SEACOOS Spring 2004 Workshop

May 17-18, 2004

Miami, Florida

Hosted by
Rosenstiel School of Marine and Atmospheric Science, University of Miami

WORKSHOP REPORT INTRODUCTION

The SEACOOS Spring 2004 Workshop was held on May 17-18 2004 in Miami, FL, and was hosted by the Rosenstiel School of Marine and Atmospheric Science, University of Miami. The aim of the workshop was to inform the academic, federal and state agency, and private sector communities of the recent progress and plans of SEACOOS and related programs, and to invite community participation in the mid-term planning of SEACOOS and associated activities. The workshop agenda contained substantial time for discussion and development of potential plans and ideas, which are summarized in this report. One consideration for the Workshop was the opportunity for participants to provide guidance to the nascent Regional Associations being established as part of the Integrated Ocean Observing System (IOOS).

Report Format

The workshop was broken down into two main types of sections: plenary, where shorter presentations were made to the group, and breakout groups assigned a central topic. This document contains reports from all of the sections. For ease of use, any presentation slides available have been placed in Appendix A. Appendix B contains detailed notes from the breakout group sessions.

Table of Contents

WORKSHOP REPORT INTRODUCTION 2

WORKSHOP AGENDA 5

PLENARY, MONDAY AM 7

NATIONAL AND REGIONAL IOOS DEVELOPMENTS 7

National Overview of IOOS (Integrated Ocean Observing System) and OOI/ORION (NSF Ocean Observing Initiative) 7
ORION/OOI 8
IOOS aspects of the Ocean Policy (Watkins) Commission Report 8
SECOORA (the prospective IOOS Regional Association for the Southeast) 10
RCOOS/SEACOOS (i.e., the prospective Regional Coastal Ocean Observing System for the Southeast) 12

Observing System Working Group 12
Modeling System and Products Working Group 13
Information Management System Working Group 13
Outreach and Education Working Group 14

SOME RELEVANT SOUTH FLORIDA PROGRAMS 14

Florida Current Cable & Calibration Surveys 14
Coastal Volunteer Observing Ships (e.g., Explorer of the Seas & SeaKeepers International) 15
CSTARS 15
NOAA South Florida Program 16
West Florida Shelf ECOHAB 16
Florida Current Billfish/Oceanographic Survey 17

MONDAY PM BREAKOUT GROUPS 18

BREAKOUT GROUP 1 -- STRATEGY FOR A FISHERIES OCEANOGRAPHY INTERFACE 18

BREAKOUT GROUP 2 -- STRATEGY FOR SURFACE WAVES AND MESOSCALE METEOROLOGICAL OBSERVATIONS AND MODELING 20

PLENARY, TUESDAY AM 22

STATUS REPORTS FOR SELECTED SEACOOS AND IOOS ACTIVITIES 22

Role and Status of Satellite Remote Sensing in SEACOOS 22
SEACOOS Information Management 24
National Backbone Issues 27

NOS/CO-OPS, Mike Szabados 27
NWS/NDBC, Suzanne van Cooten 28
NOS/CSC Coastal Services Center, Jeff Payne 29
SECOORA & SEACOOS, Sandy Bernard 30

Coastal Managers Issues 30

CSO Survey Results, Debra Hernandez (SC DHEC, CSO) 31
CAMA Program, Jeff Beal (Florida Department of Environmental Protection) 32

Education Programs – Reports on IOOS Education Workshop, COSEE programs in related to SEACOOS 33

SE COSEE, Lundie Spence 33
Florida COSEE, Barbara Spector 34

Gulf of Mexico COSEE, Mike Spranger 34

Industry IOOS Workshop Results 34

Mitch Roffer (ROFFS™) 35
Judy Gray (NOAA, AOML) 35
Chris Mooers (U. Miami, SEACOOS) 36
Rick DeVoe (SC Sea Grant, SECOORA) 36

BREAKOUT GROUPS, TUESDAY PM 38

BREAKOUT GROUP 3 -- STRATEGY FOR LAGRANGIAN OBSERVATIONS AND MODELING BREAKOUT GROUP 38

BREAKOUT GROUP 4 -- STRATEGY FOR FOSTERING PARTNERSHIPS BETWEEN PRIVATE, PUBLIC, GOVERNMENT AND ACADEMIC SECTORS 40

SEACOOS SPRING WORKSHOP ATTENDEES 45

WORKSHOP AGENDA

Workshop Aim
To inform the concerned community of the recent progress and plans of SEACOOS and related programs, and to invite community participation in the mid-term planning of SEACOOS and associated activities.

Monday AM – National and Regional IOOS Developments

8:00 – Registration & Coffee; Setup Posters

8:30 – Plenary: Chair, Jim Nelson

8:30 – WELCOME – Otis Brown

8:40 - **National Overview of IOOS (Integrated Ocean Observing System) and OOI/ORION (NSF Ocean Observing Initiative)** – Mark Luther

9:10 - **IOOS aspects of the Ocean Policy (Watkins) Commission Report** – Paul Sandifer and Frank Muller-Karger **(*in absentia*)**

9:30 - **SECOORA** (i.e., the prospective IOOS Regional Association for the Southeast) update - Rick DeVoe

9:50 – **RCOOS/SEACOOS** (i.e., the prospective Regional Coastal Ocean Observing System for the Southeast) update (10 min for the overview; 5 minutes each for the others, including Q&A)

- Overview – Jim Sanders
- Observing System Working Group – Bob Weisberg
- Modeling System Working Group – Cisco Werner
- Information Management Working Group – Madilyn Fletcher
- Outreach & Education Working Group – Jack Thigpen

10:20 – Coffee Break

10:50 – Plenary (continued) – **Some Relevant South Florida programs** (15 minutes each, including Q&A)

- **Florida Current Cable & Calibration Surveys** – Chris Meinen
- **Coastal Volunteer Observing Ships** (e.g., Explorer of the Seas & SeaKeepers International) – Rod Zika and Ed Kearns
- **CSTARS** – Hans Graber
- **NOAA South Florida Program** – Peter Ortner and Libby Johns
- **West Florida Shelf ECOHAB** – John Walsh (*in absentia)* and Bob Weisberg
- **Florida Current Billfish/Oceanographic Survey** – Bob Cowen and Kevin Leaman

12:20 - Lunch

Monday PM - Breakout Groups

1:30 – Breakout Groups

Strategy for a Fisheries Oceanography Interface

Strategy for Surface Wave and Mesoscale Meteorological Observations and Modeling

3:00 – Coffee Break

3:30 – Breakout Groups (continued)

5:00 – Plenary: Chair, Chris Mooers
Breakout Group Reports

5:30 – Adjourn

6:30 – Reception at RSMAS/University of Miami

Tuesday AM – Status Reports for Selected SEACOOS and IOOS Activities

8:30 – Plenary: Chair, Cisco Werner

- **Role and Status of Satellite Remote Sensing in SEACOOS** – Charlton Purvis, Ed Kearns, and Frank Muller-Karger (*in absentia*) (30 minutes)
- **Role and Status of Information Management in SEACOOS** – Ed Kearns, Madilyn Fletcher, and Dwayne Porter (30 minutes)
- **Status and Trends of the IOOS "National Backbone"** – SEACOOS Federal Affiliates Working Group Panel (30 minutes)

10:10 – Coffee Break

10:40 – Plenary (continued) Summaries of other IOOS activates

- **Coastal Managers Issues** – Jack Thigpen, Debra Hernandez, Jeffrey Beal (30 minutes)
- **IOOS Education Workshop Results** – Lundie Spence (30 minutes)
- **Industry-IOOS Workshop Results** – Judy Gray, Rick DeVoe, Chris Mooers, Mitch Roffer (30 minutes)

12:10 – Lunch

Tuesday PM – Breakout Groups

1:30 – Breakout Groups

Strategy for Lagrangian Observations and Modeling

Strategy for Fostering Partnerships Among Private, Public, Government, and Academic Sectors

3:00 – Coffee Break

3:30 – Breakout Groups (continued)

5:00 – Plenary: Chair, Bob Weisberg

- Breakout Group Reports
- Workshop Summary

6:00 – Adjourn

Wednesday

Internal Business
AM –SEACOOS Working Groups
PM – SEACOOS Executive Committee (adjourned at 3pm)
All SEACOOS PIs were welcome to attend the Executive Committee meeting.

PLENARY, MONDAY AM

Summary

Following opening remarks by Otis Brown (U. Miami, Dean of the Rosenstiel School of Marine and Atmospheric Science), the morning plenary session began with updates on national and SE regional developments related to the Integrated Ocean Observing System (IOOS), the regional Coastal Ocean Observing System (RCOOS and SEACOOS) and SE Regional Association (RA). This was followed by a set of short presentations on various programs in the South Florida area that are relevant to the regional coastal ocean observing program.

NATIONAL AND REGIONAL IOOS DEVELOPMENTS

National Overview of IOOS (Integrated Ocean Observing System) and OOI/ORION (NSF Ocean Observing Initiative)

Mark Luther (USF, Vice-Chair U.S. GOOS Steering Committee)

The major themes and goals that are guiding the development of the U.S. component of IOOS are:

- detecting and predicting oceanic components of climate variability,
- facilitating safe and efficient marine operations,
- ensuring national security,
- managing resources for sustainable use,
- preserving and restoring healthy marine ecosystems,
- mitigating natural hazards, and
- ensuring public health.

IOOS is envisioned to include global, national and regional elements, with linked subsystems for data acquisition, data management and data analyses/applications. A "national backbone" for the U.S. coastal ocean observing system will provide core *in situ* observing elements, incorporate satellite remote sensing, and establish data standards and protocols for exchange and capacity building. This will be supplemented by various regional systems (RCOOS) with Regional Associations (RA) providing the regional governance structure. The RA's will be linked through a National Federation of Regional Associations (see http://usnfra.org/index.jsp).

A sequential development of enhanced observing capabilities is envisioned with transitions from research to pilot projects, through a pre-operational (proof of concept) level, to operational systems. Mark noted the potential role of the Alliance for Coastal Technologies (ACT) in fostering the transition from research to pilot projects (http://www.actonline.ws/). The organizational structure for the planning and implementation of IOOS includes establishment of policies at the level of the National Ocean Research Leadership Council (NORLC) and coordination of national planning and implementation through Ocean.US.us (http://www.ocean.us/). A "Joint Operations Center" that will interact with Ocean.US and the NORLC is in the planning stages. Its role will include "certification" of component systems to be part of the Regional Associations. Mark concluded with a summary of the status of proposed funding for S1400 (presently authorizing legislation) and for Ocean.US.

ORION/OOI

Rick Jahnke (Skidaway Institute of Oceanography)

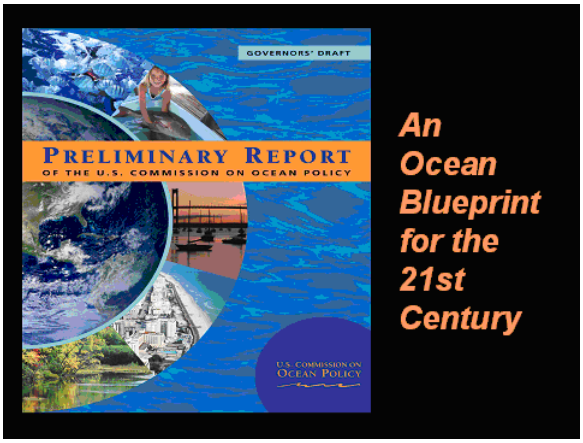
Rick Jahnke summarized developments relating to the Ocean Research Interactive Observatory Networks, ORION (see links from http://www.coreocean.org/) and the Ocean Observatories Initiative of NSF (see http://www.geo-prose.com/projects/ooi_broch.html). ORION is in the FY06 budget request at a level of $246M for 5 years for development of observatory infrastructure.

Three components of ORION are envisioned: 1) a global buoy system; 2) regional cabled observatories (e.g., NEPTUNE off the Pacific Northwest); and 3) a network of smaller scale cabled observatories (RECONN). For the coastal component of OOI, it has been proposed to develop a combination of permanent cross-shelf lines ("endurance arrays") and a movable set of real time moorings ("pioneer arrays") that will focus on specific regional processes. A workshop report on Coastal Observatory Science is available through the CoOP office (http://www.skio.peachnet.edu/research/coop/future.php). It is envisioned that "endurance arrays" would be deployed within the ecosystem areas delineated in the Report of the U.S. Commission on Ocean Policy (see Paul Sandifer presentation).

IOOS aspects of the Ocean Policy (Watkins) Commission Report

Paul Sandifer (South Carolina Department of Natural Resources, Hollings Marine Laboratory)

Paul Sandifer served as one of the sixteen members of the U.S. Commission on Ocean Policy (USCOP). The Preliminary Report of the USCOP (http://www.oceancommission.gov/) was developed over 2 ½ years through 15 public meetings, 17 regional site-visits, and testimony from 445 witnesses. Paul reported that there were 116,152 downloads of the Preliminary Report in the first week that it was available. The report has been delivered to the Governors' Offices for comment (comment period to June 4, 2004).



