2003-2004 Coastal Ocean Research and Monitoring Program (CORMP)

University of North Carolina at Wilmington
NOAA Award #NA16RP2675
Progress Report, February 1, 2004 to July 31, 2004

Submitted by:

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This progress report is for NOAA grant #NA16RP2675 for the period 1 February 2004 to 31 July 2004. The following report will detail progress during this time period in various components of CORMP and the report is organized to be consistent with the major CORMP components outlined in the 2003-2004 proposal as follows:

- Moorings and Modeling (Sections 2 and 3)
- Sediment Transport (Section 3)
- Nutrients, Bio-Optics and Ecosystem Production in OB, LB, and the CFR plume (Section 4)
- Program Managment Initiatives (Sections 5, 6, 7)
  - Outreach and Education (Section 6)
  - Program and Information Management (Sections 5 and 7)
  - Operations
- Budgetary (Section 8)

I. **MOORINGS AND MODELLING (Proposal Sections 2 and 3)**

A. Project Overview

Through a subcontract CORMP has supported NCSU coastal moorings, other data sources including in-situ data, and related high performance computing-based numerical modeling. Accomplishments during this reporting period include:

1. Advance of the design of the backbone real-time observing system including oceanographic current, wave, temperature, salinity, pressure, coastal water level and meteorological variables in Onslow Bay, Long Bay and in and around the Cape Fear River/Estuary System.
2. Plans for the continuation of the non-real time observing system including oceanographic current, wave, temperature, salinity, pressure, coastal water level and meteorological variables in Onslow Bay, Long Bay and in and around the Cape Fear River/estuary system.
3. Discussions of the planned integration of the backbone observing system for physical oceanography and meteorology with CORMP's biological, chemical and geological research and monitoring activities.
4. Discussions of integration of the CORMP and Caro-COOPS observing systems and data protocols affecting an economy of scale, and ensuring full complementarities and continuity between the two programs.
5. Determination of the observational data necessary for the evaluation of the NCSU Coastal & Estuary Marine Environmental Prediction System (CEMEPS) coupled atmospheric, current, wave, estuary model system in the CORMP area of study. This evaluation is in preparation for ongoing and further model development and reconfiguration of the model to incorporate the Cape Fear River Estuary and couple it to the coastal ocean and watershed model components
6. The Cape Fear River Estuary was incorporated into the NCSU CEMEPS Continental Margin Numerical Model for applications of coastal storm surge and flood forecasts and water quality and fisheries applications were initiated.
7. A coordinated, comprehensive expansion plan for the implementation of the full Caro-COOPS/CORMP combined mooring array was developed based on atmospheric/ocean/estuary coupled physics of the Carolinas as related to important coastal oceanographic processes and program needs.
8. Initial scoping of schedules of sufficiently large ships for a coordinated deployment of Caro-COOPS and CORMP moorings next year.
9. Scoping of instrumented Cape Fear Estuary System measurement sites and development of a strategy for deployment, maintenance, servicing, recovery, turnaround.
10. Establishment of a data assessment strategy for real-time and non-real time data and a development of a protocol for final editing.

B. Progress in Maintaining the Observing Network, Data Editing, Time Series Production

During this reporting period, NCSU:

1) has maintained the fixed observational CORMP array and is editing all of the observational data collected to date beginning in 1999 so that maximal data verity and quality is assured

2) is contributing to the design of portions of the monitoring network mooring array expansions within CORMP and Caro-COOPS
3) has defined the vessel needs for mooring deployment, recovery and servicing
4) has conducted a spatial mechanistic/statistical assessment to optimize the monitoring array and has been responsible for designing and conducting the physical oceanography/meteorology numerical modeling of the CORMP continental margin domain, the lower Cape Fear River Estuary
5) has assessed the response of a prototypical small embayment within the CORMP domain by setting and level and pattern of variation of ecologically relevant factors such as fish life histories
6) is conducting statistical evaluations related to river flow and meteorological phenomena
7) has defined the forcing fields of significant atmospheric events which have struck the Cape Fear region 1996 to the present
8) has acquired and combined bathymetric and elevation data for the domain surrounding and downscaling to the Cape Fear region
9) has prepared its observing system instruments for deployment via refurbishing, servicing and up-fits.
10) has designed a new mooring system for real time recovery of data using the Iridium satellite network. NCSU is presently assessing the mooring design for detected flaws and for data transmission and recovery issues. The new real time mooring design is shown in Figure 1

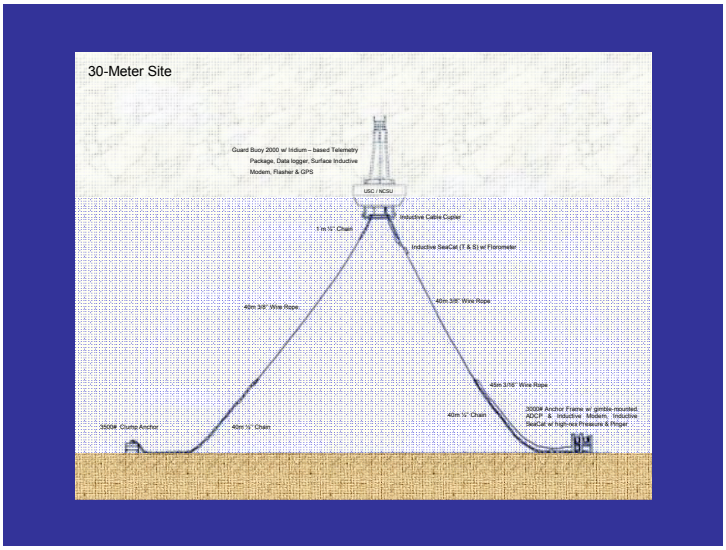

Figure 1. Caro-COOPS NCSU real time mooring design. Also adopted for NCSU role in CORMP.

