NOAA in the Carolinas

Report from the 2008 Meeting:

The Ecosystem-Climate Connection

NOAA Laboratory, Beaufort, NC
6-7 February, 2008

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NOAA in the Carolinas

Report from the 2008 Meeting: The Ecosystem-Climate Connection

Executive Summary

NOAA in the Carolinas is a OneNOAA collaboration in the Carolinas and Georgia. Ongoing objectives include: to better serve public needs through more efficient, effective, and accessible NOAA services and products; to understand and embrace a OneNOAA vision; and, enhance the regional role in NOAA's program planning and budgeting. These objectives are achieved by: 1) grassroots regional collaboration on interdisciplinary projects, for example, improving rip current safety, developing better flood and storm surge models, predicting climate change impacts, and identifying changing coastal demographics and impacts on the coastal environment; and 2) improving outreach and inreach mechanisms and efforts, such as holding regional meetings.

The fourth NOAA in the Carolinas meeting convened 6-7 February 2008 at the NOAA Laboratory in Beaufort, NC, with 86 participants from seven states and 18 different agencies and universities. The focus for the meeting was the Ecosystem-Climate Connection, a topic of increasing priority for NOAA. The agenda included plenary presentations and breakout groups.

The plenary session began with updates on three programs: (1) NOAA in the Carolinas by Steering Committee member Darin Figurskey; (2) the Southeast and Caribbean Regional Collaboration Team by Team Lead Jeff Payne; and (3) CI-FLOW (Coastal Inland FLood Observation and Warning Project) by Suzanne Van Cooten, CI-FLOW coordinator. These presentations were followed by two keynote addresses. The first was by Steve Murawski, NOAA Ecosystem Goal Team Lead and NMFS Director of Scientific Programs and Chief Scientist, emphasizing the need for conducting an integrated ecosystem assessment (IEA) for the southeast Atlantic, providing an overview of IEAs and ecosystem approaches to management, and describing NOAA's policies and plans with regard to implementing IEAs for each of its regions. Lisa Vaughan, NOAA Climate Program Office, Manager of Sectoral Applications Research Program, then described the NOAA approach for linking climate and coastal resource management, highlighting the challenges and approaches for NOAA to address the increasing demand for managing coastal resources with a changing climate.

The keynote addresses were followed by plenary presentations intended to provide background on research and management efforts pertaining to the Ecosystem-Climate Connection in the Southeast U.S. Continental Shelf Large Marine Ecosystem (SEUSCS-LME). Stan Riggs, East Carolina University, summarized his compelling findings on the effects of sea-level rise on estuarine systems in North Carolina. Rick DeVoe, Executive Director of South Carolina Sea Grant Consortium, reviewed ongoing region-wide efforts addressing ecosystem-climate issues in the southeast U.S., including federal, state, non-governmental organization, and multi-sectoral. The review highlighted that there is much opportunity to build on existing activities and information. Mike Piehler, University of North Carolina at Chapel Hill Institute of Marine Sciences, summarized a collaborative study funded by the NOAA Ecological Effects of Sea

Level Rise Program. This research focused on assessing and modeling ecological impacts of sea-level rise on estuaries. Jeff Hyland, NOAA Ocean Service, described ongoing research focused on conducting regional assessments of ecological conditions in various coastal-ocean waters around the U.S. Assessments include water quality, contaminants, and species richness, among other parameters. Chris Taylor, NOAA Ocean Service, presented preliminary results using fisheries indicators to show the link between ecosystem change and climate variation in the southeast Atlantic and the connectivity between ocean and estuarine habitats. Roldan Muñoz, NOAA Fisheries Service, showed preliminary results of climate change on warm-temperate hard-bottom communities, including the invasive lionfish, on the continental shelf of the SEUSCS-LME.

The presentations were followed by four moderated working groups tasked to contemplate the development of a region-wide program to address the Ecosystem-Climate Connection. Discussions were focused on four related topics:

1. Key institutional and scientific programs contributing to characterizing and assessing the effects of climate change on the SEUSCS-LME (see http://www.ecosystem.noaa.gov for LME delineations);
2. Parameters and related products of importance for characterizing ecologically meaningful regions and defining boundaries within the SEUSCS-LME;
3. Key challenges and drivers related to tracking and forecasting climate change and its effects on the LME, its various ecologically meaningful regions, and its living marine resources; and
4. SEUSCS-LME hard bottom communities as sentinels of climate change: scales, sampling designs, and environmental parameters including ecology, geography, oceanography, and weather.

In addition to continued success at encouraging interaction of NOAA partners, significant meeting outcomes included:

1. Hiring a NOAA in the Carolinas coordinator.
2. Submission of a proposal to the Comparative Analysis of Marine Ecosystem Organization (CAMEO) call for proposals that incorporates some of the primary issues for consideration at the meeting, as well as some of the outcomes of discussions.

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Background

The National Oceanic and Atmospheric Administration (NOAA) strategic and operating plans are founded on close working relationships both inside and outside NOAA at the national, regional and local levels. Expressed as the OneNOAA vision, program planning and execution are not constrained by bureaucratic structure, facilitating the core objective of a corporate OneNOAA to provide the most efficient and effective products and services for the public.

NOAA in the Carolinas (NinC) is a grassroots group of NOAA staff and partners in the Carolinas and Georgia. The mission of NinC is to promote a OneNOAA vision by improving regional communication and coordination, building partnerships that enhance the value of NOAA products and services, and increasing public access to NOAA resources. NOAA offices and programs in North Carolina, South Carolina, and Georgia have collaborated on many cross-Line Office, interdisciplinary projects, for example, improving rip current safety, developing better flood and storm surge models, predicting climate change impacts, and identifying changing coastal demographics and impacts on the coastal environment. For more information, visit the NinC website at http://www.carolinas.noaa.gov/.