Key findings by the USCOP were:

1. Oceans and coasts are major contributors to the US economy;
2. Our ocean and coastal resources and ecosystems are in trouble;
3. The existing management regime is outdated and incompatible with our growing understanding about complex ecosystems.

Several "cross-cutting themes" emerged from the consideration of the problems defined by the USCOP:

1. The nation needs to move toward an ecosystem-based management approach;
2. More science and data are required to provide decision makers with better information;
3. There is a need for better education that teaches citizens about the oceans and instills a sense of stewardship;
4. There is a need for an improved ocean and coastal governance system.

Among the USCOP recommendations for enhancing information for decision makers and managers were:

1. Increase ocean research budgets;
2. Implement the national IOOS;
3. Expand ocean exploration.

The USCOP proposed a new Ocean Policy framework to coordinate from national through local levels, and improve the effectiveness of governance, through:

1. A National Ocean Council;
2. A Presidential Council of Advisors on Ocean Policy;
3. Regional Ocean Councils;
4. A coordinated offshore management regime;
5. A strengthened and streamlined federal agency structure.

Chapter 26 of the Preliminary Report ("Achieving a Sustained, Integrated Ocean Observing System) highlights the USCOP findings relating to IOOS. This information is seen as critical and it was stated that the development of IOOS is "overdue and should begin immediately." A number of specific recommendations are made in Chapter 26 concerning the organization, implementation and budgeting for the IOOS effort. The Ocean.US office would play a central role in much of the planning and implementation, including obtaining input from various user communities, defining the core variables for IOOS measurements, and working with the relevant agencies to set priorities for space-based ocean observations. Transitioning earth-observing satellite systems from NASA to an operational status in NOAA, while allowing ongoing remote sensing research, was among the USCOP recommendations, along with ensuring that long-term, climate quality data records are obtained through multiple satellite missions. The ultimate goal is seen as an integrated national (& international) Earth Observing System. Capacity building by the National Ocean Council is seen as critical to the IOOS and Earth Observing System efforts. The required funding levels were summarized.

Paul summarized the USCOP vision for the future if appropriate actions are taken:

1. The coasts will be attractive places to live, work, and play;
2. The oceans will be composed of healthy habitats that maintain a high level of biodiversity while supporting multiple beneficial uses;
3. Beach closings and toxic algal blooms will be rare occurrences and damage from severe weather and other natural hazards will be minimized;
4. Knowledge about ocean and coastal systems will be greatly enhanced and all management decisions will be based on excellent scientific and monitoring information;
5. U.S. students will once again join the top ranks in math and science achievement and will possess a stewardship ethic toward the ocean;
6. On the international level, the United States will lead by example, participate in formulating new policies, and aid other nations in improving their management practices by sharing resources, information, and expertise.

In conclusion, it was seen that the USCOP Report presents a unique opportunity to build a groundswell of public and political support for the ocean. However, this requires action now and a collective and sustained effort will be needed to gain political and financial support for change.

SECOORA (the prospective IOOS Regional Association for the Southeast)

Rick DeVoe (South Carolina Sea Grant Consortium, SECOORA P.I.) and Sandy Bernard (SECOORA Program Director)

Note: The Regional Association for the SE originally named "SERA-COOS or SERA" (the SE Regional Association) is now "SECOORA".

It was emphasized that the Southeast Coastal Ocean Observations Regional Association (SECOORA) is very much a work in progress. Central to the rationale behind the Regional Association (RA) concept is that these will identify and serve regional stakeholder priorities. One of the questions facing SECOORA is which (or which mix) of the seven "societal goals" areas defined for IOOS planning (see Mark Luther's presentation above) should be the initial focus for the SE. The national context for RA development was summarized. There will be nine RA's initially. Definition of the "certification" process for RA's, and the responsibilities of the certified RA's, is part of an underway process. The RA roles will include:

1. To oversee and manage the design and sustained operation of integrated observing systems that will provide information to meet the seven societal goals;
2. Ensure the coordinated development and operation of Regional Coastal Ocean Observing Systems (RCOOS);
3. Establish geographic boundaries;
4. Obtain and disperse funds required to operate and improve regional observing systems;
5. Ensure the timely delivery of quality controlled data and information in forms specified by user groups.

The RA's will be required to provide:

- proof of a governance structure that can deliver an integrated and sustained system by incorporating, enhancing and supplementing existing infrastructure and expertise in the region;
- an acceptable business plan that has been endorsed by stakeholders (data and product providers and users) from the region.

SECOORA was initiated in October, 2003 with funding from the NOAA Coastal Services Center (CSC) for organizing efforts. An initial informational website has been established (http://www.secoora.org). The initial phase will seek to broaden regional engagement among private, public and academic sectors, and form a provisional regional association. In Phase II, the SECOORA targets further integration of existing COOS elements and business and strategic planning. These activities will thus emphasize broadening the participation in the RCOOS and broadening the stakeholder/user base. It is planned to develop an "interim" operating structure and plans for longer term governance.

Sandy Bernard listed a wide range of “stakeholder categories” that have been defined. A survey of user needs among these categories has been initiated and is continuing. Additional priority areas for SECOORA activities include:

- Coordinating SE region recommendations for the National Backbone;
- Identification of regional observing priorities and issues;
- Further developing linkages to existing regional and sub-regional systems;
- Identifying funding requirements for the RCOOS efforts.

A key challenge for SECOORA is seen as “managing expectations” without assurance of additional funding at present.

Recent and planned SECOORA organizing activities were summarized. These include: a “pre-organizational workshop” (held 1-3 June, 2004 at Jekyll Island, GA); development of an “interim” governance structure; organization of a “regional summit” (targeted for late fall, 2004); and development of a business plan (a target for SECOORA Year 2, starting in October, 2004).

A number of ongoing issues were noted. One is “keeping up with the Feds”; that is, the pace of federal developments has picked up, and RA’s are being asked for regional input to the national efforts before the formal RA’s (governance and consensus processes) have been established. Extending the observing systems beyond the core physical variables is seen as key to engaging a wide stakeholder base. Managing expectations of diverse stakeholders and balancing their priorities is another challenge. Maintaining communications is a key issue. The IOOS/COOS area involves an “acronym soup” of programs. An electronic newsletter is planned to broadly disseminate information about the RA developments and a mailing list has been established on the SECOORA web site.

RCOOS/SEACOOS (the prospective Regional Coastal Ocean Observing System for the Southeast)

Introduction - Jim Sanders (Skidaway Institute of Oceanography, Chair SEACOOS Board Advisory Board)

Jim Sanders gave a brief history and background for the development of SEACOOS, which included the over-arching goal for the system and an explanation of its component parts and organizational structure. He then outlined goals for Year 3 and introduced the Chair of each Working Group.

The Chairs then provided brief summaries in three slides each listing members and their affiliations for each Working Group (Observing System, Modeling System and Products, Information Management, Outreach and Education), and briefly described recent progress and near-term plans. Power Point summary slides can be downloaded through the project web site (www.seacoos.org).

Observing System Working Group

Bob Weisberg (USF)

Observational Working Group

Charge: Develop and maintain a Coastal Ocean Observing System (COOS) for the SE coastal ocean, inclusive of the NC, SC, GA, and the entire state of FL, for coastal ocean-atmosphere state variable estimation with multidisciplinary and societal applications.

P.I.s, Nelson and Weisberg, Co-chairs

UNC	USC	SKIO	USF	UM
H. Seim	M. Fletcher	J. Nelson	R. Weisberg	N. Shay
	G. Voulgaris	R. Jahnke	M. Luther	W. Johns
	R. Skyles	C. Barans (SCDNR) P. Work (GIT)	F. Muller Karger	E. Kearns

SEACOOS Spring Workshop, May 2004

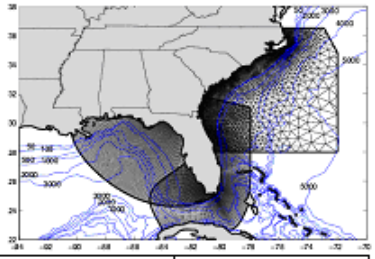
Modeling System and Products Working Group

Cisco Werner (UNC)

SEACOOS Observing Regional Ocean Conditions in the Southeastern United States

Modeling Workgroup

Charge: Develop, implement, and evaluate state-of-the-art numerical modeling systems for the SE coastal ocean for research and operational forecasting applications.



Members:

USF	UM	SkIO	UNC
Ruoying He	Inkweon Bang	Rick Jahnke	Alfredo Aretxabaleta
Mark Luther	Jerome Feichter		Brian Blanton
Bob Weisberg	Chris Mooers	CSC	Karen Edwards
Lianyuan Zheng		Dave Eslinger	Cisco Werner

SEACOOS Spring Workshop, May 2004

Information Management System Working Group

Madilyn Fletcher (USC)

SEACOOS Observing Regional Ocean Conditions in the Southeastern United States

Information Management Workgroup

Charge: Develop the software and hardware infrastructure to enable the organization, access, distribution, dissemination, visualization, and archival of SEACOOS data streams and associated information for a broad range of users and SEACOOS products.

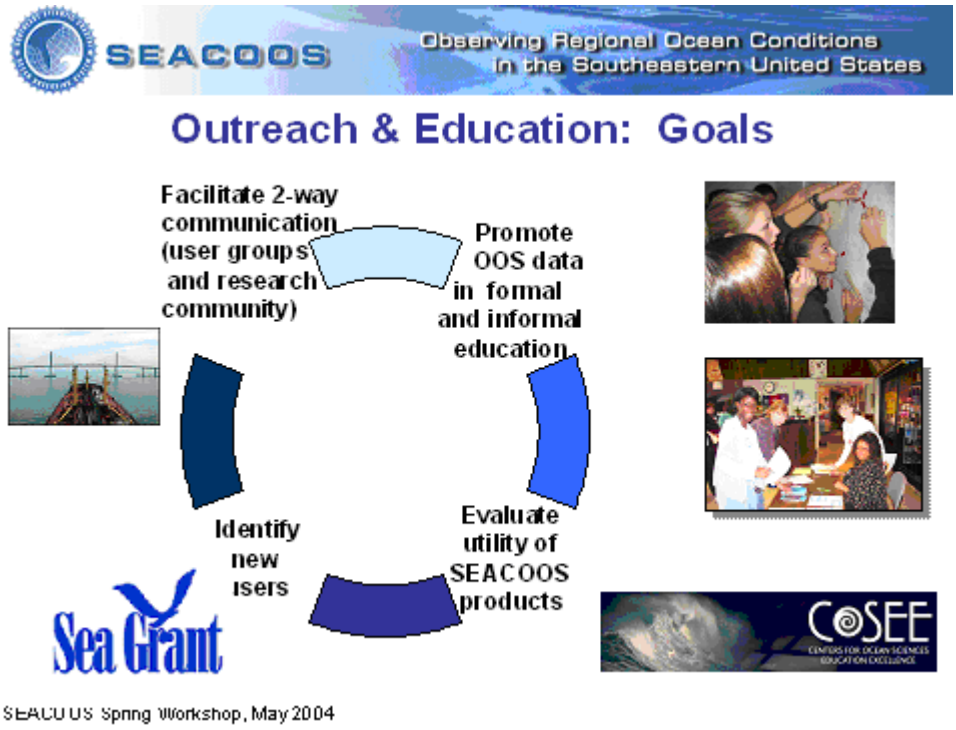
Members:

USC	UMiami	SkIO	UNC-CH
Madilyn Fletcher (Chair)	Ed Kearns	Jim Nelson	Harvey Seim
Dwayne Porter	Nick Shay	**USF**	
		Mark Luther	

SEACOOS Spring Workshop, May 2004

Outreach and Education Working Group

Jack Thigpen (NC Sea Grant)



SOME RELEVANT SOUTH FLORIDA PROGRAMS

Florida Current Cable & Calibration Surveys

Chris Meinen (U. Miami, CIMAS)

Chris Meinen summarized the past and present status of the Florida Current cable system that provides time series estimates of volume transport in the Florida Straits. Presently the cable used is between West Palm Beach and Grand Bahamas Island. The transport estimates are calibrated through eight dropsonde/XBT survey cruises per year (small ship cruises) and six CTD/oxygen/velocity sections per year (*R/V Walton Smith* and *R/V Ron Brown*). The voltage induced by the flowing water over the cable is measured at one minute intervals. The time series of cable measurements was made from 1982-1998. After a hiatus the measurements were resumed in 2000. Some technical issues have compromised the data since 2000, but since October 2003 the data quality is considered to be good. It is anticipated that near real time transport data will be served to the web soon.

Coastal Volunteer Observing Ships (e.g., Explorer of the Seas & SeaKeepers International)

Ed Kearns and Rod Zika (U. Miami)

Ed Kearns noted that there are a number of international Volunteer Observing Ship (VOS) programs. These include the "Ferrybox" program in Europe, and other global programs that include some 900-1000 vessels. An AOML program includes some 80+ ships. Applications for coastal regions could include regular measurements of surface salinity through a combination of VOS's and gliders.