11. has maintained a NCSU water level recorder at the Wrightsville Beach Coast Guard Station near Masonboro Inlet since 2001

12. has distributed data from moorings to UNCW staff scientists, at the request of UNCW scientists. Data time series are now 3.5 years long.

13. has determined that all of the current meter data and wave data are of good quality

14. has determined that all of the temperature and pressure data are of high quality

15. is still working on the Conductivity data. The data channel exhibiting the most questionable performance over time in Onslow Bay waters is conductivity. This has been attributed to bio-fouling over the course of an individual deployment and over multiple deployments. Since these SeaCat units do not utilize a pump to move water thru the cell, it is difficult, at best, to ensure good water exchange within the cell. As such, even with fresh anti-fouling plugs installed on the cell, biomass will still be present and degrade the measurement over time. NCSU has determined that three months is the longest deployment possible without observing any serious signal degradation, especially during the warm weather months. After that, the effectiveness of the anti-foul plugs decreases rapidly. However, the CORMP SeaCats have been deployed for periods of six months. Since this determination, the cycle for exchanging the Seacats on the CORMP moorings has been be shortened to three months, the same period currently used to change out the ADCPs.

16. has recommended that when deploying SeaCat (or other manufacturer) CT loggers on moorings CTD casts be performed at the beginning and end of a deployment cycle. This will most certainly help, during data post processing, in comparing and analyzing the performance of the CT logger and potentially identify any fouling issues. Without these comparisons via CTD casts, especially the post deployment cast, it is virtually impossible to bracket and correlate SeaCat performances. Since the CORMP project started, the NCSU technical staff has been uneasy with the very quick instrument turn-around schedule that CORMP has adhered to. Usually, there are literally only a few hours between instrument recovery, data retrieval, turn around and redeployment. This affords practically no time to properly review the dataset to evaluate instrument performance. This approach can be very detrimental to the overall quality of the data collected. It was recommended that enough time is allotted between recovery and redeployment to sufficiently scrutinize the data so that we can have an increased level of confidence in the performance of each and every instrument. This may require additional cruises and minor breaks in the time series, temporarily, but will ensure very high quality of data until an instrument swap out process can be implemented.

17. will supply all CORMP investigators with QA/QC protocol documentation. The delay in the data QA/QC assessment and of the reconstruction of the entire, complete time series to date has been the need to assess each 6-month block of early time series to the more recent 3-month blocks which are of higher quality simply because the time for and level of biological fouling will be reduced significantly.

18. has reassessed all wave data for quality and accuracy and has been determined to be of good quality. This was a significant undertaking.

19. has overseen the MS work of Mr. B. Speckhart, a UNCW master's degree student who finished his thesis documenting the response of Onslow Bay to multiple hurricane forcing in 1999. The NCSU data time series has been reconstituted to include all T, S and P data. The data set extended through the 1999-2000 year winter as well as having documented the oceanographic response to the passage of three hurricanes. This reconstructed data set is also intended to be used to ground truth CEMEPS model output.

20. has provided tables (Table 1 & 2) documenting the costs of NCSU designed and constructed real-time moorings for CORMP

Table 1: Caro-COOPS 30m Real-Time Moorings				
Vendor	**Item**	**No.**	**Cost**	**Total**
Mooring System Inc.	Complete NCSU 30-Meter Buoy System	1	18,000	18,000
Seabird Electronics	SeaCat	1	6,300	6,300
	1 Unit w/ 100 psia DigiQuartz Pressure Sensor	1	5,100	5,100
	SeaCat w/ 100m strain Pres	1	7,300	7,300
	w/ Pumped Wetstar Fluorometer	1	4,700	4,700
	Surface Inductive Modem	1	1,050	1,050
RD Instruments	600 KHz ADCP w/ Ext. Battery Pack & Waves Upgrade	1	21,300	21,300
	UIM	1	1,000	1,000
NCSU	ADCP Anchor Frame	1	2,500	2,500
	Battery / Instrument Buoy-Well Housing	1	500	500
	4-Stack RR Anchor	1	800	800
Nuclear Lead Co.	Casted Lead Bricks for NCSU ADCP Frames	8	275	2,200
Benthos	Pop-up Float	1	5,600	5,600
Coastal Environmental	Zeno 3200 Data Logger	1	1,700	1,700
	WeatherPak	1	9,000	9,000
Boater's World	Garmin 17N GPS Unit	1	200	200
Interstate Battery	Buoy-Well Battery Packs	1	300	300
NAL Research	Iridium Modems w/ Antennae & Cable for buoys & bay station	1	1,700	1,700
Impulse	Y-Cable for ADCP/SeaCat Connection	1	400	400
SatComm	Iridium SIM Cards for Satellite Service As Required	1	As Needed	-----
				89,650

Table 2: Caro-COOPS 10m Real-Time Moorings				
Vendor	**Item**	**No.**	**Cost**	**Total**
Mooring System Inc.	Complete NCSU 10-Meter Buoy System	1	16,200	16,200
Seabird Electronics	SeaCat	1	6,300	6,300
	1 Unit w/ 45 psia DigiQuartz Pressure Sensor	1	5,100	5,100
	Surface Inductive Modem	1	1,050	1,050
RD Instruments	600 KHz ADCP w/ Ext. Battery Pack & Waves Upgrade	1	21,300	21,300
	UIM	1	1,000	1,000
NCSU	ADCP Anchor Frame	1	2,500	2,500
	Battery / Instrument Buoy-Well Housing	1	500	500
	5-Stack RR Anchor w/ Mace Plates	1	1,000	1,000
Nuclear Lead Co.	Casted Lead Bricks for NCSU ADCP Frames	8	275	2,200
Benthos	Pop-up Float	1	5,600	5,600
Coastal Environmental	Zeno 3200 Data Logger	1	1,700	1,700
	WeatherPak	1	9,000	9,000
Boater's World	Garmin 17N GPS Unit	1	200	200
Interstate Battery	Buoy-Well Battery Packs	1	300	300
NAL Research	Iridium Modems w/ Antennae & Cable for buoys & bay station	1	1,700	1,700
Impulse	Y-Cable for ADCP/SeaCat Connection	1	400	400
SatComm	Iridium SIM Cards for Satellite Service As Required	1	As Needed	-----
				76,050