In 2004 and 2005, NOAA representatives in North Carolina and South Carolina conducted meetings in Wilmington and Asheville, NC, respectively, to highlight NOAA partnership efforts, and to recommend new potential research and outreach efforts. The resulting reports are available online at the NinC Website (http://www.carolinas.noaa.gov/). Following the 2004 and 2005 meetings, NinC Steering Committee members summarized meeting results for the NOAA Goal Team and Line Office leaders at presentations in NOAA headquarters. Subsequent to this presentation, a formal regional initiative was presented to the NOAA Weather/Water Goal Team for 2009, entitled the Coastal and Inland Flood Observation and Warning (CI-FLOW) system (http://www.nssl.noaa.gov/projects/CI-FLOW/). CI-FLOW was chosen as a OneNOAA priority because of its regional relevance across NOAA line offices and goals, efforts and success in sharing leadership and resources including among extramural and external partners, use of cutting-edge science and technology; and plans to engage end users in the application of the scientific output. Initially a Sea Grant sponsored research project, the program continues to develop and will deliver new, relevant products and services to regional managers and researchers.

NOAA leadership also endorsed the NinC grassroots regional approach to OneNOAA, encouraged the team to expand regionally, and integrate its activities with the emerging Southeast and Caribbean Regional Team (SECART), part of the NOAA regionalization initiative headed by the Office of Policy, Planning and Integration. The 2007 meeting in Charleston included new invitees from Georgia and focused on educating the region on NOAA's new regionalization program, SECART and CI-FLOW. It included moderated working groups to contribute to SECART plans and improve CI-FLOW products and services. Meeting reports and presentations are available on the website (http://www.carolinas.noaa.gov/).

Report on the 2008 Meeting

The fourth NinC meeting was held 6-7 February 2008 at the NOAA Laboratory in Beaufort, NC (Agenda – Appendix A, Acknowledgments – Appendix B). There were 86 participants from seven states and 18 different agencies and universities (Participant List – Appendix C). The theme for the meeting was the Ecosystem-Climate Connection, an issue of increasing priority for

NOAA. This theme was selected by consensus following deliberations by the NinC Steering Committee about the next topic to be addressed by NinC. A call, via the NinC email list, for specific topics resulted in the selection of two submissions as the focus of the meeting, serving as the basis for determining plenary presentations and breakout-group discussions.

The plenary session began with updates on three programs: (1) NinC by Steering Committee member Darin Figurskey; (2) the Southeast and Caribbean Regional Collaboration Team by Team Lead Jeff Payne; and (3) CI-FLOW (Coastal Inland FLood Observation and Warning Project) by Suzanne Van Cooten, CI-FLOW coordinator. These presentations were followed by two keynote addresses. The first was by Steve Murawski, NOAA Ecosystem Goal Lead and NMFS Director of Scientific Programs and Chief Scientist, emphasizing the need for conducting an integrated ecosystem assessment (IEA) for the southeast Atlantic, providing an overview of IEAs and ecosystem approaches to management, and describing NOAA's policies and plans with regard to implementing IEAs for each of its regions. Lisa Vaughan, NOAA Climate Program Office, Manager of Sectoral Applications Research Program, then described the NOAA approach for linking climate and coastal resource management, highlighting the challenges and approaches for NOAA to address the increasing demand for managing coastal resources with a changing climate. All of these presentations are available on the NinC website (http://www.carolinas.noaa.gov/). A Glossary of Acronyms is provided as Appendix D.

The keynote addresses were followed by plenary presentations intended to provide background on research and management efforts pertaining to the Ecosystem-Climate Connection in the Southeast U.S. Continental Shelf Large Marine Ecosystem (SEUSCS-LME). Stan Riggs, East Carolina University, summarized his compelling findings on the effects of sea-level rise on estuarine systems in North Carolina. Rick DeVoe, Executive Director of South Carolina Sea Grant Consortium, reviewed ongoing region-wide efforts pertaining to ecosystems and changing climate in the southeast U.S., including federal, state, non-governmental organization, and multi-sectoral. The review highlighted that there is much opportunity to build on existing activities and information. Mike Piehler, University of North Carolina at Chapel Hill Institute of Marine Sciences, summarized a collaborative study funded by the NOAA Ecological Effects of Sea Level Rise Program. This research focused on assessing and modeling ecological impacts of sea-level rise on estuaries. Jeff Hyland, NOAA Ocean Service, described ongoing research focused on conducting regional assessments of ecological conditions in various coastal-ocean waters around the U.S. Assessments include water quality, contaminants, and species richness, among other parameters. Chris Taylor, NOAA Ocean Service, presented preliminary results using fisheries indicators to show the link between ecosystem change and climate variation in the southeast Atlantic and the connectivity between ocean and estuarine habitats. Roldan Muñoz, NOAA Fisheries Service, showed preliminary results of climate change on warm-temperate hard-bottom communities, including the invasive lionfish, on the continental shelf of the SEUSCS-LME. Many of these presentations are available on the NinC website (http://www.carolinas.noaa.gov/).

The presentations were followed by moderated working groups (Breakout Group Objectives and Topics – Appendix E). Four working groups each discussed one of the following:

1. Key institutional and scientific programs contributing to characterizing and assessing the effects of climate change on the SEUSCS-LME;
2. Parameters and related products of importance for characterizing ecologically meaningful regions and defining boundaries within the SEUSCS-LME;

3. Key challenges and drivers related to tracking and forecasting climate change and its effects on the SEUSCS-LME, its various ecologically meaningful regions, and its living marine resources; and
4. Investigating SEUSCS-LME hard bottom communities as sentinels of climate change: scales, sampling designs, and environmental parameters including ecology, geography, oceanography, and weather.