The University of Miami has partnered with the Royal Caribbean Line to extensively instrument "The Explorer of the Seas" cruise ship. Liz Williams (U. Miami) maintains the Explorer program web site (http://www.rsmas.miami.edu/rccl/). The Explorer presently alternates between West and East Caribbean cruise tracks every other week. RSMAS is also a partner with the International Seakeepers, a non-profit program that has instrumented large yachts and other platforms with meteorological and oceanographic sensors (http://www.seakeepers.org/). Seakeepers has an agreement with NOAA to provide distribution of the data.

Issues for a coordinated coastal VOS program as part of IOOS include sensor calibration, data transmission and maintaining QA/QC standards. There are a number of potential ships, but which might be most valuable needs to be assessed. A "requirements list" for VOS systems would include that the systems are upgradable/adaptable. A model autonomous system, with various new sensor types being developed with industry partners, has been designed in Rod Zika's laboratory.

CSTARS

Hans Graber (U. Miami)

The Center for Southeastern Tropical Advanced Remote Sensing (CSTARS) is a satellite receiving and analysis facility sited at a former U.S. Naval Observatory time tracking station (http://www.rsmas.miami.edu/groups/cstars/about.html). The system operates in near real-time on a 24:7 basis to provide time-sensitive environmental information from satellites (including information on tropical storms, volcanic eruptions and other natural hazards, and for homeland security applications). Coverage is from the Mid-Atlantic Bight through the Caribbean and Gulf of Mexico. A high speed internet system provides 2 Gbit capabilities, with 10 Gbit planned. Power backup systems can provide up to 10 days operation, and key sub-systems have redundant back-ups. CSTARS is operated as a University Consortium.

A number of application areas were summarized, including interferometric SAR for high resolution topographic monitoring (e.g., changes due to ground water withdrawal, volcanic activity), wetlands water level monitoring (e.g., Everglades), severe weather (e.g., hurricanes, sea state and extreme wave development), high resolution coastal winds, flood potential studies, and coral reef monitoring. Current and future CSTARS

satellite reception capabilities were summarized. CSTARS provides full archiving capabilities, rapid turn-around, and a variety of "value-added" post-processing products (e.g., change and feature detection).

NOAA South Florida Program

Peter Ortner and Libby Johns (NOAA, AOML)

The South Florida restoration project is the largest ecosystem restoration program that has been attempted, with some $8 B in funding. The focus of the South Florida Program coastal oceanographic observations (http://www.aoml.noaa.gov/sfp/) is to document fresh water inputs (volumes and sources) to the southern West Florida Shelf, Florida Bay and Florida Keys regions. Observations are obtained with a combination of fixed time-series sites (buoys and pilings), bimonthly survey cruises (*R/V Walton Smith*), and satellite-tracked surface drifters. Drifters are deployed during the survey cruises and during "events" such as HABs or freshwater releases (water management "draw-downs"). (*Note: Libby Johns described the drifter program in more detail as part of the Tuesday afternoon "Lagrangian Strategy" break-out session*).

A smaller vessel survey (*R/V Virgina Key*) of Florida Bay also makes light attenuation measurements for development of light attenuation models for the Bay (sea grass habitat assessment). Similar surveys are also conducted in Biscayne Bay. Real-time pressure gauges at and offshore of passes in the Keys are being used to monitor flow through the passes that may potentially impact the Florida Keys NMS. Other observing stations are being upgraded in the Keys and passes, and with NURP additions are being made to the Aquarius (undersea laboratory) buoy instruments (including an ADCP). A "rapid response" event sampling program is planned that will be based on the expanded real-time network. In the modeling area, a nested version of HYCOM (1/25 degree resolution) is being developed for the Florida Bay/Florida Keys region.

West Florida Shelf ECOHAB

Bob Weisberg and John Walsh (USF)

Bob Weisberg described collaborative work between physical and biological oceanographers on the West Florida Shelf that has focused on the mechanisms of initiation and maintenance of blooms of the HAB species, *Karenia brevis*. Through a combination of physical and biological models with satellite and *in situ* observations, the roles of physical forcing from local processes (winds, surface heat flux, river discharge) and deep ocean processes (Loop Current/shelf break) has been investigated.

The combined effects of local and Loop Current forcing was shown to bring nutrient-rich water onto the shelf and transport it toward the coast in the bottom Ekman layer. This is consistent with observations of near-bottom blooms. The retention and growth of slow-growing, motile *K. brevis* versus faster growing, sinking diatoms and neutrally buoyant flagellates was compared. Retention of the motile *K. brevis* inside salinity fronts is indicated as one mechanism of concentration. An area of recent investigation has been the role of colored dissolved organic matter (CDOM) both as a source of nitrogen (via photolysis) and as a "sun-screen" (UV absorbing filter in the water). Photolysis of CDOM

does not appear to yield sufficient “new” N to fuel the blooms (~10-15% of total), thus N-fixation by *Trichodesmium* or other species appears to be a significant source of new N for the WFS.

Florida Current Billfish/Oceanographic Survey

Bob Cowen (U. Miami)

Bob Cowen summarized results of ship surveys for billfish larvae and juveniles in the Florida Current. The surveys (multiple cross-current lines) cover the entire Straits of Florida region, and include physical measurements (CTD, ADCP, fluorescence, downwelling irradiance) along with biological measurements (MOCNESS net tows, neuston, water samples for microzooplankton and chlorophyll). The program focuses on the source of larvae, their transport in the Florida Current system and spatial/temporal patterns of trophic structure in the Florida Current. Survey information was collected at monthly intervals.

Cross-Strait distributions of the billfish larvae generally show various peaks, with sailfish larvae more common along the Florida side of the Florida Current and white and blue marlin larvae found along the mid-to-Bahama side. More detailed analyses of billfish larvae distributions relative to the cross-current hydrographic structure indicates likely differences in the sources (spawning areas) for larvae of the billfish species and other fish families. Several likely spawning areas in the Florida Current system have been proposed to be significant for different billfish species and could be important areas for management of these large pelagic species.

MONDAY PM BREAKOUT GROUPS

BREAKOUT GROUP 1 -- STRATEGY FOR A FISHERIES OCEANOGRAPHY INTERFACE

Chairs: Madilyn Fletcher and Cisco Werner
Rapporteur: Braxton Davis

Background: SEACOOS information products on coastal ocean circulation have potential for application in a number of fisheries management areas, including assessments of the transport of larval fish, prediction of synoptic conditions in physical habitats, and tracking HAB development and transport. Focused, real-time observations and high-resolution models in the vicinity of established and proposed Marine Protected Areas (MPAs) could enhance the present generation of information products and consequent assessment and management tools.

Charge: Design a suite of progressive collaborations between regional fisheries scientists and managers and SEACOOS investigators with a possible focus on specific MPAs as well as present National Marine Sanctuaries and Estuarine Research Reserves.

Summary

Linking SEACOOS with Regional Fisheries Oceanography
An overarching concept emerged from the session discussion:

> Information on physical conditions provides the organizing framework for developing a SEACOOS interface to Fisheries Oceanography. The physical conditions include circulation, topography, three-dimensional temperature and salinity, and surface currents from HF radar.

Research Requirements
To address the regional Fisheries issues, major science information needs were identified:

- Information on spawning
  - Where does it occur?
  - Is there spatial and/or temporal partitioning of species/groups within the spawning grounds?
  - What are water column conditions at these sites through the spawning period?
  - What are the habitat conditions that influence spawning "success"?

- Information on dispersal
  - How is transport/connectivity affected by physical conditions?
  - How is survival during transport affected by physical conditions?
  - What are the interactions with other populations during dispersal?
  - How is it affected by specific physical features (e.g., transport through inlets)?

- Although priority was placed on spawning and dispersal, it was also recognized that information on adult populations is also important.
  - What is the habitat that supports reproductively successful adult populations?

How can we make the science questions tractable?
Given the constraints of available resources, there are practical limitations to the scope of fisheries research that can be addressed in SEACOOS. How can the key fisheries research areas be addressed?

- Simplify the problem by focusing on specific fish or fish complexes.
- Get a handle on variability – long term observations are essential.
- Understand the relevant spatial and temporal scales of the physics, the biology, and their coupling for the questions addressed.
- Advance the technologies.

Role for SEACOOS – Where do we go from here?
What can be done by SEACOOS now and in the near future to build the interface to regional Fisheries Oceanography and help address the key fisheries research and management issues. What are the "low hanging fruit"? A number of suggestions were provided:

- Provide routine data streams that are interpretable by the fisheries biologists (and are in a form that can be utilized, e.g. manipulated in statistical analyses).
- Test and validate the predictability of specific events that have demonstrated biological impacts; e.g. cold water events. Such physically based forecasts are useful for management decisions.
- Locate new observing system assets in biologically significant areas.
- Establish and maintain interactive relationships and build communication between disparate disciplinary groups and sectors within the SE.
- Identify optimum study sites. For example, the Florida Keys National Marine Sanctuary may be a good candidate for a study site. It is complex oceanographically, is situated at the intersection of multiple "regions", and there is abundant biological data. Also, the FKNMS lies in the transition zone between the 5 and 25 meter isobaths, where saltwater meets freshwater. Although very significant for most coastal species, the coupling between physics and biology in this zone is not well characterized.
- Address interactions between the estuaries and the shelf.
- Establish a product-based outreach/educational program for the fisheries community. <u>This can be done NOW</u>. Provide customized products and information.
- Include physical conditions in the historical data that are considered and utilized by the fisheries managers. Insights into stock assessment may be gained, which can assist in management decisions.
- Perform hindcast analyses – identify factors that should be assessed now.
- Determine the significance of the bottom boundary layer.

BREAKOUT GROUP 2 -- STRATEGY FOR SURFACE WAVES AND MESOSCALE METEOROLOGICAL OBSERVATIONS AND MODELING

Chairs: Chris Mooers and Mark Luther
Rapporteur: Jim Nelson

Background: SEACOOS aims to increase its activity on the inner shelf and contribute to societal topics; e.g., beach erosion and rip tides, through developing a surface wave observing system and modeling activity that fits well with other SEACOOS and non-SEACOOS activities (e.g., those of the NWS, USACE and USGS). In addition to its intrinsic value to marine weather forecasting of the Southeast, a mesoscale meteorological observation and modeling activity is needed for both SEACOOS coastal ocean circulation and surface wave modeling.

Charge: Design a joint approach to facilitate acquisition, evaluation, and integration of synoptic, operational surface wave and surface atmospheric forcing information throughout the SEACOOS domain using a judicious mix of *in situ* and remote sensing observations and numerical surface wave and mesoscale meteorological models, based on both operational and research systems.

Summary

The present status of directional wave observations in the SE.
Directional wave observations are sorely lacking in SE US coastal ocean.

- NDBC receives many requests for wave information, but is faced with issues of formalized requirements, specified zones, etc., that go into decisions of where to locate their observational assets.
- The NWS Science Operations Officers (SOOs) find themselves tasked with making wave forecasts, but with no real verification.
- From the USACE perspective, Bob Jensen would like to see directional wave information at ½ degree resolution along shelf break. The USACE is adding directional wave capabilities to NDBC discus buoys, but budget levels for this remain uncertain.

Present Status of operational wave models – implementation and validation.
The presently available wave forecasting models are NCEP WaveWatch III, WAM and SWAN. Will NCEP adopt SWAN? For the near future, Erick Rogers does not see this as occurring at NCEP, but rather as being distributed among the WFOs. Some data exists for validation of modeling systems, but this is presently too sparse for careful validation of wave transformation across the continental shelf and into the nearshore (< 8 m depth). Assistance from groups such as SEACOOS is needed in this area.

Research requirements
What are the needs for observing system elements, models, and experiments? Can SEACOOS develop operational wave models? What will this require? Requirements include:

- Near-shore as well as offshore data.

- Information on the time evolution of bed forms (frictional coefficients may be quite large).
- The influence of tidal inlets must be considered in some parts of the SEACOOS domain, particularly along the Georgia and South Carolina coasts.
- Consideration of wave-current interactions. On the circulation side, these include the impact of waves on bottom stress in shallow water, and of waves on wind stress/air-sea exchange effects.
- Detailed observations, notably winds, in the test-bed areas. These will be needed to couple wave models to circulation models; that is, the correct surface wind field is essential for obtaining the correct coastal ocean currents.
- Coordinated analysis/evaluation of wave products from various measurement systems (e.g., buoys, ADCPs, pressure sensor arrays, HF radar, X-band radar, SAR imagery). Emerging technologies must be thoroughly evaluated before being adopted for operational applications.

A role for SEACOOS?

Wave model verification is seen as being needed for a number of locations representing the types of coastlines found in the SE region. Development of wave modeling systems linked to circulation models may be supported by SEACOOS, and it is anticipated that other wave modeling systems (funded through other programs) will begin to appear at the WFOs. SEACOOS could provide some of the data needed for model validation.