During this period UNCW accomplished the following:

1. Field Activities

- OB27 Sampling. Sampling activities at OB27 continued during this period. Instrumentation was deployed and recovered twice over the reporting period, in April and July. All data recovered and downloaded successfully, and are of good quality.
- Position of the quadpod relocated to a new position slightly east of the hardbottom. This was undertaken to examine the role of hardbottom topography on near bottom physical processes. This was accomplished with minimal interruption of the data time series.
- Deployment of instrumentation at OB1-4.
- Mooring turn-arounds occurred at OB1-4 as well in April and July.

2. Lab Activities

- One of the microcats was sent to Seattle for calibration in May.
- Purchase of instrumentation: During this reporting period UNCW purchased 3 ADCP's and 3 microcats for use in CORMP plume moorings.
- UNCW graduate student, Chris Canaday, has been working on the ADCP and pressure data collected at our moorings.
- Temperature, pressure and conductivity data quality were evaluated from the OB1-4 moorings over the past year.

3. Research and Data Products

- *Presentations:*

Dr. Bingham presented a seminar on Feb. 11, 2004 at the UNC Chapel Hill, Department of Marine Science. Title: "Physical Response of the Ocean to Hurricane Isabel in Onslow Bay, NC".

- *Publications*:

Blanton, et al., 2004. Barotropic Tides in the South Atlantic Bight. Journal of Geophysical Research, in press.

4. Major accomplishments with regards to proposed objectives

- Dr. Bingham worked on the mooring design and configuration, including attendance at the MTS Buoy meeting held in St. Petersburg, FL in March. Also in attendance were Drs. Moss and Leonard.

5. Other relevant Information

- During the summer, observations were made on how the National Weather Service makes their forecasts. Some analyses of data from Frying Pan Shoals were conducted to help the NWS determine criteria for small craft advisories. We hope to put together a Frying Pan Shoals climatology page in the near future to post on the NWS website.
- Dr. Bingham attended the 6th Annual NWS Wilmington Groundhog Day Observance, Feb. 3, 2004 at Wilmington International Airport. He gave a

presentation entitled "Coastal Ocean Research and Monitoring Program (CORMP): A Collaborative Coastal Ocean Research and Monitoring Program".

- Drs. Leonard, Bingham and Dantzler met with NWS staff in April to consult on placement of moorings in the offshore array and to discuss NWS data needs.
- Dr. Moss and Ansley Wren represented CORMP at the NWS "Break the Grip of Rip" media event in Wrightsville Beach in May and later gave a presentation about CORMP to the NWS Director.

C. Progress in Modeling

For the 2003-2004 project year, the CORMP modeling focused on the development of a three dimensional, time dependent storm surge simulation tool for the offshore North Carolina region and the Cape Fear River Estuary (CFRE) at high resolution.

A substantial effort has been made to ensure the development of a high resolution, hydrodynamically complete and correct, state of the science quality modeling system for the offshore waters and the entire CFRE system. For example, we have adopted a triple nesting approach for model downscaling, from relatively low to relatively high spatial resolution. As a result, we have not only developed the high-resolution model for the CFRE, but we have also developed the model for two other coarser domains.

However, during the last reporting period we reported that due to the shutdown of the North Carolina Supercomputing Center, the NCSU/CORMP modeling effort had to be repositioned to another high performance computing platform and the modeling group invested a large amount of time and effort in transferring the modeling system and data from the old supercomputing facility (which consisted of a SGI type computing platform) to the new NCSU Computing Center (an IBM Linux cluster computing platform). Thus the model and model codes had to reconfigured and tested for completeness, accuracy and efficiency. Despite of this extra effort due to NCSC closing, the modeling team has completed all proposed tasks. Specific accomplishments for this reporting period are listed below.

During this reporting period the model team:

1) safely transferred the modeling system and data from the North Carolina Supercomputing Center (NCSC) to the North Carolina State University Supercomputing Center, and reconfigure the modeling system to a new and different computing platform
2) has continued to develop the CFRE runoff (stream flow) interface for historical hurricane cases
3) has searched and extracted precipitation data for the periods of recent extreme events
4) has continued to calibrate model for selected historical hurricane cases.
5) has continued to customize and document model output
6) has validated the model for selected historical hurricane cases. We have designed a validation strategy, selected validation variables (surge time series, timing of peak surge) and validation methods (point-wise validation, peak surge validation). The

validation strategy depends on the availability of observational data and data distribution

7) have analyzed model results and created visualizations of model output.
8) Conducted an experimental real-time forecast during hurricane Charley (Fig. 2). Graphics and animations of the forecast have been provided to the project PI.