Summary of Outcomes

Information from the four working groups (WG) will assist in development of a regional, cross-Line Office, interdisciplinary program for evaluating the effects of climate change on the SEUSCS-LME. The first WG focused on a discussion of data sets available to researchers that pertain to characterizing and assessing the effects of climate change on the SEUSCS-LME. Although it is expected that researchers will have knowledge of, and access to, numerous data sets, an important opportunity existed at the NinC meeting to brainstorm about available data sets in order to develop as complete a list as possible within the time available for the WG to meet. The WG generated an extensive list of current and historical data sets (Appendix F). It is likely that many of the data sets discussed are well-known. However, some may note data sets that are obscure or unknown to them, making the list a useful reference. The breakout group was comprised primarily of individuals familiar with meteorology, hydrology, and/or climatology. Among the group, there was only limited experience in marine life and ecosystems. Still, a variety of data sets available over air, land, and sea were discussed. WG members agreed that most or all of the data sets will provide information on the historical status of the SEUSCS-LME and can be used to detect changes in climate or the impact of climate changes on the ecosystem. The WG also identified some data-set needs for future ecosystem models and IEAs, including (1) the need to digitize historical data; (2) development of ways to link the data sets, particularly given that a climate portal may not be as appropriate as an ecosystem portal and that the scales of the data from different sources will vary; and (3) the need for more fishery-independent data.

The second WG developed initial thoughts on characterizing ecologically meaningful regions and boundaries within the SEUSCS-LME (Appendix G). The SEUSCS-LME comprises diverse habitats, ranging from the northern limit at Cape Hatteras, NC, that is influenced by the Labrador Current in winter to the southern limit in the Florida Straits that include coral reefs, from the extensive estuaries to vast hard and soft-bottom regions on the continental shelf, as well as the pelagic zone affected by the Gulf Stream offshore and freshwater run-off nearshore. The large and diverse area included in the SEUSCS-LME invites stratification into ecoregions where different regions will have different biomes and may have different stressors. Several recently published papers provide examples of defining subregions within the SEUSCS-LME and other LMEs. These different papers offer very different approaches. A goal of this WG was to discuss options for approaching defining ecoregions with the SEUSCS-LME. The WG identified a number of factors to take into account when defining the ecoregions and emphasized the need to define the question or management issue to be addressed when developing subregions or criteria for defining ecoregions.

The third WG approached the question of identifying key challenges and drivers related to tracking and forecasting climate change and its effect on the SEUSCS-LME by developing a conceptual model that linked stressors resulting from climate change with impacts on valuable coastal resources (Appendix H). Participants developed thoughtful lists of primary drivers of

ecosystem change, indicators that may be measured to detect the effects of stressors, and most valued products and services.

The fourth WG focused on using hard-bottom communities in offshore areas of the SEUSCS-LME as sentinels of climate change (Appendix I). This region and setting are optimal for an ecosystem-climate research initiative given the carbonate setting, abundance of corals, range of biogeographic provinces, position in the North Atlantic Circulation, and severe impacts of changes and responses, such as warming, acidification, storms, sea-level rise, and related sand mining and beach renourishment projects. The WG made a number of recommendations. The research initiative should span the entire LME, from North Carolina to Florida and beach to upper slope. This LME approach requires careful selection of transects, best done in partnership with existing ocean observing system programs. Key environmental parameters to assess should include: density and assemblage structure of living marine resources at multiple trophic levels; physics and chemistry of bottom water; Gulf Stream related events such as eddies and upwelling events; atmospheric characteristics; and substrate geology. Appropriate temporal scales range from geological (paleoclimate) to microscale (hourly) and include various sampling strategies, including seasonal, spanning episodic events from storms to ENSO (El Niño Southern Oscillation) cycles, and continuous, using buoys or other remote sampling devices. Spatial scales would also range widely focusing on biogeographical transition areas and other representative subregions. One outcome from this session included incorporating some of this research into a proposal, entitled "Characterizing The Southeast US Continental Shelf - Large Marine Ecosystem in the Midst of a Changing Climate: Historical Synthesis and a Multidisciplinary Research Initiative", submitted by some meeting participants to NOAA's Comparative Analysis of Marine Ecosystem Organization (CAMEO) funding announcement (see http://cameo.noaa.gov/) (decision pending at time of this report). A next step recognized by the WG was an ad hoc working group to design this research initiative, which is one objective in the CAMEO proposal.

Some specific recommendations from the working groups were:

1. WG1: identify additional data sets on living marine resources; and
2. WG4: convene one-day session to discuss further refining the proposed research program

A final panel in the plenary session provided perspectives on NinC with regard to the value of the group and suggestions for improvement (Appendix J). Panel members were Rick DeVoe (SC Sea Grant), Suzanne Van Cooten (NOAA National Severe Storms Laboratory) and Susan White (NOAA Hollings Marine Laboratory). The panel cited the merit of NinC as an exemplar grass roots group that was reaching out to regional constituencies, both internal and external to NOAA. This approach should help to engage the community, reduce redundancy, and enhance synergy. They recommended that the outreach be extended to engage additional extramural partners, notably from states and academia, as well as to increase diversity (underserved communities). Both goals might be better achieved with a NinC mission statement and strategic plan. Doing so would also help define the relationship between NinC and SECART, especially given that four members of the NinC Steering Committee are also on SECART. Concern was expressed over the difficulty in achieving NinC goals as an all-volunteer group. Overall, panelists were supportive of the organization, initiative development efforts, and outreach/inreach efforts including continuation of the website, Steering Committee, and meetings.

Participants were asked to complete a meeting evaluation form. Results are in Appendix K.

Next Steps

The next steps for NinC in developing a regional program to address the ecosystem-climate connection for the SEUSCS-LME are:

1. Find funding and employ a NinC Program Coordinator;
2. Use the expertise and resources of the Program Coordinator to further NinC coordination and planning;
3. Engage the NinC and non-NOAA partners in development of a new, regional multi-partner ecosystem-climate connection initiative;
3. Submission of a proposal to the CAMEO call for proposals that incorporates some of the primary issues for consideration at the meeting, as well as some of the outcomes of discussions;
4. Through SECART, promote a multi-partner ecosystem-climate connection initiative for regional support in 2010 and beyond, including to NOAA goal teams for inclusion in the NOAA Program Planning, Budgeting, and Execution System (PPBES), using input obtained from NinC and non-NOAA partners.