- In terms of a possible SEACOOS role in surface wave measurements, it is explicit in IOOS plans that RA's can operate aspects of "the National Backbone", provided these are proven to be sustainable, and consistent with the national operating standards.
- Test-bed approach. There are already the makings of 3-to-4 test-beds in SEACOOS domain (W FL, SE FL, GA/SC, NC) that represent the varied coast lines of the SE region (e.g., broad and narrow shelves; tidal ranges of <1 m to 2-to-3 m; multiple inlet barrier inland systems versus long barrier islands or long coastal beaches).
- Evaluation of surface wave models for a given region could be undertaken as a series of "short" period experiments (e.g., ~ 12 months) with a high density of observations (possibly with a mix of real time and non-real time observations).
- Evaluation of directional wave information from WERA HF radar could be an important contribution from SEACOOS.
- Many of the individual WFO's are running mesoscale meteorological models ("straddling" the hydrostatic/non-hydrostatic boundary), motivated by the need to include local effects in the forecasting models (including island effects in the Florida Keys; and the influence of the sea breeze/land breeze effects throughout the SE coastal region). There are a number of potential applications of the higher resolution models for wave forecasts in the SEACOOS "test-bed" regions and opportunities for SEACOOS interaction with the WFO's.

PLENARY, TUESDAY AM

STATUS REPORTS FOR SELECTED SEACOOS AND IOOS ACTIVITIES

Role and Status of Satellite Remote Sensing in SEACOOS

The SEACOOS Remote Sensing subcommittee includes:
Ed Kearns, Frank Muller-Karger, Chuanmin Hu, Bob Helber, Charlton Purvis, Bob Weisberg, Jim Nelson, Joaquin Trinnanes, Dwayne Porter, and Judd Taylor.

Other contributors include Andrew Bingham from the Jet Propulsion Laboratory, Physical Oceanography Department, Distributed Active Archive Center (JPL PO DAAC).

Ed posed the fundamental questions: Why include Remote Sensing in SEACOOS? Is this useful for the SEACOOS community? Does SEACOOS need to support this? Can RS information be merged with *in situ* observations and modeling information products?

One argument for including an RS program within SEACOOS is that the regional approach provides the opportunity to tailor end products for specific users of the information. Also, near real-time capabilities are being emphasized, which requires direct download to the regional system in some cases. It was emphasized that this effort is not intended to deliver value-added products (as are provided by several private companies), but to address how users want the data.

Approach:
It was emphasized that this effort is seen as an "experiment" at this point; exploring how near real time remote sensing can be implemented for a regional program. The basic infrastructure required for acquisition of Remote Sensing information is costly (satellites, sensor development, ground stations, processing capabilities), far more than the regional program can support alone. Thus, there is a need to leverage existing infrastructure. This has been the approach used for SEACOOS Remote Sensing experiment; utilizing the existing ground-station, processing and personnel expertise at USF and U. Miami, and data merging/web portal systems developed at USC.

Goals of the SEACOOS Remote Sensing "Experiment" have been to:
-- merge data from various satellite sources;
-- merge satellite data with 2-D *in situ* observations.

Charlton Purvis demonstrated the SEACOOS Remote Sensing web site (a developmental site). A central part of the experiment has been establishing a "data model": how to acquire and process the satellite imagery in near-real time; aggregation of data from various sources; refining the interface. There are a number of challenges for the aggregation objective. Issues faced in developing this include those associated with pulling together data that differs in times of acquisition and delivery. The overpass for polar orbiting satellites is ~5 minutes for the SEACOOS domain, and acquiring the higher resolution imagery (1 km) requires local download; i.e., a receiving station. Different satellites have different orbits and different coverage (e.g., swath widths, swath positions), so what is acquired and when varies. And, the data are inherently patchy (see OI product, below).

Presently, SST data are passed on to Charlton Purvis at USC 20 min after the data from the satellite at USF. For SST, the best combination of resolution, and minimum rms error is for MODIS SST at this point. The SST time series from the USF archive will eventually extend back to 1993. The present portal is set up for the last 2 weeks.

Objective Interpolation (OI) product for SST

Infrared and visible imagery is inherently discontinuous due to varying cloud cover. As a means of "filling the gaps", Bob Helber and Bob Weisberg (USF) have provided an OI product to produce a continuous, smoothed field for SST imagery. This uses 4 different SST products with a time integration of about 7 days for a weighted average value for a given location. A sequence of daily SST OI ("cloud free") imagery over a week was shown for the SE region.

Comparisons with *in situ* SST

The web portal for *in situ* SST was developed as a result of the "Interoperability Project" over the past year. This provides tabular display of *in situ* data (e.g., buoys) and satellite pixel values (note the buoy sensor is below surface as opposed to the "skin" temperature measured by the satellite). Bob Weisberg noted that the prior OI product-buoy comparison showed 0.5°C rms. However, this was done on a relatively small spatial scale. He sees the need for such a comparison over a broader scale within the SEACOOS domain.

Other satellites

As a proof of concept, gridded maps, netCDF formatted data are being supplied to SEACOOS by the JPL PO DAAC (http://podaac-www.jpl.nasa.gov/). An example was shown for the QuikScat wind product, in this case received by Charlton at USC from JPL within ~2 h of the satellite pass.

Next steps planned for SEACOOS Remote Sensing

The next steps for the RS subgroup will be to include capabilities for additional RS products, and their evaluation. These include:

-- ocean color (chlorophyll; turbidity/attenuation products; "true color" products);
-- other SST products (e.g., GOES);
-- SAR (synthetic aperture radar).

Making the data accessible for modeling applications is a core objective. The point of the SEACOOS RS "experiment" is the "interoperability": how the RS data can be used within SEACOOS. It is also planned to develop archives for the regional RS products.

Some Conclusions based on the SEACOOS Remote Sensing efforts to date

- SEACOOS cannot rely solely on national sources for RS data.
- There is a need to downlink the RS information at the Regional Association level; this is the only way to get the data in a timely (near real-time) fashion at the regional level.
- There is a need for redundancy in capabilities for acquisition, processing, and dissemination of near real-time RS information within the region. For example, a shut down of the USF due to lightning had been experienced. Redundant systems

would also help ensure continuous operations as tropical systems are approaching and transiting the region (i.e., during critical time-frames for the information).

- TIME and SPACE conventions are critical.
  It is essential to have consistent time stamps between RS and *in situ* data. Similarly, a consistent system for spatial identity is required for interoperability with *in situ* and modeled fields and for the OI evaluation.

Questions/Comments/Discussion:
Q: Are the remote sensing data readily available?
A: Depends on the satellite. Some require licenses; in some cases the data are only available on a pay-per-image basis.

Q: Tom Leming (NOAA/NMFS) – Are SST data being acquired from NOAA AOML CoastWatch?
A: Ed Kearns -- The data go through the NOAA system first. The problem of timely data acquisition is greater for some of the NASA data sources. How to integrate with the efforts of NOAA CoastWatch in terms of data sharing and product development will need to be considered further.

Q: Will there be compositing for the satellite imagery as well? User selected composites?
A: USF produces some on the fly already.

Lundie Spence (SE COSEE) noted that there is a regional HBSC that is developing RS infrastructure. This might be another opportunity for partnering and providing redundancy in regional capabilities.

Cisco Werner (UNC) reported that the transition to new SEACOOS web site is scheduled for Friday 24 May, 2004 (www.seacoos.org).

SEACOOS Information Management

Discussion Moderators**:** Madilyn Fletcher (USC), Dwayne Porter (USC), and Ed Kearns (UM)

Several key issues were identified by Madilyn Fletcher in introducing the Information Management session.

- **Data Aggregation** – There has been a good deal of work involved in "creating" new products as a result of aggregation efforts by the SEACOOS Data Management Coordinating Committee (DMCC). The national "Interoperability" exercise, in which SEACOOS personnel played a large role, is an example of such aggregated products.

- **Data Standards** – This includes consistency in formats, data "libraries", QA/QC procedures, flagging schemes, metadata and has been an area emphasized in IOOS planning documents.

- **Data Liability** – Liability is commonly noted as a concern among national, regional and sub-regional data providers.

- **Integration of Coastal Ocean with near-shore, estuarine data sources** – The basis for integrating COOS data and information products with those being generated in near-shore and estuarine programs must be developed. The latter necessarily include many non-real time data sets (e.g., much of the biological and chemical data).

Data Aggregation and data identity.
Dwayne Porter (USC) summarized a number of issues that have come up in SEACOOS discussions and meetings and in those concerning IOOS. One is the question of "data identity." For regional and sub-regional efforts, there are techniques for pushing data to a particular location. This can be done, but there can be the issue of a perceived "loss of identity" for individual projects; loss of attribution of support from particular funding sources. An example in the SEACOOS region is Caro-COOPS, which receives support through NOAA COTS. Some independent documentation may be seen as being needed. Similarly, this may also be the case for data obtained from federal or other sources.

Comments:

Russ Lea (UNC) – At present, SEACOOS has a role as a proto-regional association. At a point there will the transition to the RCOOS. This is an open process. At the initial SEACOOS "kick-off" meeting, the advice given concerning credit for the data and analyses was: get your piece published promptly to ensure that you get the credit.

Chris Mooers (UM) – There is also a "forensic" aspect here, being able to trace the origin of the data.

Ed Kearns (UM) – In the old style GTS (Global Telecommunications System), SeaKeeper data were being repackaged, but with a loss of metadata. Aggregation is easier to do these days, but can be performed without adequate documentation.

Madilyn Fletcher (USC) -- Aggregation can be seen as a "value-added" activity (i.e., as a product).

Bill Johns (UM) – There are "comfortable data", data that most people are comfortable with reporting in near-RT (e.g., temperature), while other data are typically considered to be more "research quality" (e.g., can often be the case for biological, chemical data). Bill sees the need for a different "envelope" (delivery system) for data that might be of less validated quality. He noted that the value of the observing system comes from sharing the data, but that some level of protection for researchers may be needed.

John Van Veer (U. Miami) – Some sort of attribution stamp for quality control and credit could be provided.

Dwayne Porter – This is being done already, but do we need this "controlled" in some way?

Bob Weisberg (USF) – Mentioned the issue of individual project-dependent funding versus sustained funding. Sustained funding will help motivate more open sharing of data.

Mark Luther (USF) – For the remote sensing community, various data levels are defined. A similar system may be needed for COOS data (e.g., near-real time raw; levels of QA/QC, etc.).

Ed Kearns (UM) – A QA/QC flagging scheme was one of the issues discussed at the December QARTOD workshop (Quality Assurance of Real Time Ocean Data, http://www.rsmas.miami.edu/~edk/qartod/). Schemes, flagging, tests are being evaluated in SEACOOS. Ed feels SEACOOS is not too far from having a common flagging scheme. "Data library" conventions are being developed. *Jeremy Cothran (USC)* said a "programmatic approach" to this is being pursued for SEACOOS.

Q: How much time will be needed to further establish this "culture"? *A:* Ed thought about 6 months.

Dwayne Porter (USC) – We need the knowledge of the data, as well as the DM procedures.

Judy Gray (NOAA) – Noted liability concerns in areas like Carbon-related data for climate models (that is, data that could form the basis for policy decisions). This results in some of these data sets being of more limited availability.

Dwayne Porter (USC) – The NERR program has experience with constructing a "data liability" statement.

Russ Lea (UNC, Office of the President) – No amount of disclaimers will keep good science from being misinterpreted and vice versa. It is important to do the best job you can and find out what needs to be improved, etc.

Dwayne Porter (USC) – Raised the issue of "research data" versus "operational data", with the example of the NWS as providing/using operational data. In part sees this as a matter of perception of the outside world.

Madilyn Fletcher (USC) – There is also the question of what becomes operational and the role of academic institutions in running operational systems.

Comment: In the Ocean Commission report the issue of liability is raised. A standardized liability statement is proposed.

Q: What is the extent of alignment with NCDDC (NOAA National Coastal Data Development Center)?
A: NCDDC has been involved in discussions with SEACOOS IM and NCDDC representatives are at the workshop.

Q: Archives? Who will do it? Will it be done by individual institutions or at the RA level?
A: Madilyn Fletcher (USC) -- This is also an area of focus for the SURA/SCOOP initiative (see, www.sura.org/coastal/man.html).

Jeremy Cothran (USC) – The present focus within SEACOOS DMCC is on real time data exchange and common data formats. He feels that these efforts are building the basis for a data archive, but that right now addressing the archiving task is a matter of personnel and resource allocation (i.e., it hasn't been the near-term objective).

Madilyn Fletcher (USC) -- Requested further input / comments from the work shop participants.

Suzanne Van Cooten (NDBC): Noted that SEACOOS observing sites have made efforts to work with NDBC personnel to get data formatted and delivered to NDBC and into their archive system.

Chris Mooers (UM) – There will be the chance to pursue various archiving issues as the aggregation system is being developed.

National Backbone Issues

Federal Affiliates Working Group Panel Discussion

Panel Moderator: Chris Mooers (UM, SEACOOS)
Panelists: Mike Szabados (NOAA, NOS, CO-OPS), Jeff Payne (NOAA, NOS, CSC), Suzanne Van Cooten (NOAA, NWS, NDBC), Sandy Bernard (SECOORA, SEACOOS)

Chris Mooers introduced the panel and opened the panel discussion ("looking for spontaneous combustion").

NOS, Mike Szabados

Mike Szabados (NOS) reviewed the status of several programs in NOS related to COOS/IOOS activities. The Center for Operational Oceanographic Products and Services (CO-OPS) at NOS includes the National Water Level Observation Network (NWLON), the Physical Oceanographic Real-Time System (PORTS), and programs associated with currents and coastal modeling. NOS was originally established for navigational safety, but now also includes roles in coastal flooding and spill tracking.