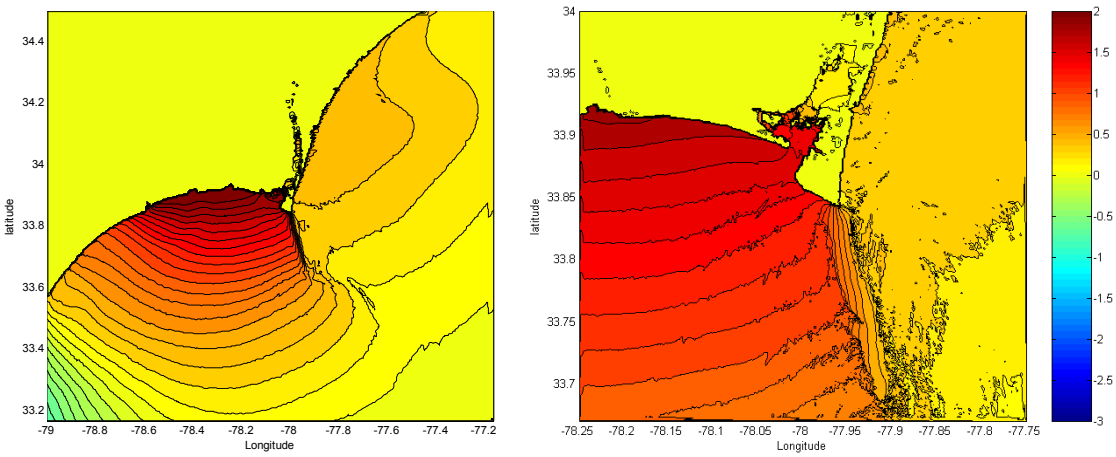

Fig. 2. Experimental storm surge forecast during Hurricane Charley. Left: Middle nesting window. Right: inner-nesting window. Both are for a 36-hour forecast.

II. SEDIMENT TRANSPORT (Proposal Sections 2 and 3)

A. Field Activities

- Sidescan cruise in Long Bay conducted in May 2004. This cruise was conducted to increase map coverage of the plume-impacted region in Long Bay.
- Continuous 6-week deployments of the PCADP data at OB27. During this reporting period, we relocated the position of the quad further from the hardbottom reef known as 23-mile rock. This activity was undertaken so that we could more thoroughly examine the role that marine hardbottom topography has on near bottom currents, wave-fields, and sediment transport.
- Continuous 3-month deployments of the ADCP at OB3. Until July 2004, this was undertaken using an instrument provided through subcontract with NCSU. In late July, CORMP deployed one of the new instruments purchased in spring 2004 at this site.
- Box cores continue to be collected at OB3 approximately every 6 weeks. We have discontinued collection at boxcores at the new OB27 location due to the presence of dense clays that are essentially impenetrable.
- Water column total suspended solids are measured at the surface, mid-depth, and near-bottom at all plume sampling sites on each of the bi-monthly RV Cape Fear Long Bay cruises. In addition, these samples are analyzed for % loss on combustion at 500 degrees Celsius.

- Surface sediment grabs, collected using a petite ponar grab sampler, are collected bi-monthly at each of the Long Bay plume sampling stations.
- Sediment tubes are retrieved from OB3 and OB27 every six weeks.

B. Lab Activities

- Side scan sonar data have been processed and are currently being georeferenced and mosaiced.
- All PCADP data have been downloaded, reviewed for QA/QC, and archived
- Box cores have been photographed, described, and subsampled. Relief peels have been taken and archived. All boxcore images are now available in digital form on the CORMP website.
- All water samples collected through the reporting period have been analyzed for TSS concentration and % organic content. These data have been archived and tabular results have been prepared for posting to the CORMP database.
- The grain size and percent organic content of all grab samples have been completed. These data are now in preparation for entry into the CORMP database.

C. Research and Data products

- Depth averaged PCADP data and current direction are available on the CORMP website for deployments from 2000 to 2003. Data are available in ascii format. Limited metadata and header information are also available.
- Digital images of all boxcores collected and processed through 2003 are available on line.
- Summaries of research results are maintained on the sediment transport CORMP homepage (http://people.uncw.edu/lynnl/comp/bbl.html)
- *Abstracts and presentations*

  Slattery, M.P. 2004. The influence of the Cape Fear River plume on the composition of shelf sediments. In: Geological Society of America Abstracts with Programs 36(2) p.46. March 25-27. Washington DC.

  Marshall, J.A., Leonard, L. and Grindlay, N. 2004. Observations of near-bed conditions and sediment response during the passage of Hurricane Isabel on the inner continental shelf of Onslow Bay, NC. In: Geological Society of America Abstracts with Programs 36(2) p.131. March 25-27. Washington DC.
- *Papers*

  Wren, P.A. and Leonard, L.A, 2004. Sediment transport on the mid-continental shelf in Onslow Bay, North Carolina during Hurricane Isabel. Submitted to *Estuarine, Coastal, and Shelf Science* (in press as of 10/15/04)
- *Theses:*

  Wren, P.A. 2004. Sediment Transport Measurements on the Mid-Continental Shelf in Onslow Bay, North Carolina. Unpublished Ph.D. Dissertation, North Carolina State University. 168p.

  Marshall, J.A. 2004. Event driven sediment mobility on the inner continental shelf of Onslow Bay, NC. Unpublished M.S. Thesis, University of North Carolina Wilmington. 90p.

D. Accomplishments and Constraints

- Hiring J. Marshall as a part-time technician/part-time outreach coordinator to assist with pier moorings, teacher workshops, and other outreach efforts.
- Resignation of post-doctoral associate (A. Wren) to take position at TAMU. Expect to hire replacement in spring 2005 to work with wave data that will be generated by offshore and pier moorings. Funds from the post-doctoral position were reprogrammed to fund a part-time technician (J. Marshall) to assist with development of the pier-based wave moorings and to assist with project outreach efforts.