Following the workshop, the NinC Steering Committee was successful in fulfilling two of the next steps. For step 1, we obtain support from Sea Grant and SECART for a new NinC Program Coordinator. Program Coordinator responsibilities may include: development of a NinC charter and strategic plan; continued development and promotion of new regional multi-partner initiatives; coordination and leadership for ongoing programs, focusing on a balance between enhancing coastal community development and resiliency and preserving environmental resources; coordinating the NinC Steering Committee efforts in identifying important regional projects; bringing project teams together for planning purposes; identifying project funding sources; and leading the effort to secure project resources. For step 4, a proposal was submitted in July 2008 in response to the CAMEO request for proposals.

Appendices

Appendix A: Agenda

NOAA in the Carolinas 4th Meeting: The Ecosystem-Climate Connection

6-7 February 2008
NOAA Laboratory, Beaufort NC

Agenda

Day 1: Wednesday 6 February 2008, 9am - 6pm

8:00 – 9:00am Registration (coffee)

Welcome
Dr. Aleta Hohn, NOAA, NMFS, SEFSC, Director of NMFS Programs at NOAA Beaufort Lab

NOAA in the Carolinas: Background and Update
Darin Figurskey, NOAA, NWS, Meteorologist-in-Charge Raleigh Forecast Center

NOAA Southeast and Caribbean Regional Team (SECART): Work plan, Key Intersections with NOAA in the Carolinas, and Ideas for Future Collaboration
Dr. Jeff Payne, NOAA Regional Team Lead and Deputy Director, NOAA Coastal Services Center

Morning break

CI-FLOW Update, Progress, Tangible Short- and Mid-Term Outcomes
Dr. Suzanne Van Cooten, NOAA, OAR, National Severe Storms Laboratory

Keynote Address 1: Integrated Ecosystem Assessment (IEA) of the South Atlantic Large Marine Ecosystem: The Time Has Come for a Regional Approach
Dr. Steve Murawski, NOAA Ecosystem Goal Lead and NMFS Director of Scientific Programs

Lunch

Keynote Address 2: A NOAA Approach to Linking Climate and Coastal Resource Management
Lisa Vaughan, NOAA Climate Program Office, Program Manager Sectoral Applications Research Program

Panel discussion with Keynote speakers on the ecosystem-climate connection

The South Atlantic Large Marine Ecosystem: An Overview
Dr. Stan Riggs, East Carolina University

Afternoon break and group photo

Ongoing Region-Wide Efforts in the Southeastern U.S. Coastal Ocean: A Selected Review
Rick DeVoe, Executive Director South Carolina Sea Grant Consortium

Assessing and Modeling Ecological Impacts of Sea-Level Rise on Estuaries: NOAA Ecological Effects of Sea Level Rise (EESLR) Projects in North Carolina
Dr. Mike Piehler, Univ. of North Carolina at Chapel Hill Institute of Marine Sciences

Assessing Ecological Conditions in U.S. Coastal-Ocean Waters: Implications for an Integrated Ecosystem Assessment (IEA) in the Southeast
Dr. Jeff Hyland, NOAA NOS Center for Coastal Environmental Health & Biomolecular Research

Wrap up Day 1

6:00 – 9:00pm Evening reception and poster session at Duke Auditorium

Day 2: Thursday 7 February 2008, 8am - noon

Review of plans for Day 2

Fisheries Indicators for the Southeast Atlantic: Ecosystem Change and Links to Climate Variation
Dr. Chris Taylor, NOAA NOS

Tracking Climate Change and Invasive Species in the U.S. South Atlantic Bight: A Multistressor Ecosystem Investigation of Warm-Temperate Hardbottom Communities
Dr. Roldan Muñoz, NOAA NMFS Southeast Fisheries Science Center, NOAA Beaufort Lab

Breakout groups to begin laying the foundation for a regional initiative

Report back by breakout groups

Wrap-up and next steps

Appendix B: Acknowledgments

Local Organizing Committee

Brian Efland	NC Sea Grant
Rebecca Ellin	NC National Estuarine Research Reserve (NC NERR)
Aleta Hohn	NOAA NMFS
Rachel Lo Piccolo	Contractor to NOAA NMFS

Contribution of Resources (materials and staff time)

North Carolina Sea Grant
NC NERR
NOAA NMFS
NOAA NOS

Other Assistance

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Katie Mosher	NC Sea Grant
Jack Thigpen	NC Sea Grant

Appendix C

NOAA in the Carolinas 2008 Meeting
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Appendix D: Glossary of Acronyms