The NWLON network (http://www.co-ops.nos.noaa.gov/data_res.html) has 175 stations in the U.S., and includes 16 stations in the SEACOOS region. For the desired applications, NOS seeks to double this number. NOS is working with Caro-COOPS for 3 more sites in the Carolinas, also with the NWS for a site at Wrightsville Beach, and others in Florida. The "network" consists of data collection, processing and delivery to users (e.g., coastal managers).

The PORTS (http://www.co-ops.nos.noaa.gov/d_ports.html) provides ship captains and harbor pilots real time information for harbors with the goal of preventing collisions and

groundings. The goals is to expand the PORTS program to 150 sites (top priorities by shipping tonnage) with the objective being to provide real time data. In the SEACOOS region this would include Tampa Bay, St Johns River, Savannah and Charleston. Presently, the only PORTS in SEACOOS domain is in Tampa Bay (http://ompl.marine.usf.edu/PORTS/index.html).

The NWLON has funds to upgrade to real time communications (FY05), with some issues bringing in the new technologies. So the distinction between NWLON and PORTS is blurring. Mike sees a major issue not in the distinction, but in the overall data management for the system. He thinks that data management needs to be addressed as a community, and is needed for the "National Backbone." And there are lessons to be learned from NOS that will apply to the development of the IOOS "National Backbone. Mike stated that the NWLON wants to work with others to establish additional coastal water level stations. The NOS contact for such cooperative projects is Portia Weeks.

Comments/questions:

Q: Mark Luther (USF) – Some ports have established their own component systems (e.g., Port Everglades by the Navy). Are there plans to incorporate or ingest this to NOS?
A: Mike – There is interest, but there are issues with how to manage the data ingest, QA and products.

Q: Bob Weisberg (USF) – How will the partnership evolve, i.e., between the "National Backbone" and the Regional Associations?
A: Mike – Sees a large effort in Data Management and data centers, with procedure documentation being critical. The national program will need to review the standards, document these, and publish them, so people can meet the standards requirements (for example, NOS does not have a clear definition of WL standards for a network in the Columbia River).

Jeff Payne (CSC) – Noted that the Regional Associations are envisioned as a conduit for getting information into the national system; but that there has been the experience that some federal groups don't necessarily "reach out" too well. It is hoped that the RAs can provide a more effective interface.

Mark Luther (USF) – Suggested as a first step, getting more WL information into the NWLON.

NDBC, Suzanne van Cooten

Suzanne stated that NDBC sees additional real time data with quality control as priorities, but that this needs to be sustainable if the NWS and NDBC are to use it. Ingest into the NDBC data stream is an important consideration. In this regard, NDBC is looking for a central focal point to document what observing assets are deployed, what is being reported from these sites, and plans for additional deployments. She emphasized that NDBC needs the points of contact for this information and asked if there are SEACOOS plans in this area (as opposed to contacts among individual components in SEACOOS).

Summarizing other IOOS-related developments for NDBC "NOAA partners" there is an emphasis in NDBC on QA/QC and OpenDAP issues. Suzanne sees the need for a lot of cross-exchange. She encouraged input to Ocean.US for the regional perspective.

Comments/questions:

Q: Is NDBC pushing for more information "below the surface" (i.e., subsurface S, T, etc.)?
A: NDBC is involved in the SEACOOS region in a project to obtain surface and sub-surface salinity. A pumped system is being tried with a 6-month target for servicing intervals. There are communications, power and bandwidth issues for the existing buoys. Iridium is being tested in the NW, and there is an SBIR announcement out for lower power sensors/smart sensors.

Q: Bob Weisberg (USF) – Is NDBC open to suggestions on how to operate? For example, there is a question of whether Iridium will become too expensive for the Regional Associations. Could making communication links available be a part of the NDBC program? Also, is NDBC open to input on the distribution of buoys? What determined the present configuration?

A: Suzanne – In the NWS, the primary mission is to protect people and property. This emphasis determines in part where buoys are located. Partnerships are also a factor that can determine buoy locations. She noted there is also sensitivity (i.e., resistance) to moving existing buoys where time series records have been established.

Q: Trent Moore (SkIO): Is there a central contact person for NDBC for the non-federal observing programs?
A: Suzanne – She will be the primary contact for the Gulf of Mexico to the Carolinas.

NOAA Coastal Services Center, Jeff Payne

The Coastal Services Center is working with various Regional Associations in getting these established. The CSC is also working with the users in assessing applications, what is wanted and how to provide these.

The RA development support by the CSC is being done in coordination with Ocean.us. Jeff noted that increased management needs have come as a result of congressionally directed funding. In FY04 there are 14 earmarks associated with regional systems. This shows the regional interest, but is not seen as a sustainable model. There is a need to determine the optimal configuration for the regional systems.

Jeff raised a concern about resources and personnel, noting that there is a lot of work to be done in "moving the process", but there are difficulties in interacting with the relevant groups and achieving the benefits of a collective process. He sees that "time and will" will be required to make the RA development a collegial enterprise, and importantly, a need to keep the accelerating process manageable.

A Congressional Report is due 30 June, 2004, with information requirements for what has happened to date and what is coming out of this process. Questions that need to be addressed include: What is optimal configuration of Regional systems? And by what criteria? What are the benefits to federal mission-oriented agencies? Also in the present FY04 Omnibus language (prelude) is the request for estimates of matching funds (what is the contribution from the RA s at this point), in addition to what is provided by federal sources.

For the purposes of the CSC role in the RA development process, Jeff would like to see a clear articulation of the value of the RA s, their status (e.g., how is money being spent?), and their goals. He emphasized that these goals should be "keeping the eye on the prize"; that is, justified in terms of regionally and locally important issues.

Primary CSC contacts for the RA development issues are: Geno Olmi, Dave Eslinger, Jim Boyd

Comments:

Mark Luther (USF) — The matching requirement would be a killer for IOOS, and is generally recognized as such. Apparently the match language was inserted by someone who has now departed.

SECOORA & SEACOOS, Sandy Bernard

Sandy summarized the Ocean.US request for RA priorities from SECOORA. The session time was running short, so Sandy's comments were limited. Information is needed on regional priorities for the RA for Ocean.US. Sandy sees this exercise as one step in developing a structure for a two-way information flow. She will be updating information on the SECOORA web site.

Coastal Managers Issues

Panel: Jack Thigpen (NCSU, NC Sea Grant), Debra Hernandez (SC DHEC), Jeffrey Beal (FDEP)

Overview. Jack Thigpen introduced the session, with the observation that coastal managers are a key user group, and that a range of end users of SEACOOS information will interact with coastal managers. Therefore SEACOOS should make sure the coastal managers are well informed about SEACOOS activities and understand ocean observing systems in general. Presentations were made by Debra Hernandez (South Carolina Department of Health and Environmental Control, and current Chair of the Coastal States Organization) and Jeff Beal (Florida Department of Environmental Protection), followed by a comment/discussion period.

CSO Survey Results, Debra Hernandez (SC DHEC, CSO)

The Coastal States Organization (CSO), delegated by the Governors of 35 coastal states, territories and commonwealths, acts as an advocate for improved management of the nation's coasts, oceans, and Great Lakes (http://www.sso.org/cso/). The CSO maintains a small office in Washington.

Debra feels that much of the coastal management community needs a "translator" to understand SEACOOS and its potential applications to coastal management issues, and that there is a need to connect the science community with user communities. As a "Chair's Initiative", the CSO has conducted a survey of coastal manager science needs over the last 6 months. The survey was funded by NC Sea Grant, CICEET and NOAA. CSO contractors for the survey were the Urban Harbor Institute and the University of New Hampshire Survey Center. A handout in the workshop package summarized the Project Team, organizations surveyed, and survey results.

Of the survey responses, 46% were from CSO members. However, the input to the responses varied between states. Some were the responses of one manager. Others were collective responses from organizations, or with input from technical staffs. For example, SC had multiple individuals answer the survey to determine science needs. For multiple responses from a single organization, the survey team had to make decisions concerning weighting of responses for prioritizing coastal management science needs. The handout summarized survey results for: 1) respondent organizations; 2) importance of issues to programs over next five years (e.g., coastal hazards, non-indigenous species); 3) management priorities by region; 4) management priorities by association; 5) research needs in the SE; 6) Observation and monitoring needs nationally; 7) observation and monitoring needs in the SE; 7) additional needs in the SE by management topic.

The survey results showed consistency across regions and across affiliations in terms of the management priorities. Issues related to land use and its ecosystem impact (habitat change) were high priorities both nationally and regionally. Coastal eutrophication (nutrient enrichment) was also a high priority for research and monitoring. Aerial/satellite imagery was listed as an important observation/monitoring need by managers. Yet some of the survey responses indicate that many managers are not sure what information satellites can provide. For example, ocean color was a very low priority, yet information on water clarity/turbidity/light penetration (for which there are ocean color products) was seen as a significant need for assessing habitat change, nutrient enrichment, and ocean management.

Debra also referred to "lessons learned" from the GoMOOS program that are applicable to the SE (document available at www.ocean.us/documents/docs /GoMOOS_Lessons_Learned.doc). With regard to coastal ocean information from GoMOOS, one lesson is that coastal managers were not primary users, rather the primary users are fishermen and marine transportation workers. Also, defining "real needs" of managers comes from more systematic one-on-one meetings. Large-scale surveys of users can be helpful, but meetings with small groups are more effective, particularly for managers. It was felt that researchers and managers speak different "languages", and have different expectations about how data can and should be used.

In summary, Debra sees that managers need an awareness of what data are available and what might be developed to help them monitor the environment. There is a perception that the scale of focus for COOS observations is typically larger than what is seen as needed by coastal managers to address local issues in estuaries, etc. And, the type of data that is often desired by coastal managers is summaries of trends and changes, rather than access to real time observations. Thus, Debra emphasized the need for analysis and synthesis; turning the data into products that are useful to managers. Is this being attended to in SEACOOS?

As some next steps and opportunities, Debra highlighted communications, pointing to two "white papers" (State Best Practices in Science Translation; Examination of Federal Research Dissemination Practices). Suggested activities were:

1) regional focus groups where managers could work with scientists to define management goals;

2) a pilot project to have scientists define how ocean observing can be of use to managers.

CAMA Program, Jeff Beal (Florida Department of Environmental Protection)

Jeff gave an overview of Florida's Coastal and Aquatic Managed Areas (CAMA) program. This includes Florida Aquatic Reserves, State "buffer" preserves, NERR sites and the Florida Keys National Marine Sanctuary. This encompasses ~5 million acres of submerged lands, primarily estuaries in Florida, and 41 reserves. These are by law deemed "exceptional" in biological, aesthetic or scientific value; meaning these have to meet public interest, with benefits of reserve status outweighing the "costs" (e.g., loss of potential for development). The "Outstanding Florida Waters" policy sets limits on impacts to these areas (e.g. the magnitude of turbidity resulting from a dredging project, acceptable BOD levels). Ocean and environmental sensors will be very important in establishing limits for impacts.

CAMA program goals are in four areas: research, monitoring, education, and restoration. CAMA acts as a consultant to many agencies, and to the private sector, as experts in local coastal systems. Water quality monitoring is one area of emphasis and is based on the NERR model for real time systems. This will hopefully incorporate nutrient sensors. Other monitoring needs are for seagrass and fish restoration programs; including aerial/satellite digital imagery for seagrass habitat surveys and tracking restoration progress. For coral reef monitoring, CAMA has adopted the methodology of the Florida Marine Research Institute (used in the Florida Keys). Other areas of interest are invasive species tracking (e.g., non-native *Caulerpa*.) and restoration of spoil islands to native species (e.g, mangrove as opposed to non-native Australian pine, Brazilian pepper trees). For marine exotic tracking and for tracking possible nutrient input from ground water (e.g., from deep well injection), improved information on coastal physical circulation/transport is needed. Also, coastal monitoring is also of relevance to hydrologic restoration of riverine habitats, since small changes in sea level can have large impacts on wetland habitats in this region. Thus, Jeff sees a link between what CAMA does and what physical oceanographers and SEACOOS can provide.

Comments:
Mac Rawson (Georgia Sea Grant) -- Land use impacts on coastal habitats and water quality were also top information need priorities for a survey of Georgia Sea Grant constituents. *Q:* Can one link land use patterns with water quality issues from SEACOOS data?
A: *Madilyn Fletcher(USC)* – This needs to be done, but is not currently.

Rod Zika (U. Miami) – A clarification regarding applications of ocean color data. Ocean color products that are sensitive to sediment loading and algal blooms, combined with *in situ* nutrient measurements, are "diagnostic" indicators for water quality. Land use influences both sediment and nutrient loading. Water quality sensors for these properties are needed but are not regularly available. What is available now is expensive and doesn't have a long field life.

Dave Eslinger (CSC) – The CSC is currently addressing related issues through an RFP. This includes airborne analysis of water quality, with a demonstration project in the Pataxaut River next fall. And a land cover / water quality project exists in Hawaii. Good local data are needed to "tune" the relationships.