E. Major accomplishments with respect to proposed objectives

- We are currently on task with respect to side scan surveys, geological and boundary layer data collection efforts in Onslow Bay
- We proposed to have completed instrumentation in Long Bay by this reporting period and this objective has not been met. Our initial plan was to instrument two non-real-time moorings with ADCP and turbidity sensors; one inside of and one outside of the region of plume impact. Following submission of the CORMP 2004-2005 proposal, however, our scope of work was redefined to focus more on the deployment of systems with real-time capability. For this reason, we postponed instrumentation of Long Bay and reallocated the funds originally programmed for this task to the purchase of equipment that would be real-time ready. In the meantime, we have modified a trawl-proof housing for the plume area and have entered into an agreement with NCSU to use one of their ADCPs to instrument the plume region in a non-real-time mode until our first Long Bay real-time station is functional (expected in spring 2005).
- We are on task with other Long Bay geological sampling efforts.
- L. Leonard attended the SECOORA planning workshop in Jekyll Island, GA in May 2004.
- L. Leonard attended the ONR/MTS BUOY WORKSHOP 2004 in St. Petersburg in March 2004. Used this opportunity to discuss mooring design and to identify operational partners for CORMP ocean-observing network needs.

III. NUTRIENTS, BIO-OPTICS AND ECOSYSTEM PRODUCTION IN ONSLOW BAY, LONG BAY, AND THE CAPE FEAR RIVER PLUME (Proposal Section 4)

A. Field Activities

- Sampling in the Cape Fear River Plume occurred on February 19, March 4, April 6, May 17, June 15, and July 13. Samples were collected for the following parameters: depth, water temperature, pH, conductivity, salinity, turbidity, dissolved oxygen (all at three depths), ammonium, nitrate, orthophosphate, silicate, and chlorophyll *a*.
- Sampling for nutrients and chlorophyll at the Onslow Bay stations was successfully performed March 9, May 5, and July 27.

- At each CFR plume and Onslow Bay station (except CFP02 on July 13), surface water samples were collected, and SeaWiFS –channel reflectances were measured at the surface using a Satlantic Micro-SAS, while depth-dependent reflectances were measured by conducting profiles with a Satlantic MicroPro free-fall radiometer. The attenuation of photosynthetically active radiation (PAR) was measured by profiling with a Licor irradiance meter.
- The Chelsea Fast Repetition Rate Fluorometer (FRRF) was deployed for the first time during the July cruises. Vertical profiles were conducted with the FRRF housed in its newly-constructed protective frame.
- Since February of 2004, benthic grab sampling trips for the Cape Fear River plume project (benthic studies) were conducted on March 11 and June 9. Five stations were sampled on each trip (collection sites= CFP1, CFP2, CFP6, CFP8, and CFP9) representing a mix of stations that are primarily within the river plume and stations that are outside of the river plume. Six grab samples were collected at each site, five for infaunal analysis and 1 sample for sediment analysis. Normal sampling for this project is conducted quarterly (winter=Jan-Feb, Spring=April-May, Summer=July-August, and fall=October-November).
- Benthic core samples were collected on May 5th and July 6th. Core samples were collected, by divers, at three offshore reef sites (OB5, OB 15, and OB27). Five replicate core samples were collected from each station. No samples were collected for the winter sampling period (Jan.-Feb) because poor sea conditions prevented all scheduled missions for this portion of the project.
- Blue crab utilization of coastal ocean habitat: Trawl samples, using a modified 20ft. Tri-net samples were collected on June 22 and July 19. Ten replicate trawl samples were collected around the mouth of the Cape Fear River and around Carolina Beach Inlet.
- Sampling associated with subcontract to Dennis Allen (Baruch Instititute, USC) has been completed.

B. Lab Activities

- Samples for water-quality parameters are being processed on schedule. A new YSI multiparameter instrument was purchased using CORMP funds and is in use.
- Inherent optical properties of surface water samples from cruises were analyzed; total attenuation, and contributions to total attenuation such as CDOM absorption, particulate (detrital + pigment) absorption, and detrital absorption were determined.
- Prior to its first deployment, experiments were conducted with the FRRF in a tank, software bugs were identified, and protocols for controlling the instrument were developed. Second-party data processing software for the FRRF (by Sam Laney) was obtained, and Matlab software was purchased for using this software.
- Satellite and remote sensing: A Sun workstation and a Linux workstation were set up on the network and SeaDAS software installed for use with ocean color data. A three-year archive of Level 1A 1 km resolution SeaWiFS data was obtained. Two FTP servers were set up outside the university firewall for receipt

of SST images. IDL program modification for SeaWiFS processing in the local region was initiated. Some MODIS ocean color data were examined for potential detection of harmful algal blooms at the request of South Carolina Dept. of Natural Resources (Jason Kempton).

- Processing of benthic grab samples (Cape Fear Plume study) and benthic core samples (Onslow Bay transects samples) is on going. Processing of these samples requires the sorting (removal of all macrofauna) of samples and species identification and enumeration of all organisms.
- All QA/QC procedures from sorting, identification, and data processing of benthic samples are ongoing. All taxa not recorded from previous sampling periods must be verified. Training of new undergraduate and research technicians is continuing.
- Sorting, identification and analysis of monthly CFR plume ichthyoplankton samples completed.
- Dr. Allen (USC) has processed ichthyoplankton and decapod samples from Winyah Bay, SC plume through July 2004. Decapod samples will be typed genetically for positive identification of blue crabs within the coming months. Data for CRF and Winyah Bay plumes will be assembled for comparison.

C. Research and Data Products

- We now have an extensive CORMP data set on the CFR plume that spans the period February 2000 through the present. During this project year sampling was discontinued at Stations CFRP3 and CFRP4, and sampling was added at Stations CFRP8 and CFRP9. The reasoning behind this was that the first three years of our CORMP occurred during drought years; upon cessation of the drought in early 2003 the plume was noted to extend further into oceanic waters. Stations 8 and 9 are farther offshore and allow us to capture more offshore effects of the plume, especially following major terrestrial rain events.
- *Theses*

Markovsky W. Coult. 2004. Role of the Cape Fear River discharge plume in fisheries production. UNCW M.S. thesis (defended successfully in July 2004). Currently preparing a manuscript for publication.