Compilation from 2004-2008 Meetings

AOP	Annual Operating Plan
ARL	NOAA Air Resources Laboratory
ASOS	Automated Surface Observing System
AVHRR	Advanced Very High Resolution Radiometer
BiOP	Biological Opinion
CAMEO	Comparative Analysis of Marine Ecosystem Organization
Caro-COOPS	Carolinas Coastal Ocean Observing and Prediction System
CCEHBR	Center for Coastal Environmental Health and Biomolecular Research
CCFHR	Center for Coastal Fisheries and Habitat Research
CCMAH	Cooperative Center for Marine Animal Health
CEMEPS	Coastal and Estuarine Modeling and Environmental Prediction System
CERIS	Coastal-Estuary-River Information System
CI-FLOW	Coastal Inland FLood Observation and Warning Project
C-MAP	Clean Air Mapping and Analysis
CMAST	Center for Marine Sciences and Technologies
CO-OPS	NOS Center for Operational Oceanographic Products and Services
CORMP	Coastal Ocean Research and Monitoring Program
COSEE	Centers for Ocean Science Education Excellence
COTS	NOAA Coastal Observation Technology System
CRONOS	21North Carolina Climate Retrieval and Observations Network of the Southeast
CSC	NOAA Coastal Services Center
CSCOR	Center for Sponsored Coastal Ocean Research
CWISE	Climate and Weather Impacts on Society and Environment
CZMA	Coastal Zone Management Act
DEM	Digital Elevation Maps
DENR	Department of Environment and Natural Resources
DNR	Department of Natural Resources
DoD	Department of Defense
EESLR	Ecological Effects of Sea Level Rise
EOG	Executive Oversight Group (part of NOAA Regionalization)
EPA	Environmental Protection Agency
ESA	Endangered Species Act
FATE	Fisheries and the Environment – NOAA program that supports NOAA's mission to ensure the sustainable use of U.S. fishery resources under a changing climate
FEMA	Federal Emergency Management Agency
FIRM	Flood Insurance Rate Maps
FMP	Fishery Management Plan
FSL	NOAA Forecast Systems Laboratory
GAO	Government Accounting Office
GIS	Geographic Information System
GPS	Global Positioning System
HL-RDHM	Hydrologic Laboratory – Research Distributed Hydrologic Model
HMT	NOAA Hydrometeorological Testbed
ICOADS	International Comprehensive Ocean-Atmosphere Data Set
IEA	Integrated Ecosystem Assessment
IOOS	Integrated Ocean Observing System
IPCC	Intergovernmental Panel on Climate Change
IWRS	Integrated Water Resource Services
LIDAR	Light Detection and Ranging

LME	Large Marine Ecosystem
MMPA	Marine Mammal Protection Act
MPE	Multisensor Precipitation Estimator
MMS	Minerals Management Service
MSRA	Magnuson-Stevens Reauthorization Act
NASA	National Aeronautics and Space Administration
NCCOS	NOAA Centers for Coastal Ocean Service
NCDC	National Climatic Data Center
NCDDC	NOAA National Coastal Data Development Center
NCDCM	North Carolina Division of Coastal Management
NCFMP	North Carolina Floodplain Mapping Program
NCSU	North Carolina State University
NDBC	NOAA National Data Buoy Center
NEC	NOAA Executive Council
NEP	NOAA Executive Panel
NERON	NOAA Environmental Real-time Observations Network
NERRS	National Estuarine Research Reserve System
NESDIS	NOAA National Environmental Satellite and Data Information Service
NGDC	NOAA National Geophysical Data Center
NGS	NOAA Geodetic Survey
NIDIS	National Integrated Drought Information System
NinC	NOAA in the Carolinas
NIST	National Institute of Science and Technology
NMAO	NOAA Office of Marine and Aviation Operations
NMFS	NOAA National Marine Fisheries Service
NMQ	National Mosaic for Quantitative Precipitation
NMSA	National Marine Sanctuaries Act
NMSP	National Marine Sanctuary Program
NOAA	National Oceanic and Atmospheric Administration
NODC	NOAA National Oceanographic Data Center
NOS	NOAA National Ocean Service
NPS	National Park Service
NSSL	NOAA National Severe Storms Laboratory
NURP	NOAA Undersea Research Program
NWLON	NOS National Water Level Observing Network
NWS	NOAA National Weather Service
OAR	NOAA Office of Oceans and Atmospheric Research
OCRM	Office of Ocean and Coastal Resource Management
OHD	NOAA National Weather Service Office of Hydrologic Development
PATT	Priority Area Task Team (part of NOAA Regionalization)
PPBES	Program Planning, Budgeting, and Execution System
PPI	NOAA Office of Program Planning and Integration
QPE	Quantitative Precipitation Estimate
SAB	South Atlantic Bight
SABSOON	South Atlantic Bight Synoptic Offshore Observational Network
SAMFC	South Atlantic Fishery Management Council
SEACOOS	Southeast Atlantic Coastal Ocean Observing System
SeaWiFS	Sea-Viewing Wide Field of View Sensor
SECART	Southeast and Caribbean Regional Team
SECOORA	Southeast Coastal Ocean Observations Regional Association
SERO	NMFS Southeast Regional Office
SEFSC	NOAA Southeast Fisheries Science Center
SERFC	Southeast River Forecast Center
SERPPAS	Southeast Regional Partnership for Planning and Sustainability

SEUSCS-LME	Southeast U.S. Continental Shelf Large Marine Ecosystem
SF-ROS	South Florida Regional Observing System
SG	Sea Grant
SLR	Sea Level Rise
SP	Strategic Plan
SST	Sea Surface Temperature
SWMP	NERRS System-Wide Monitoring Program
UNC-CH	University of North Carolina at Chapel Hill
UNCW	University of North Carolina at Wilmington
USACE	U.S. Army Corps of Engineers
USC	University of South Carolina
USGS	U.S. Geological Survey
VOS	Volunteer Observing Ship
VPR	Vertical Profile of Reflectivity
WFO	Weather Forecast Office

NOAA in the Carolinas 4th Meeting
The Ecosystem-Climate Connection

Breakout Groups
Objectives and Topics

Climate Change and NOAA's Ecosystem Responsibilities

Issues as defined by Steve Murawski:

- NOAA has direct responsibility to interpret climate change and variability impacts for the natural resources and areas it manages
- There are many examples of Climate Impacts on NOAA resources, but no coordinated, systematic approach for observations, predictions, peer review, use in management & communication of climate information in executing its statutory responsibilities

NinC's goal is to help NOAA develop a coordinated, systematic approach for the Southeast U.S. Continental Shelf Large Marine Ecosystem (SEUSCS-LME) incorporating the following elements identified by Steve Murawski:

- **Identifying and prioritizing** climate change factors, identifying current resources, and analyzing effects
- **Engaging a wide variety of NOAA offices & partners** to assess requirements and capabilities
- **Combining NOAA's observations, models and forecasts** as sentinels of climate change's impact on resources and the environment (e.g., **marine phenology* network**)
- Develop an approach to **address and understand** at least part of the Ecosystem/Climate connection
- Develop a **strategy to communicate** with regulators, constituents, and the public the impacts of climate change factors on resources and people managed by NOAA

Breakout group outcomes need to serve these objectives.