Education Programs – Reports on IOOS Education Workshop, COSEE programs in related to SEACOOS

SE COSEE, Lundie Spence

Chapter 8 of the Ocean Commission Report has 16 recommendations relating to the COSEE program. The goal of the COSEE program is to increase interactions between scientists and educators. A central issue is how to deal with oceanographic data in the education arena. Lundie emphasized the importance of getting input and feedback from the SEACOOS science community in creating education material.

The recent IOOS Education Workshop held at the Coastal Service Center, jointly sponsored by the CSC, Ocean.US, SE COSEE, SC Sea Grant Consortium and SEACOOS (http://nia.ecsu.edu/noaa/0304/040322ioos/eduworkshop.htm, and http://ocean.us/documents/workshop.jsp), was held to initiate an education network associated with IOOS/COOS activities. A project initiated at the workshop is an issue of "Current" (newsletter of the National Marine Educators Association) about IOOS (2006 target). The web site for the SE COSEE program is http://www.scseagrant.org/se-cosee/.

As one effort to get ocean observations into middle schools, Lundie, Carrie Thomas and others have put together a poster on waves ("Making Waves"). This will be posted on the (new) SEACOOS web site and linked to local wave data. Designing materials appropriate for various student levels is a key challenge. The goal is to get kids interested with the general facts, then build to the science lessons. SE COSEE is also targeting increased awareness of SEACOOS via SEPORT and other portals to teachers and science centers. A goal is to educate the audience to prepare them to receive the information that is or will be available from the scientists.

Florida COSEE, Barbara Spector

A flyer included in the workshop packet described a Florida COSEE program that will bring scientists and middle school educators together in June, 2004 at USF ("Boats, Buoys and Physical Science Teachers: A Winning Combination"). The Florida COSEE also has designed a web portal (http://floridacosee.net/). This was designed to allow anyone to upload information. It goes through peer-reviewed process, and the information that is disseminated is tagged as either peer-reviewed or not. Barbara asks the workshop participants to register and provide review and feedback (this can be done on-line). The site includes links to other information portals, such as DLESE (Digital Library for Earth System Education, http://www.dlese.org/dds/index.jsp). The goal is to service diverse audiences, so help in catering to a variety of audiences is requested.

Gulf of Mexico COSEE, Mike Spranger

The Gulf of Mexico COSEE encompasses 5 Gulf coast states and their watersheds. Areas of focus in the G of M program include: coastal processes; coastal habitats; and technology (http://cosee-central-gom.org/). A week-long field-based program (Cedar Key) will involve 8 scientists and 12 teachers. This is intended to foster mutual understanding between groups, such as acquainting researchers with the pedagogy of lesson plans (i.e., how the teachers have to package the material). There will be a second workshop for informal educators, again with the goal of bridging the gap between scientists and educators. How to translate information learned from workshops to policy? We are the model for doing this!

Discussion:
Lundie Spence – Researchers submitting NSF proposals can contact the COSEE programs for advice and models for how to incorporate education into the research proposals (i.e., addressing the educational aspect of the "Broader Impacts" area).

Jeff Payne (CSC) – A focus on episodic events seems like a sensible way to teach (and a good hook for kids). It makes it real to them. Also, from a stewardship standpoint, this gets students thinking in terms of decadal change/century changes. What has changed in the last century? And what do we project for future changes? What do we have today that allows us to better monitor change? This way, we better understand what's going on now via episodic events AND understand climate and coastal history -- where have we been and how are we monitoring change over time?

> *Q: Chris Mooers (UM)* -- Link between COSEE and NMEA in SE Florida?
> *A: Mike Spranger* – They will have a display to increase awareness of SEACOOS in SE FL during the next NMEA meeting.

Industry IOOS Workshop Results

Panelists**:** Judy Gray (NOAA, OAR, Atlantic Oceanographic and Meteorological Laboratory), Rick DeVoe (SC SeaGrant, SECOORA), Chris Mooers (UM, SEACOOS), Mitch Roffer (Roffer's Ocean Fish Forecasting Service, ROFFS™)

A workshop to define the interests and potential roles of the private sector in the regional/coastal ocean component of the U.S. Integrated Ocean Observing System (IOOS) was recently held at the Marathon Oil Co. in Houston, Texas (March 2-4, 2004). The workshop objectives, various background documents and agenda are available at the GCOOS web site (http://www-ocean.tamu.edu/GCOOS/industry/agenda.html). The panel discussion here was held to review and follow-up on the workshop discussions. Each panelist had attended the workshop and provide input here from the viewpoints of industry (Roffer), federal agency (Gray), regional association (DeVoe) and SEACOOS (Mooers).

Mitch Roffer (ROFFS™)

Mitch described the genesis of the Houston Industry IOOS Workshop. He stated that, from the industry perspective, there are a number of issues and concerns about the development of IOOS and Regional Associations. In particular, Mitch noted a concern in private industry about possible duplication of services. He sees considerable overlap in the users that SEACOOS and industry serve, and sees the need to identify the basis for interaction between private industry and SEACOOS (and other COOS interests), in particular, definition of: modes of cooperation; business opportunities; and potential areas of conflict.

As background, Mitch gave examples of private industry involvement in environmental data delivery and forecasting services. These include weather and wave forecasting services (e.g., services for the offshore oil industry in the Gulf of Mexico) and his own ocean fishing services. He noted that industry has experience in providing 24:7 services and experience serving "customers."

Mitch feels that industry desires IOOS, but that there are concerns about possible areas of conflict, notably in terms of: 1) tailored value-added products; and 2) a perceived "change in terminology" by which academics have moved toward serving "clients." In 1991, NOAA defined the NWS as a "wholesaler" of weather information and private industry as the "retailer." If value is being added, where does this activity belong, in the private or public sectors? Industry wants access to the data, but protection of intellectual property rights, and needs to see opportunities to develop trust. Mitch stated that industry is currently not strongly supporting IOOS, but is in a "watch and wait" mode.

Judy Gray (NOAA, AOML)

Judy sees important questions for SEACOOS in addressing the role of the private sector in coastal ocean observations, and in identifying the boundary between SEACOOS and private industry. What can industry do? In terms of running an operational system, industry can basically do everything. The transition from research to operations is not an easy one (e.g., the TAO array). Judy listed various approaches to doing this: a "pull" model; a "push" model; and a "continuous" model (where researchers don't "let go" completely). In Judy's NOAA experience, the time scales of research to operational transitions can be long (even "career length"). Issues for interactions with industry include what is proprietary (e.g., what if QA/QC procedures are considered such?). She sees communications and partnerships as essential, and suggests that the new Regional Associations include private sector involvement early on in the process.

Chris Mooers (U. Miami, SEACOOS)

Chris's additional observations from the Houston meeting were that the industry representatives are decisive people, who, he feels, will insist on involvement. He sees fluid boundaries between the public/private sector areas. Also that private industry could "resist" implementing IOOS if not involved. Even within academia, issues concerning "proprietary data" will have to be resolved. He reported that the private sector representatives at the Houston workshop would like to see a full-time liaison with Ocean.US. And that they want data pushed out to them on a regular basis.

Rick DeVoe (SC Sea Grant, SECOORA)

Rick commented on the number of private sector representatives at the Houston workshop, and the range of their oceanographic roles, and in the variety of users. Rick sees several basic questions that need to be addressed in the SE: What level of private sector participation do we have in SE? Who are they? What do they provide? What do they need? How do we develop partnerships with them?

Rick noted that the IOOS vision of a National Federation of Regional Associations will need to include representation of both private and public sectors. With an overall goal of the Regional Association being to bring together information from public, private, academia sources to meet societal goals and to create value-added products. For the SE Regional Association (SECOORA), Andy Clark (Harris Corporation) will serve as the private sector representative at this time, along with Rick. A challenge for the RA development is how to bring SECOORA and SEACOOS together, and at the same time, bring government and private sectors into SECOORA and IOOS.

Comments/Discussion:
Madilyn Fletcher (USC) -- We will need to see where the dialog going. New infrastructure in place will create new opportunities. Communication is the key. How do we get that started?

Judy Gray (NOAA, AOML) -- Suggested we all need some tolerance for ambiguity.

Chris Mooers (UM) -- We can anticipate that industry will be involved in more than data acquisition. At present, we need to maintain the embryonic observing system. On the academic side, traditional education and scholarly research will remain an area of focus. Industry will not perform those functions, so there is not direct competition.

Jeff Payne (CSC) – The NWS is a reasonable model. The NWS is predicated on the fact that the federal government funds the infrastructure necessary to provide the forecasts ($1-1.5B/year if including the satellites). Information from public-interest funded projects is made available to the private sector. Through this relationship, the private sector has a forum to engage the federal government, and a private weather industry has developed. The issue is not IOOS versus industry. Rather, it is how IOOS is serving the public, and what public good can come from the relationship with private sector.

John Van Leer (U. Miami) – Private industry also collects data. Industry infrastructure and capabilities are sophisticated and diverse, far exceeding our capabilities (e.g. oil industry geophysical surveys/models). We'll not get all the proprietary data.

Mitch Roffer (ROFFS) -- The SeaWiFs "data industry" can't access all information from satellites. We can benefit each other.

BREAKOUT GROUPS, TUESDAY PM

BREAKOUT GROUP 3 -- STRATEGY FOR LAGRANGIAN OBSERVATIONS AND MODELING BREAKOUT GROUP

Co-Chairs: Bob Weisberg and Bill Johns
Rapporteur: Jim Nelson

Background: Many of the potential applications (e.g., search and rescue, oil spill mitigation, fisheries management, and HAB mitigation) of SEACOOS information products involve Lagrangian transport information of one kind or another. Presently, quasi-Lagrangian transport estimates are made from Eulerian observations and models.

Charge: Design a possible joint program of Lagrangian observations and modeling to complement and assess the present SEACOOS strategy. Examine the scientific questions and the observational requirements and options.

Summary

Present Status of Lagrangian Observations and Modeling in the SE
Deployment of Lagrangian drifters is a component of several ongoing programs in the Florida portion of the SEACOOS domain (Florida Keys, Florida Bay, West Florida Shelf). These are presently associated with specific transport/exchange studies (e.g., freshwater releases in South Florida, assessing dispersal of sea turtles from hatching beaches, exchange between sub-basins of Florida Bay, tracking water impacted by a WFS phosphate plant). Other satellite-tracked drifters deployed in the Gulf of Mexico also occasionally transit the SEACOOS domain, and there have been discussions concerning continued tracking of these drifters after they leave the Gulf. There is not presently an active drifter program in the South Atlantic Bight (previously some drifter work by John Hare, NOAA NMFS, Beaufort, NC with the Gray's Reef National Marine Sanctuary Program).

Simulated Lagrangian drifters and quasi-Lagrangian transport estimates are part of several modeling programs in the SEACOOS region. These are used as an alternative to vector plots to represent modeled shelf circulation (e.g., providing better visualizations for the non-tidal motions), and in the context of specific transport studies (e.g., where is there separation of the surface and bottom Ekman layers and consequences for shelf circulation). Art Mariano described a Lagrangian stochastic modeling approach that is being combined with HF Radar surface current information (the latter providing the background mean field). A funded project will pursue this further for the Florida Current in the area of the U. Miami WERA range. It is felt that evaluation of the parameters of the Lagrangian stochastic model need to be evaluated over a broad spatial domain (i.e., differences are to be expected within the SEACOOS region).

There was limited discussion of new drifter technologies (there is certainly interest in this). Most of the discussion after the initial presentations focused on potential applications, issues associated with Lagrangian approaches, potential Lagrangian products, and possible case studies that might be conducted as part of the SEACOOS observational program.

Potential Applications of Lagrangian Approaches in the SEACOOS.
There are a range of practical and research applications for Lagrangian observations and modeling. Application areas include:

- Search and Rescue;
- Contaminant Tracking;
- Water Management (e.g., freshwater releases, groundwater tracking);
- HAB tracking;
- Fisheries Management (this includes larval/juvenile transport, dispersal of exotic species, design of MPAs);
- Forensic information;
- Feature analysis for remotely sensed imagery;
- Assessing particle transport following sediment resuspension events;
- As a component of basic research programs on coastal and shelf circulation, biological-physical coupling, material transport, etc.

A Role for SEACOOS?
What sort of Lagrangian products would people like to see from SEACOOS? These would obviously include products related to each of the application areas listed above. For "routine" SEACOOS products, suggestions were:

- Modeled "drogues" as output from operational models;
- A user-driven interface for Lagrangian tracking (including subsurface trajectories);
- Probability distributions (i.e., probability of a particle reaching a specified location over a specified time frame);

Also suggested were Lagrangian products that are of a more event-driven nature, focused on particular locales, or targeting more specific water parcel information:

- An emphasis on targeted locations (such as outfalls, freshwater discharge sites, shipping channels and harbor entrances where oil spills and debris input may be of particular concern).
- Spawning sites and times for particular fish species (e.g., grouper) or sea turtle hatching locations/times (as is part of the South Florida program).
- Reconstructing "histories" of water parcel material properties along trajectories (e.g., separating changes in chemical/biological properties due to physical processes versus reactions, growth/loss processes during transit).

And, appropriately tailored for the target users:

- Educational products that include Lagrangian representations.