- *Presentations*

Mallin, M.A., J. M. O'Reilly, L.A. Leonard, P.A. Wren, J.J. Souza and D.H. Wells. 2004. "Impact of Hurricane Isabel on nearshore and offshore Onslow Bay." Southeastern Estuarine Research Society, Harbor Branch Institute, Florida.

Woods W. et al. 2004. "Remote sensing, optics and primary production component of CORMP North Carolina's Coastal Ocean Research & Monitoring Program." NASA Ocean Color Research Team meeting in April 2004 in Washington, D.C.

- *Publications*

Quattrini, A., D. Lindquist, F. Bingham, T. Lankford, J. Govoni, 2004. Distribution of Larval Fishes in Shelf and Gulf Stream Waters in Onslow Bay, North Carolina: Implications for Cross-shelf Exchange. *Fisheries Oceanography* (in press)

Mallin, M.A., L.B. Cahoon and M.J. Durako. Contrasting food-web support bases for adjoining river-influenced and non-river influenced continental shelf ecosystems. *Estuarine, Coastal and Shelf Science* (in press).

- In accord with continued field sampling in Onslow Bay and the Cape Fear Plume, the database of optical parameters in coastal waters was extended, providing additional matchup days for satellite data intercomparisons and algorithm development.
- A new tool became available to CORMP with newly-acquired access to the Hydrolight 4.2 radiance transfer model. This model provides the capability to examine the effects of individual components (e.g., CDOM, pigments, detritus) on the overall light field. This capability supports our effort to determine whether spatial patterns of biomass and primary production in Onslow Bay and Long Bay can be related to variable light penetration to the benthos in river plume impacted regions.
- Data set for plume and Onslow Bay benthic productivity projects are updated regularly (following verification of identifications and QA/QC). We have generated new data sets based on the trawl samples. These data sets include crab species and abundance around the inlets as well as data on shrimp and fish species collected in these same regions. These data sets are of particular interest to the Division of Marine Fisheries that has used these data to determine opening and closures of the shrimp fishery. The data on select finfish species has also been of interest to the DMF since it has contributed in part to the preliminary development of the Fishery Management Plan for the Northern Kingfish (*Menticirrhus saxatilis*).

D. Accomplishments and Constraints

- Productivity: We continue to make great progress in addressing our objectives as stated in the 2003-2004 CORMP proposal. One of our principal objectives was to determine if benthic primary producers dominate in clear, nutrient-poor waters and phytoplankton dominate in waters with higher attenuation coefficients and nutrient levels. The Mallin, Cahoon and Durako paper (accepted for publication, see above) demonstrates that planktonic chlorophyll and nutrients in the nearshore Long Bay well-exceed those of nearshore and offshore Onslow Bay. Likewise, suspended sediments and CDOM from river discharge contribute to much higher light attenuation in the plume-influenced area of Long Bay than in any portion of Onslow Bay that this program samples.
- Water Quality: A long-standing objective of the CORMP program has been to analyze the effect of major events on coastal and shelf waters. We had that opportunity to address this following the passage of Hurricane Isabel over Onslow Bay, offshore of the North Carolina coast. Large amounts of suspended sediment transport occurred after hurricane winds began to directly affect the area and wind-driven currents were generated. Acoustic backscatter signals indicated extremely high levels of suspended sediments in the bottom boundary layer during peak conditions of the storm, especially in the lower 30 cm. Total phosphorus, orthophosphate, and nitrate concentrations showed little difference between pre-and post-hurricane samples. However, ammonium concentrations

increased 2-7X over pre-hurricane conditions at all sites and depths. Contrary to our expectations, chlorophyll *a* did not increase following the event, and decreased from 2.5 to 0.5 μg/L in OB5 surface waters. The event caused secchi depth to decrease from 12.0 to 4.5 m at OB5, from 13.0 to 6.0 m at OB15, and from 11.0 to 7.0 m at OB27. We hypothesize that decreases in light availability constrained phytoplankton productivity despite the increased inorganic nitrogen (ammonium) concentrations following the storm. The effect of deep mixing by Hurricane Isabella was to suppress rather than enhance phytoplankton productivity in Onslow Bay. These results were presented at the Spring 2004 meeting of the Southeastern Estuarine Research Federation at Harbor Branch, Florida, by P.I. Mallin along with coauthors O'Reilly, Leonard, Wrenn, Souza and Wells.

Finally, we continue to build up a solid data-base to be used for a modeling effort to assess the impact of terrestrial rainfall and runoff on the chemical and biological constituents of the plume. Recent rainy periods give us a broader range of hydrological regimes to work with than the previous drought-dominated sampling periods.

- Bio-Optics: Collaborative research was undertaken with Drs. Rick Stumpf, Varis Ransibrahmanakul and Timothy Wynne (NOAA National Ocean Service, Center for Coastal Monitoring and Assessment). The focus of this work is the improvement of the atmospheric correction applied to coastal ocean color data. Earlier work by Piotr Kowalczuk and others in CORMP compared *in situ* and remotely-sensed reflectance data and investigated scale differences as a potential cause of disparities. In the current work, NOAA/NOS is providing satellite data processed with a special atmospheric correction including absorbing aerosol correction. These data will be compared with satellite data processed using the standard SeaDAS software (no absorbing aerosol correction) and also compared to in situ measurements from the same day, to determine whether better agreement is observed. The goal of this research is the quantitative use of ocean color data for the retrieval of biogeochemical surface water constituents such as chlorophyll and CDOM concentrations, facilitating long-term monitoring efforts.

