sensor robustness and consistency (e.g., prevention/reduction of instrument bio-fouling; use of marine-suitable and compatible materials; improvements in underwater mateable diver/AUV docking connection methods; and low current/power designs).
2. Establishment of a sensor development/evaluation program for emerging technologies (e.g., acoustic rain gages).
3. Establishment of a sensor development/evaluation program for existing technologies (e.g., improvement in ambiguity in differentiating between suspended sediment and biologics with acoustic/optical systems; and adaptive sampling schemes with real-time systems).
4. Detailed and continuous sensor/platform records (e.g. calibration and site service maintenance).
5. Sensor compatibility and interchangeability between partners and individual sites.

**Education and Outreach to Public and Private Sector, Co-Chairs: Phil Hsueh, FSU and George Maul, FIT and Rapporteur: David Stooksbury**

Make sure SE-COOS is working closely with SURA/SCOOP.

What are the requirements and opportunities for approaching?

- Private/Public Sector often times does not know what they really want or what is available.

Public/Private Sector Needs?

- Determine (and Engage) Users: US, Univ, Fed/ST Agencies, Local Govt, Industry, General Public, Commercial & Sport Fisheries, Tourism, Media, Resource Managers, and Decision-Makers, Politicians

**Education**

- our own scientists on how to communicate with the press and public
- SE-COOS needs to translate scientific research to easily understandable level
- Joint degree between journalism and marine science
- Student exchange and academic recognition between participating universities
- Education Ocean Commission and SURA
- Education Workshop for managers/decision makers
- Summer classes (Professional Development) for high school science teachers
  - o How to use data
- Work with Sea Grant (marine extension, ag extension)
- SE-COOS Advisory Board
  - o (sub-regional?) with a major users component
- User Needs Assessment
  - o With 2-way education
    - Education of users on possibilities
    - Education on the needs
- Develop prototype products with users
- Test prototype products with users
- Refine prototype products with users
- Release product

**Getting the Info Out**

Make sure the mass media knows we are here and have the material available

- Promotional material
  - o SE-COOS Website-any volunteers (Mark Luther)
  - o We need a host-need a mission statement
  - o We need a logo-need to be inclusive

- Name start using-don't draw line
- New Name
- \*Include Ed/Outreach coordinates

### Funding through Outreach

Funding is easier to obtain products

- users, fed/state

### **Organization, Communication, Technical Personnel, and Finances, Presenter: John Morrison, NCSU**

An organizational model for SE-COOS was discussed. Possible candidates included university consortia such as UCAR or SURA (Jefferson Lab), or a non-profit corporation such as GoMOOS. Several concerns were raised:

- a) university consortia have not been involved in running an operational facility (versus a research facility). Are universities the appropriate sites to house the resources necessary for round-the-clock operations? There needs to be an organizational component dedicated to long-term maintenance of the system which may be outside the scope of the mission of the universities; and
- b) the corporate model (GoMOOS) is very popular at the moment, it establishes a utility that provides information to a broad range of users. The concern voiced was that the GoMOOS model works because of its limited geographic area, and that, for SE-COOS, it will be very difficult for the four states to commit to a corporate entity because of the states' competing interests and conflicting regulatory structures; that situation could change over time if the governors formed a SE-Marine Environmental Council.

Main question raised was, "What organizational structure is best-suited to permit coordination of the states?"

The role of NOAA and other federal agencies was extensively discussed. NOAA is obviously an important ally in the observing system, has many offices that must contribute to a complete regional system, and should in fact be responsible for its operation in an ideal world. Is there any possibility of re-organizing NOS in a fashion similar to the regional NWS offices? This would provide federal oversight and impose interstate coordination and maintain a regional focus. [In plenary with NOAA personnel later in the day, the chances of affecting any change in the NOAA organization were considered very slim. It was suggested that consultation with business schools within the region to discuss organizational models might be the best way to proceed].

Because of the need to develop SE-COOS at this point (routine operation of a regional observing system is at least 5-10 years in the future), the group decided that an

academic consortium to establish an experimental institute was the best short-term strategy. The consortium would carry out pilot studies to help define the technical methods needed for the operational system, and begin to put them in place. At the same time, a more permanent organizational structure needs to be investigated because R&D and operations need to co-exist to optimally design the final system.

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