*Phenology is defined as a branch of science dealing with the relations between climate and periodic biological phenomena; the study of the response of living organisms to seasonal and climatic changes to the environment in which they live. Seasonal changes include variations in the duration of sunlight, precipitation, temperature and other life-controlling factors.

Topics for Concurrent Breakout Groups

Group 1 topic: Key institutional and scientific programs contributing to characterizing and assessing the effects of climate change on the SEUSCS-LME.

Objectives:

1. Identify existing (current and historic) data sets.
2. Identify which of those data sets provide historical status of the SEUSCS-LME.
3. Identify which of those data sets might be useful to detect changes in climate or the effect of changes in climate on the ecosystem.
4. Identify specific contacts to find other existing data sets (i.e., existing information not identified by this group).

Group 2 topic: Parameters and related products of importance for characterizing ecologically meaningful regions and defining boundaries within the SEUSCS-LME.

Objectives:

1. Identify existing methods of characterizing marine ecosystems, along with the strengths and weaknesses of each.
2. Identify potential *a priori* ecologically meaningful regions in a broad context.
3. Generate a list of parameters and related products that may be important in characterizing the ecologically meaningful regions within the SEUSCS-LME.
4. Identify which of those parameters are likely to be of most importance in future data collection efforts (might rank high, medium, low importance).
5. Discuss how boundaries could be defined and for what purposes.

Group 3 topic: Identify key challenges and drivers related to tracking and forecasting climate change and its effects on the LME, its various ecologically meaningful regions, and its living marine resources.

Objectives:

1. Identify components of conceptual models linking primary climate change drivers (e.g., seal level rise; sea surface temperature change; rainfall/runoff) and ecosystem end points of concern (e.g., fisheries harvest, protected species populations).
2. Identify intermediate stressors and intermediate biological effects through which climate change drivers force ecosystem impacts.
3. Identify spatial temporal extent of ecosystem subsystems where ecosystem impacts are likely to be most probable and severe.
4. Identify what impacts of climate change on the LME NOAA might be able to forecast successfully in the next ten years.

Group 4 topic: Investigating SEUSCS-LME hard bottom communities as sentinels of climate change: scales, sampling designs, and environmental parameters including ecology, geography, oceanography, and weather.

Objectives:

1. Identify appropriate environmental parameters
2. Identify appropriate temporal and spatial scales
3. Identify potential sampling program designs

Appendix F: Summary of Discussion from Breakout Group 1

Facilitator, Darin Figurskey
Recorder, Mike Emlaw

Group 1 topic: Key institutional and scientific programs contributing to characterizing and assessing the effects of climate change on the SEUSCS-LME.

1. Identify existing (current and historic) data sets.
2. Identify which of those data sets provide historical status of the SEUSCS-LME.
3. Identify which of those data sets might be useful to detect changes in climate or the effect of changes in climate on the ecosystem.
4. Identify specific contacts to find other existing data sets (i.e., existing information not identified by this group).

The breakout group was comprised primarily of individuals familiar with meteorology, hydrology, and/or climatology. Among the group, there was only limited experience in marine life and ecosystems. Still, a variety of data sets available over air, land, and sea were discussed, as well as data sets anticipated to be important for the future.

Identify current and existing historic data sets.

The following represents a list of current and existing historic data sets for possible use in characterizing and assessing the effects of climate change on the SEUSCS-LME:

1) Temperature and precipitation data via ASOS and Buoy data from NCDC. Climate data and modernization (CDMP) is ongoing at NCDC.
2) 1982-2005 Reynolds seas surface temperature data sets.
3) 1987 to present for blended winds
4) Hurricane and climatology data sets. Hurricane reanalysis is being done to determine a 100-year surge probability using the NOAA hurricane climatology data.
5) Cloud cover data sets
6) Sea sediments via the NCDC Paleoclimatology wing.
7) ICOADS data/ships at sea via VOS data.
8) Patchwork of national and international data sets from NCDC.
9) SECOORA
10) SAB data sets
11) Archive of different data sets including C-MAP data, fisheries data, buoy data, ocean gridded climate data, AVHRR, TRWW, chlorophyll, CoastWatch and SeaWiFS via NODC. There could be some accessibility caveats with respect to at least some of these data sets.
12) NODC/NCDDC (National Coastal Data Development Center), working to bring large data sets together in an ecosystem context. Currently involved in data discovery with a focus on metadata using whatever data sets that are available through the Web (http://ecowatch.ncddc.noaa.gov)
13) Several satellite data sets through NESDIS and NASA.
14) Trim data, remote precipitation data from sounders. Equipment on buoys to provide ground truth.
15) NC Division of Water Resources has some stream data sets that look at water quality/turbidity.
16) USGS has gage and stream flow data.
17) North Carolina State Climate Office is building large data sets from both land and water (CRONOS).
18) NESDIS has topographic and bathymetry grids, side scan data, sediment cores, CO-OPS (NOS), and sea level rise.