- Fisheries: Working with Jeff Marshall, we have developed a hands-on exercise for high school students to illustrate the influence of the CFR discharge plume on the abundance and composition of fish larvae in the coastal ocean. The exercise includes a collection of representative larval fishes from plume versus ocean water masses along with physicochemical data from collection dates, taxonomic identification guides, and unsorted samples to provide the experience of sample processing.

- Hired Dr. Steve Kinsey as a research advisor to facilitate coordination among the CORMP research groups. A regularly-scheduled set of research meetings was initiated to promote integration among the groups with respect to both the

scientific objectives and the operational procedures. This resulted in a long-range plan for research that codifies the unified mission of the various groups and promotes integration of research within the CORMP program's observing network.

IV. PROGRAM MANAGEMENT INITIATIVES (Proposal Sections 5, 6, 7 and 8)

A. Information Management

- Continued to download, quality check and locally archive CORMP-collected oceanographic data
- Continued Data Management Consulting Agreement Contract with Dr. Dave White to assist CORMP in further developing and implementing our Data Management Strategy
- Established a Task Order to identify CORMP Metadata requirements, modify Caro-COOPS Metadata Tools to include CORMP Information Management System needs, and coordinate Caro-COOPS and CORMP data systems and web access development to ensure compatibility. The result will be a CORMP Data Management Tool (data entry and data base components).
- CORMP Data Manager Position: February 2004- Conducted recruitment process, including advertising the position, evaluating application packages, and interviewing the 3 most competitive candidates. Selected Xiaoyan Qi for the position (Applications Programmer II), effective June 23, 2004. Delay due to time required for applicant to obtain H1-B Visa.
- Future Plans: Plan to develop position description for Senior Data Manager Position included in 2004/2005 proposal. Advertise, review applications, conduct interviews and hire candidate as soon after proposal approval as possible

A. Education

- CORMP professional development pilot program for middle and high school teachers was initiated on July 26 through 29th at the UNCW Center for Marine Science. Jeff Marshall and Dr. Richard Huber were the primary instructors.
- Five (5) science teachers from New Hanover, Onslow, Bladen, and Brunswick county schools toured CMS facilities and were introduced to CORMP personnel
- Several CORMP PI's gave insightful Powerpoint presentations reviewing major objectives and accomplishments of CORMP to date.
- Principal investigators also each gave brief summaries of their CORMP related research activities and teachers brainstormed how CORMP data could be integrated into their existing curricula.
- Dr. Richard Huber led a workshop introducing the RiverView Data Visualization Tool (DVT), which is an online data module that displays CORMP water quality data in an easy to read, graphical format (see section C below). Teachers discussed ways to utilize this DVT in accordance with the North Carolina Standard Course of Study.

- Teachers and Jeff Marshall attended the bimonthly July sampling cruise of Onslow Bay where they gained hands on experience with sampling procedures used by CORMP field personnel.
- Field operations staff, Morgan Bailey, Dave Wells, Jay Souza and crew of the R/V Cape Fear made it a positive learning experience for each of the teachers involved.
- At the culmination of the four day program, teachers and instructors further developed ideas on how CORMP data and resources could be best used in the middle and high school classroom
- September 11, 2004 was chosen as the first meeting of teachers and Jeff Marshall (of six scheduled). At this meeting, teachers were to report back with more specific requests for CORMP data and suggestions for improving the RiverView DVT. Dr. Huber also planned on giving a hands-on demonstration of Vernier Probeware that can be used to sample water quality parameters similar to CORMP sampling procedures.

B. Outreach:

- Contacted Johnny Mercer pier manager, Matt Johnson regarding his potential partnership/collaboration with CORMP in installing a real-time wave and current meter off pier and housing a real-time display within the pier house itself.
- Met with Matt Johnson and discussed time-frame for instrument deployment, positive outcomes of being involved w/ CORMP, the possibility of also sponsoring a beach-cam at the Johnny Mercer Pier location.
- Re-designed the CORMP webpage, purchased the www.cormp.org domain name.
- Held detailed discussions with Director of UNCW Science and Math Education Center in preparation for implementation of summer professional development opportunities for secondary school science educators
    - Plan to invite representative group of approximately 5 secondary school science educators (one from each of the nearby coastal counties)
    - Plan to develop one-week summer program to provide introduction to CORMP research program and researchers, research laboratory orientation, and one-day research cruise.
    - This core group of secondary school science educators will meet over several weekends during the upcoming school year to identify opportunities and develop modalities for broad-scale integration of CORMP science as an enhancement to curricular-driven science education to increase student achievement in meeting secondary school science education objectives.
    - We plan to use this core team of teachers to introduce this CORMP-related science education enhancement program to a larger group of (up to 25) secondary school science educator during the summer of 2005, upon approval of our 2004/2005 proposal.
- Continued to develop partnership with National Weather Service, agreeing to collocate CORMP pier-based oceanographic monitoring equipment with NWS-provided meteorological station to complement NWS rip-current forecasting effort.