Possible Lagrangian case studies in the SEACOOS domain.
The extent to which Lagrangian measurements should be a routine part of SEACOOS observational efforts was not resolved. The value of Lagrangian observations may only be fully realized through multiple deployments over an extended period. However, funding considerations suggest that developing partnerships (e.g., through "leveraged" studies) will be necessary for a sustained drifter program. The cost-effective use of available resources must be considered. Also, it was felt that several questions concerning Lagrangian methodologies need to be considered: Is there a need to evaluate tracking algorithms? Should there be a hierarchy of these? Is there an accepted methodology? Can Lagrangian information be assimilated into models?

As a starting point for further consideration of a Lagrangian measurement/modeling program in SEACOOS, several "case study" ideas were posed. These included:

- Targeting the coastal radar "test beds" in the SEACOOS domain;
- A focus on anomalous periods, combining measurements with hindcast models;
- Fresh-water discharge issues, alternate "use" scenarios;
- Targeted fisheries applications (for particular species and locations);
- Focus on the proposed "design" of Marine Protected Areas within the SEACOOS region;
- Comparative studies of estimates of cross-shelf exchange derived from models and observations.

Priorities for Lagrangian case studies were not determined, and further considerations of the design and associated costs for Lagrangian observations within SEACOOS will be needed. There is broad interest in Lagrangian visualizations as part of SEACOOS model output, with broad range of potential applications. Developing Lagrangian products for specific applications, such as Education, will require input from each of the SEACOOS Working Groups, as well as from the potential user groups.

BREAKOUT GROUP 4 -- STRATEGY FOR FOSTERING PARTNERSHIPS BETWEEN PRIVATE, PUBLIC, GOVERNMENT AND ACADEMIC SECTORS

Co-Chairs: Chris Mooers and Jack Thigpen
Rapporteur: Chris Simoniello

Background: In addition to relationships with the government sector, SEACOOS needs to develop viable, constructive relationships with the private and public sectors. There are many potential avenues of engagement between SEACOOS and various components of the private sector. These components include instrumentation, RCOOS infrastructure (e.g., telecommunications and technician support), environmental modeling, environmental studies, value-added environmental information, and other industries (news media, etc.).

Charge: Design a broad (non-exclusive), two-way programmatic interface to the private sector users (e.g., the value-added environmental information industry) for SEACOOS Web-based information. This exchange may serve as the basis for a proposed joint

project. It should include feedback to SEACOOS about the value of the information that is used and suggestions for improvements.

It was recognized that private industry was under-represented and that broader representation in future sessions would be needed to develop this area. This session was useful even though it generated more questions than answers.

Some initial questions discussed included:

- The Sea Grant role: What should be the role of Sea Grant in educating the public? And should Sea Grant be involved in raising public awareness of private industry products?
- Should SEACOOS have links to private sector as an avenue for possible funding? Some university attorneys have advised against directly linking to private sector websites, as this may compromise nonprofit status.
- How to develop industry representation within SEACOOS (*or SECOORA*)?

There was a sentiment from some private sector representatives that they had not been invited to become affiliates of SEACOOS. It was acknowledged that private companies have sought out SEACOOS rather that being solicited due to issues that might arise concerning favoritism or unfair advantage.

Mitch Roffer (ROFFS™) presented a PowerPoint presentation that summarized his major issues concerning public and private relationships in ocean observing information dissemination. His points included:

- There are differences in the uses of information in academia versus industry: in science it is "Publish or Perish"; in industry it is "Publish and Perish" (i.e., if information is shared with competitors, you are soon out of business).
- A critical subject in terms of communication between SEACOOS and private industry is where and when meetings are held. Information about SEACOOS is not disseminated in a manner that fosters private participation.
- Partnerships are being formed all the time, most of them "quietly."
- Industry is already interacting with federal agencies and academia.
- If there's money to be made, there's an interest!
- Industry has experience in 24-7 operations. This and customer support are best left to industry
- Industry contributes to infrastructure.
- Funds for research and development could be used by private industry
- There is the desire to partner to improve both the science and to conduct business, but why must academia create value-added products?

Roffer feels that the public sector should stick to providing health, safety and homeland security information, and cited a number of satellite products as examples of publicly created value-added products that are in competition with private industry: e.g.,

Coast/Watch SST and Ocean Color, Rutgers University "The Cool Room", US Naval Research Laboratory Image Products; NASA "What Will They Do?"; new SEACOOS fishing products. This raised discussion concerning what constitutes value-added and the public/private relationship. Roffer considers that anything other than data is value-added. The public research/outreach viewpoint focused on two roles: 1) the public institutions and agencies providing generalized products and 2) private companies customizing and tailoring specialized products for specific needs and for paying customers.

- It was acknowledged that as technologies change, definitions of what constitutes a "value-added" product changes as well. For example, while the 1991 NWS "agreement" is cited as a model for setting the boundaries on information products, much has changed since then, such as the emergence of the World Wide Web as a mechanism for information delivery. As the definition of what is a "value-added" evolves, the relationships between companies that are delivering tailor-made forecast products will change as well. By the time products are developed for a specific research or management application, the transition from these to products of more general application, and even specific products for targeted end users, may not be a large step. Potential conflicts with commercial interests who sell tailored "value-added" products derived from the same information stream can arise. This points to the need for recognition of potential areas of conflict, as well as the mechanisms for resolving conflict; e.g., a continuing "tribunal" to handle issues as they arise (and there will be many).

There was a statement made that "without industry, it will be impossible to have an IOOS. Industry needs to be incorporated into the fabric of IOOS and needs to have a voice. Otherwise, industry will get discouraged and abandon the mission. We need to include industry at every level". Questions then arose on the topics of:

- Forming Partnerships -- on what basis do we proceed? What are the mechanisms for communications and how do we improve the dialog in the SE?

- What are the existing models for private-public partnerships in providing environmental information?

- What are the "Rules of engagement"? One idea is to consolidate industry interests, such as providing "collective membership." That might help getting them to tell you what they want to do. Industry probably won't support a grant for R&D without knowing how it will benefit them. There will be a greater chance for support if they are incorporated into the fabric; the key is to get them in as a group. Common interest will then facilitate funding.

- What are the appropriate guidelines for SEACOOS interactions with private industry? Are there existing formalized guidelines in other similar contexts? Specific suggestions for investigation included NOAA National Weather Service, Farm Bureaus, and the Land Grant College Extension Programs.

- Mechanisms for the engagement of private industry by SEACOOS were discussed. Suggestions included:

- Better information dissemination; for example, invitations to meetings, the development of appropriate distribution lists (possibly developed from SECOORA contacts) and the possibility of private business representation within SEACOOS working groups and Board of Directors. SEACOOS affiliates could make presentations to industry to inform them about SEACOOS, and then start bringing new affiliates to the table.
- SEACOOS engagement with industry through sponsorships; e.g., new ways to use their equipment, who could then use SEACOOS in their ads. Engaging various industries, such as those involved in instrumentation, platforms, etc., could mean potential revenue for the industries and help to sustain SEACOOS; a win/win situation.

In terms of SEACOOS education and outreach, marine educators, teachers and the commercial sector could be engaged through textbooks, education materials, and the development of new ways to deliver sound scientific information. Also, the NWS outreach people (NWS warning coordination meteorologists) know the local "ins and outs", and should be engaged in these programs. It was noted that two professional meetings are coming up NWA (National Weather Association) and AMS (American Meteorological Society). AMS hosts a large conference for the weather media, which could be another potential forum to engage SEACOOS with industry. As an example of the economic impact of weather/climate forecasting: the billion dollar weather re-insurance industry is based on climatology.

Chris Mooers initiated a discussion focusing on possible topics for a hypothetical joint project that might be developed in the remaining time for the session. Possible target industries for the project included the marine weather industry (optimal ship routing), fish forecasting and the communication media (e.g., Weather Channel interest in IOOS).
A specific example was that of using the Weather Channel; SEACOOS could distribute information via a weather information service. This initial focus on the "low hanging fruit" could serve as an example of partnering success. It was noted that the media can help develop ocean information products that they can utilize. Even where they have in-house expertise, weather information services often go to other companies for products and information. There is a need for information more than once or twice a day and private industry can fill the gaps with specialized products.

In addition, targets for products that might be developed in coordination with industry included:

- Public information – health and safety (boating safety, HABs)
- Emergency Management
- Hazardous materials planning/response
- Resource Management
- Education
- Research
- Enhanced efficiencies or competitive advantage for private industries (e.g., for offshore oil services, shipping [routing], commercial and chartered sport fishing, tournament fishing [prize money]),

- Media-based weather services
- Value-added products
- Diving visibility, remote sensing

Closing comments -- Chris Mooers

Chris noted that the academic community cannot successfully conceive of collaborative projects with industry in isolation because industry will have its ideas for joint projects. It was suggested that industry representatives could submit a proposal for joint development with SEACOOS. If something comes to fruition, the private sector can market and sell the resulting product(s).

SEACOOS SPRING WORKSHOP ATTENDEES

Mr. Bill Abler
Skidaway Institute of Oceanography
10 Ocean Science Circle
Savannah, GA 31411
babler@rocketmail.com

Ms. Katherine D Andrews
FLDEP
3900 Commonwealth Blvd., M.S. 235
Tallahassee, FL 32399
Work: 850-245-2094
Katherine.Andrews@dep.state.fl.us

Mr. Alfredo Aretxabaleta
UNC-CH
Department of Marine Sciences
UNC-CH
Chapel Hill, NC 27599
alfredo@unc.edu

Dr. William S Arnold
FLFWC
100 Eighth Avenue SE
St. Petersburg, FL 33701
Work: 727-896-8626
Bill.Arnold@fwc.state.fl.us

Dr. Jerald S Ault
University of Miami RSMAS
4600 Rickenbacker Causeway
Miami, FL 33149
Work: 305-361-4884
ault@rsmas.miami.edu

Dr. Inkweon Bang
University of Miami, RSMAS
4600 Rickenbacker Causeway
Miami, FL 33149
ibang@rsmas.miami.edu

Mr. Joseph S. Bartoszek
NASA
XA-I
Kennedy Space Center, FL 32899
Work: 321-867-4257
joseph.s.bartoszek@nasa.gov

Mr. Jeff Beal
FL Dept of Environmental Protection
9737 Gumbo Limbo Lane
Jensen Beach, fl 34957
772-873-6590
jeffrey.beal@dep.state.fl.us

Ms. Sandy Bernard
South Carolina Sea Grant
287 Meeting Street
Charleston, 29401
843-727-6497
sandy.bernard@scseagrant.org

Mr. Jay Blaire
Univ. of Miami
4600 Rickenbacker Causeway
Miami, FL 33437
Work: 305-361-4000
jblaire@rsmas.miami.edu

Dr. Brian Blanton
UNC-Chapel Hill
12-7 Venable Hall, CB#3300
UNC-Chapel Hill
Chapel Hill, NC 27599-3300
Brian_blanton@unc.edu

Dr. Michael Brown
RSMAS/UM
4600 Rickenbacker Cswy
Miami, FL 33149
Work: 305-361-4640
mbrown@rsmas.miami.edu

Mr. Chris Calloway
UNC
CB #3056
012 Howell Hall
Chapel Hill, NC 27599
Mobile : 919-599-3530
cbc@unc.edu

Mr. Jesse Cleary
UNC Chapel Hill
302 Blueridge Road
Carrboro, NC 27510
919-969-1488
jcleary@email.unc.edu

Mr. Jeremy Cothran
Caro-COOPS
Baruch Institute
University of South Carolina
Columbia, SC 29208
jcothran@carocoops.org

Dr. Robert K. Cowen
RSMAS/UM
4600 Rickenbacker Causeway
Miami, FL 33149
305-361-4023
rcowen@rsmas.miami.edu

Dr. Braxton Davis
University of South Carolina
Baruch Institute, EWS 609
University of South Carolina
Columbia, SC 29208
(803) 777-5583
bdavis@caro-coops.org

Mr. Andrew Devanas
National Weather Service
3535 S. Roosevelt Blvd
Key West, FL 33040
andrew.devanas@noaa.gov

Mr. Jeff Donovan
Universiy of South Florida
140 7th Avenue South
St. Petersburg, FL 33701
Work: 727-553-1116
jdonovan@marine.usf.edu

Ms. Claire Eager
UNC-Chapel Hill
CB #3056, Howell Hall 012
Chapel Hill, NC 27599
Work: 919-843-6259
eager@unc.edu

Ms. Karen Pehrson Edwards
UNC-CH
CB #3300
12-7 Venable Hall
Chapel Hill, NC 27599
919-962-4466
kpedwards@unc.edu

Mr. John Englander
International SeaKeepers Society
757 SE 17th Street #650
Ft. Lauderdale, FL 33316
561-392-3648
englander@seakeepers.org

Dr. David L. Eslinger
NOAA Coastal Services Center
2234 S. Hobson Ave.
Charleston, SC 29405
Work: 843-740-1270
dave.eslinger@noaa.gov

Mr. Jerome Fiechter
University of Miami - RSMAS
4600 Rickenbacker Causeway
Miami , FL 33149
305-361-4984
jfiechter@rsmas.miami.edu