19) Florida has its own network of tide gages that include one-foot mean lower low water water temperature sensors. Florida maintains these tide gages which are also equipped with metadata sensors.
20) Army Corp of Engineers
21) NSSL has Doppler radar archives that are used to run a 15-year analysis of precipitation data.
22) Storm data
23) NGS, CO-OPS and EPA Ecosystems Research Division are working with NERRs to determine the impact of water level on areas where the land is subsiding.
24) States do beach monitoring and track changes with LIDAR.
25) USGS doing sea floor mapping, side scale scanning, and erosion rate.
26) submerged aquatic vegetation bed mapping for NC coast to look at water quality in the near future. Will have a complete map of submerged aquatic vegetation beds.
27) Historical shoreline data covering thousands of years.
28) Peat samples and carbon dating. The East Carolina University has a wealth of information. (Stan Riggs information)
29) NGS used to do mapping, good reference for changes over time.
30) Hand written observation logs that some Weather Forecast Offices have on station.
31) FEMA climatology of hurricanes, including reoccurrence frequencies and developing models for doing risk analysis.
32) Population growth and infrastructure change that is occurring and the impacts it has on the environment.
33) Avian species count. Audubon does a bird count.
34) Data on mortality events, marine mammal standings, bird and fish kills.
35) NOS Data Explorer (Geospatial data sets) to get data sets consistent. (http://oceanservice.noaa.gov/dataexplorer/welcome.html).
36) SE Data Explorer, CSC and NOAA Southeast and Caribbean Regional Team; project just underway.
37) Carbon data for ocean acidification.
38) NOAA research council (science fact sheet) on episodic flooding and state of the science and research.
39) Shallow Water Assessment Program a shallow water device that uses photography and mapping of undersea water grasses and fishes. Will be turned over to the U of Miami.
40) NC State Climate Office is building a sea surface climatology project for the Gulf Stream. (May use 20 year satellite set as possible input into this project).
41) NC State Climate Office working on adding metadata sensors to existing water monitoring sites. (ECONET) (http://www.nc-climate.ncsu.edu/econet)
42) FSL-GPS water vapor sites.
43) Subsidence rate of land in conjunction with sea level rise information. USGS has lots of information.
44) Metadata observations from oil platforms. MMS (Marine Mineral Service through the Marine Minerals Program) indicated that NOAA had to be allowed access to place sensors in oil platforms and other places. In addition, there is a legal boundary with NOAA.
45) Tidal and subsidence observations in cooperation with NOAA CSC, USACE and FEMA.
46) SWAN (Simulating Waves Nearshore) model forecast can be used to rerun old cases.
47) Marine grid parcel mapping. (Map Cadaster)
48) Ferry reports for 14 years at NWS Newport, NC including water and salinity.
49) Web cams
50) Information from the National Geospatial Program Office, housed under the USGS. There are USGS Geospatial Liaisons in every state, including both North and South Carolina.
51) NOAA and Navy operational ocean model output

Identify which of those data sets provide historical status of SEUSCS-LME.
Most if not all of the above provide historical status of SEUSCS-LME.

Identify which of theses data sets might be useful to detect changes in climate or the effect of changes in climate on the ecosystem.
Most if not all of the above provide information that might be useful to detect changes in the climate or the impact of climate changes on the ecosystem.

Identify specific contacts to find other existing data sets (i.e., existing information not identified by this group.)
This was not discussed.

Anticipate future data sets needed.

The following represents discussion comments on future data sets that may be needed or useful in characterizing and assessing the effects of climate change on the SEUSCS-LME:

- Digitized data sets – needed for future analyses
- CI-FLOW portal.
- Historical fish count.
- Geographic Information System cross sections of several data sources.
- The ability to tie into different data sets.
    - This may be useful over a small portion of the basin. Could the Tar River be a demo for future expansion? Need to be aware of water quality issues, EPA involvement.
    - One size does not fit all so putting everything in one portal may not be the best. Portal information will be very different in terms of users, needs, and scale.
    - Linking the data sets is an interesting challenge. A climate portal may be different that an ecosystem portal.
- Wind farms offshore, leasing rights with respect to state and others.
- Legislative boundaries and the regulations that go with those boundaries.
- Tidal information.
- Fisheries and marine surveys.
- Commercial fishing data.
- Living marine data sets.
- Fishery-independent data and surveys.
- Historical climate general circulation model (GCM) data
    - GCMs are becoming a central tool of climate science.
- Data from Quikscat or its replacement.

Appendix G: Summary of Discussion from Breakout Group 2

Facilitator, Rebecca Ellin
Recorder, Richard Bandy

Group 2 topic: Parameters and related products of importance for characterizing ecologically meaningful regions and defining boundaries within the SEUSCS-LME.

Objectives:

1. Identify existing methods of characterizing marine ecosystems, along with the strengths and weaknesses of each.
2. Identify potential *a priori* ecologically meaningful regions in a broad context.
3. Generate a list of parameters and related products that may be important in characterizing the ecologically meaningful regions within the SEUSCS-LME.
4. Identify which of those parameters are likely to be of most importance in future data collection efforts (might rank high, medium, low importance).
5. Discuss how boundaries could be defined and for what purposes.

Discussion of Objectives was mixed together. Attempts were made to organize comments based on objectives. Action items and consensus points are illustrated in bold.

Objective 1: Identify existing methods of characterizing marine ecosystems, along with the strengths and weaknesses of each.

- Temperature - Global warming context. Number of sources, bottom temp, historical data, buoy data, NOAA SST data.
- Physical oceanographic parameters - distribution, tracking changes. Shifting flora and fauna north (
- Chlorophyll levels and changes in productivity, mainly in open ocean areas. Track changes in climate causing changes in productivity showing shifting ecosystems
- One approach for defining eco-regions has been proposed by The Nature Conservancy.
- Mark Spalding paper - divided ecosystems into ecological zones.
- Start by reviewing existing peer reviewed publications.
- ACTION: Compile pre-existing papers.

Objective 2: Identify potential a priori ecologically meaningful regions in a broad context.

- Scale question for manageability. Tidal Creek systems characterized through monitoring and amount of development related to areas. Impact of development in estuarine areas.
- Eco-Regions: broad (ecosystem scale) then sub-eco region definitions, then boundaries in terms of hydrologic units. Watersheds, ocean circulation patterns. Further fine tuning - draw boundaries in terms of habitat types (hard bottoms vs. soft bottoms, wetlands vs. subtidal estuarine waters, gradient estuaries, salinity zones. Venice classification system data available from NCCOS

Objective 3: Generate a list of parameters and related products that may be important in characterizing the ecologically meaningful regions within the SEUSCS-LME.