    - Held preliminary discussions with owner of a Wilmington fishing pier in preparation for deployment of offshore oceanographic monitoring equipment
    - Participated in national media event hosted by the National Weather Service at this Wilmington fishing pier to launch the NWS national rip-current forecasting initiative
- Continued to develop partnership with USMC at Camp Lejeune
    - Dr. Marvin Moss facilitated meeting of Camp Lejeune and SERDP (Strategic Environmental Research and Development Program) officials, leading to SERDP decision to establish 10-year, $10 million+ estuarine environmental monitoring and research program.
    - Dr. Marvin Moss and Dennis Ihnat participated in SERDP Estuary Ecosystem Workshop with Camp Lejeune to define scientific objectives for SERDP project with USMC and identify CORMP role in the project
    - Obtained budget commitment from USMC to share the cost of an oceanographic and meteorological buoy for the Camp Lejeune Integrated Operations Network (CLION) and as a supplement to the CORMP IOOS network. USMC transferred $125,000 directly to NDBC.
    - Worked with Dr. Geno Olmi, NOAA Program Officer to have NOAA Grants Office withhold $125,000 from 2004/2005 CORMP award for direct transfer to NDBC to meet approved proposal requirements for CORMP cost-share with USMC.
    - Continuing to develop plan to provide data to CLION from the CORMP Onslow Bay IOOS network as applicable

C. Data Visualization Tool Development

- The data visualization tool for CORMP is moving forward. The tool can be accessed at http://www.uncw.edu/riverview/ . Users can examine and interact with Cape Fear River plume data or view transects of the Onslow Bay data. While the river plume data is complete and has been field tested with teachers, the Onslow Bay data needs additional work and will not be field tested with teachers until late November. Lesson plans for the *Riverview* website are being developed and will be ready for teacher workshops in the spring.
- During the last 6 months the *Riverview* website has been presented to teachers and researchers at numerous conferences and seminars. Major presentations were as follows:

"Data Visualization Tools for Facilitating Scientific Inquiry,' A seminar presented to the University of Port Elizabeth Zoology Department, Port Elizabeth, South Africa. April 21, 2004

"Using Interactive Technologies to Facilitate Science Inquiry," Watson School of Education Summer Technology Institute 2004, Wilmington, NC June 2004.

"Modeling Environmental Data a Call for Partners," ED Media 2004—World Conference on Educational Multimedia, Hypermedia & Telecommunications, Lugano, Switzerland, June 2004.

"Using Interactive Internet Resources to Facilitate Scientific Inquiry," ED Media 2004—World Conference on Educational Multimedia, Hypermedia & Telecommunications, Lugano, Switzerland, June 2004.

D. Program Management

- Extended temporary assignment of Boyce Steiner as CORMP Administrative Assistant pending creation of permanent Administrative Assistant included in 2004/2005 proposal.
- Dr. H. Lee Dantzler was assigned on an IPA to NOAA Coastal Services Center for further assignment to Ocean US to assist other key federal and non-federal agencies in the planning and subsequent implementation of a viable data management and communications (DMAC) strategy for IOOS.
- Continued to work with the UNCW/CMS Director to identify space for CORMP personnel
- Future Plans: Plan to meet with representatives of NC Port Authority, Military Ocean Terminal Sunny Point and US Coast Guard to determine benefits of CORMP IOOS to these organizations and identify potential opportunities for future collaborations (such as providing oceanographic data that can be used to enhance safety of maritime commerce and possible Homeland Security considerations).

E. Operations

- Field Activities
  - Dive Operations
    a. February: 4 missions, 26 dives
    b. March: 4 missions, 35 dives
    c. April: 6 missions, 36 dives
    d. May: 3 missions, 33 dives
    e. June: 4 missions, 35 dives
    f. July: 5 missions, 47 dives
    g. Total for reporting period = 28 missions, 227 dives

  - Cruises
    a. Onslow Bay: Large Vessel with CTD, hull mounted ADCP- March 9, May 5, July 27 (Teacher Outreach Cruise with NURC ROV, giving live diver demonstration), Collected 692 water samples (TN, TP, NO_3, PO_4, NH_4, chl a, Benthic Chl), Benthic Ecology Cores: May 5, July 27, Collected 30 samples
    b. Cape Fear River Plume: Large Vessel with CTD, LISST, hull mounted ADCP- March 4, May 17, July 13, Collected 1407 water samples (TN, TP, NO_3, PO_4, NH_4, chl a, Si, Phytoplankton, Benthic Chl)
    c. Cape Fear River Plume: Small vessel surface samples only - February 19, April 6, June 15, Collected 801 water samples (TN, TP, NO_3, PO_4, NH_4, chl a, Si, Phytoplankton); Benthic Ecology sediment ponar grabs- March 11, June 9, August 9, Collected 75 Grab samples, Collected 15 sediment samples

d. Total samples collected: 3020

- Lab Activities
  - Onslow Bay
    a. Processed 692 samples (TN, TP, NO_3, PO_4, NH_4, chl a, Benthic Chl)
  - Cape Fear River Plume
    a. Processed 1173 samples (TN, TP, NO_3, PO_4, chl a, Benthic Chl)
  - Total samples processed: 1865 + 55 CTD casts (Cruises and Mooring calibrations)
- Data
  - All data was given to specific Principal Investigators, or placed on server.
- Accomplishments
  - CORMP Operations successfully turned around the NCSU moorings during the months of March and July. In July, UNCW outfitted the existing mooring sites with UNCW instruments to cover gap in NCSU data.
  - Operations successfully executed Teacher Outreach Cruise with ROV live diver demonstration. This was part of the CORMP Outreach Program.
  - Operations successfully completed all but one monthly sampling cruise. August 2004 was canceled to severely inclimate weather.

F. Budget

- Twenty-seven people were paid for CORMP time & effort (Permanent Staff, full-time, part-time and temporary; Research Scientists; graduate student Research Assistants; and Undergraduate Student Assistants)
- Three subaward agreements and one consulting agreement were administered
- Expenditure of CORMP funds were managed per approved budget and as submitted in financial reports filed separately by UNCW Office of Sponsored Programs.
- Funds provided by Caro-COOPS ($74,000) were applied to purchase of oceanographic equipment in support of future upgrade of CORMP moorings to real-time capability.
- We anticipate carrying forward approximately $325,000 at end of current grant year. Primary factors responsible for this carry over, include process delays in hiring budgeted positions and delays in purchasing major oceanographic equipment and supplies related to principal subcontract for new offshore observation system specification development. The availability of these funds has been integrated into the next work program described in the 2004/2005 proposal.