Dr. Madilyn Fletcher
University of South Carolina
Baruch Institute
EWS 609
Columbia, SC 29208
803-777-5288
fletcher@sc.edu

Ms. Ingelise Giles
Florida Institute of Oceanography
PO BOX 968
Long Key, FL 33001
Work: 305 664 9101
I_Giles@keysmarinelab.org

Dr. Rick Gleeson
GTM National Estuarine Research Reserve
9741 Ocean Shore Blvd.
St. Augustine, FL 32080
Work: (904)461-4054
rglee@whitney.ufl.edu

Ms. Judith Gray
NOAA/Atlantic Ocean. & Met. Lab
4301 Rickenbacker Causeway
Miami, FL 33149
Work: 305-361-4306
judy.gray@noaa.gov

Ms. Sara Haines
University of North Carolina
CB 3300, 12-7 Venable Hall
Chapel Hill, NC 27599
Work: 919-962-1253
sara_haines@unc.edu

Dr. Gregory Han
Seakeepers
685 Curtiswood Dr
Key Biscayne, FL 33149
Work: 3053612133
ghan@greghan.com

Dr. Brian K. Haus
University of Miami
RSMAS/AMP
4600 Rickenbacker Causeway
Miami, FL 33149
305-361-4932
bhaus@rsmas.miami.edu

Dr. Robert William Helber
University of South Florida
140 7th Avenue S
St. Petersburg, FL 33701
Work: 727-553-1627
helber@marine.usf.edu

Ms. Debra Hernandez
SCDHEC
1362 McMillan Ave., Suite 400
Charleston, SC 29451
843.747.4323
hernandl@dhec.sc.gov

Mr. Rex Hervey
National Coastal Data Development Center
NCDDC
Building 1100, Room 101
Stennis Space Center, MS 39529
Work: 228-688-5774
rex.hervey@noaa.gov

Dr. Gary Hitchcock
University of Miami
4600 Rickenbacker Cswy.
Miami, FL 33149
305-361-4926
g.hitchcock@miami.edu

Dr. Chuanmin Hu
University of South Florida
140 Seventh Ave. S.
St. Petersburg, FL 33701
Work: (727)5533987
hu@seas.marine.usf.edu

Mr. James Chris Humphrey
Florida Institute of Oceanography
PO BOX 968
Long Key, FL 33001
Work: 305 664 9101
Humphrey_J@popmail.firm.edu

Dr. Rick Jahnke
Skidaway Institute of Oceanography
10 Ocean Science Circle
Savannah, GA 31411
Work: 912.598.2491
rick@skio.peachnet.edu

Dr. Robert E. Jensen
USAE Engineer Research and Development Center
ATTN: CEERD-HC-CS
3909 Halls Ferry Rd.
Vicksburg, MS 39180
Work: 601-634-2101
Robert.E.Jensen@erdc.usace.army.mil

Dr. Libby Johns
NOAA/AOML
4301 Rickenbacker Causeway
Miami, FL 33149
Work: 305-361-4360
libby.johns@noaa.gov

Dr. Edward Kearns
University of Miami RSMAS
4600 Rickenbacker Cswy
Miami, FL 33189
Mobile: 305 799 9135
ekearns@rsmas.miami.edu

Dr Brian D. Keller
Florida Keys National Marine Sanctuary
PO Box 500368
Marathon, FL 33050
Work: 305/743-2437x25
brian.keller@noaa.gov

Ms. Shana Kinsey
Florida Department of Environmental Protection
3900 Commonwealth Blvd
MS-47
Tallahassee, FL 32399
Work: 850-245-2163
shana.kinsey@dep.state.fl.us

Ms. Pam Knox
University of Georgia
Driftmier Engineering Center
University of Georgia
Athens, GA 30602
Work: 706-542-6067
pknox@engr.uga.edu

Dr. Villy Kourafalou
University of Miami, RSMAS
4600 Rickenbacker Cswy.
Miami, FL 33149
305 361 4905
villy@rsmas.miami.edu

Dr. John Lamkin
NOAA - SEFSC
75 Virginia Beach Drive
Miami, FL 33149
john.lamkin@noaa.gov

Dr. Steven M Lazarus
Florida Tech
150 W. University Boulevard
Melbourne, FL 32901
Work: 321-394-2160
slazarus@fit.edu

Dr. Russ Lea
UNC Office of the President
PO Box 2866
Chapel Hill, NC 27515
Work: 919/962-4623
rlea@northcarolina.edu

Dr. Tom Leming
NOAA/NMFS
Bldg 1103 Room 218
Stennis Space Center, MS 39529
Work: 228-688-1214
Tom.Leming@noaa.gov

Dr. Mark E. Luther
USF Marine Science
140 7th Ave. S.
St Petersburg, FL 33701
Work: 727-553-1528
luther@marine.usf.edu

Dr. Arthur J. Mariano
RSMAS/UM
RSMAS/MPO
4600 Rickenbacker Causeway
Miami, FL 33149
Work: 305-361-4193
amariano@rsmas.miami.edu

Dr. Maia McGuire
Florida Sea Grant
3125 Agricultural Center Drive
St. Augustine, FL 32092
Work: 904-824-4564
mpmcguire@ifas.ufl.edu

Dr. Christopher Meinen
CIMAS/Univ. of Miami
4600 Rickenbacker Causeway
Miami, FL 33149
Christopher.Meinen@noaa.gov

Prof. Christopher N. K. Mooers
OPEL/AMP/RSMAS/UM
4600 RICKENBACKER CSWY.
MIAMI, FL 33149
Work: 305-361-4088
CMOOERS@RSMAS.MIAMI.EDU

Mr. Trent Moore
Skidaway Institute of Oceanography
10 Ocean Science Circle
Savannah, Ga 31411
Work: 912-598-3308
moore@skio.peachnet.edu

Dr. Marvin K. Moss
University of NC at Wilmington
Center for Marine Sciences
5600 Marvin K Moss Lane/UNCW
Wilmington, NC 28409
Work: 910-962-2465
mmoss@uncw.edu

Mr. Mike Muglia
UNC-Coastal Studies Institute
217 Budleigh St.
Manteo, NC 27954
252-475-3663
muglia@csi.northcarolina.edu

Dr. James Nelson
Skidaway Institute of Oceanography
10 Ocean Science Circle
Savannah, GA 31411
Work: 912-598-2473
nelson@skio.peachnet.edu

Ms. Kathleen OKeife
Florida Fish & Wildlife Conservation Commission
100 8th Ave SE
St Petersburg, FL 33701
Work: 727.896.8626
kathleen.okeife@fwc.state.fl.us

Dr. Peter B. Ortner
NOAA/AOML
4301 Rickenbacker Cswy
Miami, FL 33149
Work: 305/361-4300
peter.ortner@noaa.gov

Dr. Claire Paris
Rosenstiel School of Marine and Atmospheric Science
4600 Rickenbacker Causeway
Miami, FL
Work: 305 361 4978
cparis@rsmas.miami.edu

Mr. Matt Patterson
National Park Service
950 N Krome Avenue
Homestead, FL 33030
Work: 305-224-4211
Matt_patterson@nps.gov

Mr. Charlie Paxton
NOAA/Regional NWS Tampa
Charlie.Paxton@noaa.gov

Dr. Jeffrey L. Payne
NOAA Coastal Services Center
2234 South Hobson Avenue
Charleston, SC 29405
Work: 843-740-1207

jeff.payne@noaa.gov

Dr. Dwayne Edward Porter
Baruch Institute and Arnold School of Public Health
University of South Carolina
Columbia, SC 29208
Work: 803-777-4615
porter@sc.edu

Mr. Charlton Purvis
University of South Carolina
Baruch Institute
University of South Carolina
Columbia, SC 29208
cpurvis@sc.edu

Dr. Desiraju B. Rao
NCEP
5200 Auth Road, Room 209
Camp Springs, MD 20906
Work: 301-763-8000
desiraju.b.rao@noaa.gov

Dr. Mac Rawson
Sea Grant, Georgia
257 Marine Sciences Bldg.
Athens, GA 30602
706-542-6009
mrawson@arches.uga.edu

Dr. Mitchell Alan Roffer
Roffer's Ocean Fishing Forecasting Service, Inc.
2871 SW 69th Court
Miami, Fl 33155
Work: 3052628336
roffers@bellsouth.net

Mr. Erick Rogers
Naval Research Laboratory
Code 7322
Bldg 1009
Stennis Space Center, MS 39529
Work: (228) 688-4727
rogers@nrlssc.navy.mil

Mr. Don Roman
The University of Southern Mississippi
1020 Balch Boulevard
Stennis Space Center, MS 39539
Work: 2286883720
don.roman@usm.edu

Dr. James Sanders
Skidaway Institute of Oceanography
10 Ocean Science Circle
Savannah, GA 31411
Work: 912/598-3340
sanders@skio.peachnet.edu

Dr. Paul Sandifer
Hollings Marine Lab
331 Fort Johnson Road
Charleston, SC 29412
Work: 843-762-8814
paul.sandifer@noaa.gov

Dr. Pablo Santos
NOAA/NWS Regional, Miami
National Weather Service Miami Weather Forecast Office
11691 SW 17th Street
Miami, FL 33165
pablo.santos@noaa.gov

Dr. 'Nick' Lynn K. Shay
University of Miami, RSMAS
4600 Rickenbacker Causeway
Miami, FL 33149
Work: 305-361-4075
lshay@rsmas.miami.edu

Dr. Chris Simoniello
Sea Grant/USF
140 7th Avenue South
St. Petersburg, FL 33701
Work: 727.553.1237
simo@marine.usf.edu

Dr. Don Slinn
University of Florida
slinn@coastal.ufl.edu

Mr. Ryan Smith
NOAA/AOML
4301 Rickenbacker Causeway
Miami, FL 33149
Work: 305-361-4328
ryan.smith@noaa.gov

Ms. Sarah Means Smith
University of North Carolina Office of the President
910 Raleigh Road
Chapel Hill, NC 27514

Work: 919 962 4557
smsmith@northcarolina.edu

Prof. Alex Soloviev
NOVA Southeastern University
8000 N. Ocean Dr.
Dania Beach, FL 33004
Work: (954) 262-3659
soloviev@nova.edu

Dr. Barbara S. Spector
USF COSEE
15836 Sanctuary Dr
Tampa, FL 33647
spector@marine.usf.edu

Dr. Mike Spranger
Sea Grant, Florida
PO Box 110405
Gainesville, FL 32611
Work: 352-392-1837
MSSpranger@mail.ifas.ufl.edu

Mr. Vembu Subramanian
University of South Florida
140 7th Avenue South
St. Petersburg, FL 33703
Work: (727)-553-1625
vembu@marine.usf.edu

Mr. Mike Szabados
NOAA, Center for Operational Ocean Products and Services/NOS
SSMc4, Station 6633
1305 East-West Hwy.
Silver Springs, MD 20910
301-713-2981x12
mike.szabados@noaa.gov

Mr. Judd Taylor
University of South Florida
140 7th Avenue South
St. Petersburg, FL 33701
Work: (727) 553-1186
judd@marine.usf.edu

Dr. Jack Thigpen
NC Sea Grant
Box 8605
NC State Univ
Raleigh, NC 27695
jack_thigpen@ncsu.edu

Ms. Suzanne Van Cooten
NWS/National Data Buoy Center
Building 1100
Stennis Space Center, MS 39529
Work: (228) 688-2817
Suzanne.Van.Cooten@noaa.gov

Dr. John Van Leer
University of Miami
4600 Rickenbacker Causeway
Miami, FL 33149
305-361-4044
jvanleer@rsmas.miami.edu

Dr. Sandra Vargo
Florida Institute of Oceanography
830 First Street South
St. Petersburg, FL 33701
727-553-1100
svargo@seas.marine.usf.edu

Dr. Bill Venezia
NSWC CD SFTF
8010 N. Ocean Drive
Dania Beach, FL 33431
954-926-4001
veneziawa@nswccd.navy.mil

Dr. George Voulgaris
University of South Carolina
701 Sumter Street
Columbia, SC 29208
Work: 803 - 777 2549
gvoulgaris@geol.sc.edu

Prof. Cisco E. Werner
U of North Carolina
12-7 Venable Hall
CB# 3300
Chapel Hill, NC 27599
Work: 919-962-0269
cisco@unc.edu

Ms. Lauren McKinnon Wetzell
University of South Florida
140 7th Avenue South
St. Petersburg, FL 33701
Work: 727-553-3336
lwetzell@marine.usf.edu

Ms. Samantha R. Whitcraft
NOAA-Fisheries
75 Virginia Beach Drive
Miami, Fl 33149
Work: 305-361-4570
Samantha.Whitcraft@noaa.gov

Dr. David White
USC/Baruch Institute
University of South Carolina
Columbia, SC 29208
dwhite@carocoops.org

Ms. Liz Williams
University of Miami
4600 Rickenbacker Cswy
Miami, Fl 33144
Work: 305-361-4070
ewilliams@rsmas.miami.edu

Mr. Xinglong Wu
Rosenstiel School of Marine and Atmospheric Science
4600 Rickenbacker Causeway
Miami, FL 33149
Work: 305-361-4984
xwu@rsmas.miami.edu