- Temperature - Global warming context. Number of sources, bottom temp, historical data, buoy data, NOAA SST data.
- Physical oceanographic parameters - distribution, tracking changes. Shifting flora and fauna north
- Chlorophyll levels and changes in productivity, mainly in open ocean areas. Track changes in climate causing changes in productivity showing shifting ecosystems.

- Must establish boundaries, could be based on geomorphology. Bathymetry data sets to identify regions example: capes of NC separating bays and Bays can be units. Spatial framework used to partition studies, i.e., bays and depth of regions in bays. Areas don't change. Can see changes occur within the fixed area.
- Hierarchical approach. Great diversity north to south as well as estuarine to coast to open water.
- Two approaches- 1. Spatial assessment of status (pattern). 2. Temporal time series observations to depict trends.
- Understand there is no cement wall, fish and mobile resources move around.
- Climate change and community regime shift changes, recommend managers determine sub regions.
- Murawski presentation cited - Develop broad stakeholder governance. Focus on essential parts of ecosystems and underlying processes that affect them.
- Development if IEA based on policy boundary (what questions are you asking). The issue will drive the definition.
- What is the climate change connection? What are we looking to answer?
- Long term data sets show climate change. Phenology concept. Changes in seasonality of events rather than yearly averages. Changes in species concentrations. Create a long term context, spiked with short term positive results.
- Include humans in the equation. Socio-economic and living marine resourced (ecological and biological). Need clear, usable thresholds, defined targets (example: oxygen levels) to drive management action.

Objective 4: Identify which of those parameters are likely to be of most importance in future data collection efforts. (High, Medium, or Low)

The group did not prioritize the parameters that were discussed.

Objective 5: Discuss how boundaries could be defined and for what purposes.

- Eco-Regions LME broad then sub eco-region definitions, then boundaries in terms of hydrologic units. Watersheds, ocean circulation patterns. Further fine tuning - draw boundaries in terms of habitat types (hard bottoms vs. soft bottoms, wetlands vs. subtidal estuarine waters, gradient estuaries, salinity zones. Venice classification system data available from NCCOS
- Utilize ecologically meaningful regions and marine protected areas (NERRS, Marine Sanctuaries). Consider political boundaries (managed areas and state boundaries).
- Don't like boundaries due to interactions. Boundaries must be credible. Sills in estuaries capes off coast affect communication between areas.
- Perhaps talk about regions vs. boundaries.
- Take all the capes together a subregion. Then tropical regions, then in between, outer shelf.
- Crucial that we take action and develop sub-regions and ideas.
- Issue based ideas have resonance with politicians. Break down LME to something manageable and scalable, but need to base it on issue you are trying to monitor and guard against what is happening.

Two major issues were identified:

1. Climate change impacts on coastal and human systems (effects on the coast, erosional sea level rise, loss of habitat).
2. Climate change impacts on living marine resources. Pick appropriate indicators within those issues. Base boundaries on how science will look at these issues.

- Determine impacts and how we want to address them. Make boundaries and regions based on that.

- How far down you go in defining boundaries depends on management questions. Broader for offshore fisheries. More detailed for near shore (sediment transfer and contaminants). Could use watersheds near shore.
- Could be in a single estuary, single state, or even in the whole region. Hierarchical definition based on questions being asked.
- Representative system design so that results can be extrapolated to other regions within LME.
- Planning for sampling, optimize sampling strategies. How to get most bang for the buck. Identify areas based on this. Example sills in Pamlico Sounds. Fine detail can be applied in estuaries but not on shelf.

Other thoughts:

- Use existing, long-term data sets.
- Need for monitoring in a broad sense. Collection of data. Tie effort into IOOS activities and other data networks (Tide gages, EPA) Take advantage of systems and tools in place. Observing systems contribute to this.
- There are ways to define ecosystems from broad down to minute. Don't break down until you have defined the issues and the management questions.
- Coastal Managers have workshops to determine what they are interested in as related to climate change. Utilize those ideas.
- Look at broad regional dynamics as a framework. Then drill down into fine details. Entire coastline is changing, recognize that.
- Need a big predictive model.
- Steering committee should determine cost and model we will follow, e.g., one presented by Dr. Murowski.
- Compile existing research that have defined areas and what parameters they have used (see action from objective 1)
- Be hierarchical when defining regions.
- Define regions based on what questions you are trying to answer.
- Make sure parameters/indicators are appropriately chosen to determine ecological issues and trigger management action.

Appendix H: Summary of Discussion from Breakout Group 3

David Evans, facilitator
Jack Thigpen, recorder

Group 3 topic: Identify key challenges and drivers related to tracking and forecasting climate change and its effects on the LME, its various ecologically meaningful regions, and its living marine resources.

Objectives:

1. Identify components of conceptual models linking primary climate change drivers (e.g., sea level rise; sea surface temperature change; rainfall/runoff) and ecosystem end points of concern (e.g., fisheries harvest,; protected species populations).
2. Identify intermediate stressors and intermediate biological effects through which climate change drivers force ecosystem impacts.
3. Identify spatial temporal extent of ecosystem subsystems where ecosystem impacts are likely to be most probable and severe.
4. Identify what impacts of climate change on the LME NOAA might be able to forecast successfully in the next ten years.

Breakout Group 3 was initially charged with developing and ranking questions pertaining to the effects of climate change on the meaningful regions of the LME. This charge was changed to one of how to integrate across regions, effects, and drivers of climate change.

The approach taken was to develop a preliminary conceptual model that linked environmental stressors (i.e., drivers) resulting from climate change with the possible impacts on coastal resources that we value. Connecting the stressors and values in the conceptual model are causal pathways and environmental indicators. A conceptual model of ecological impacts of hurricane was presented as an example

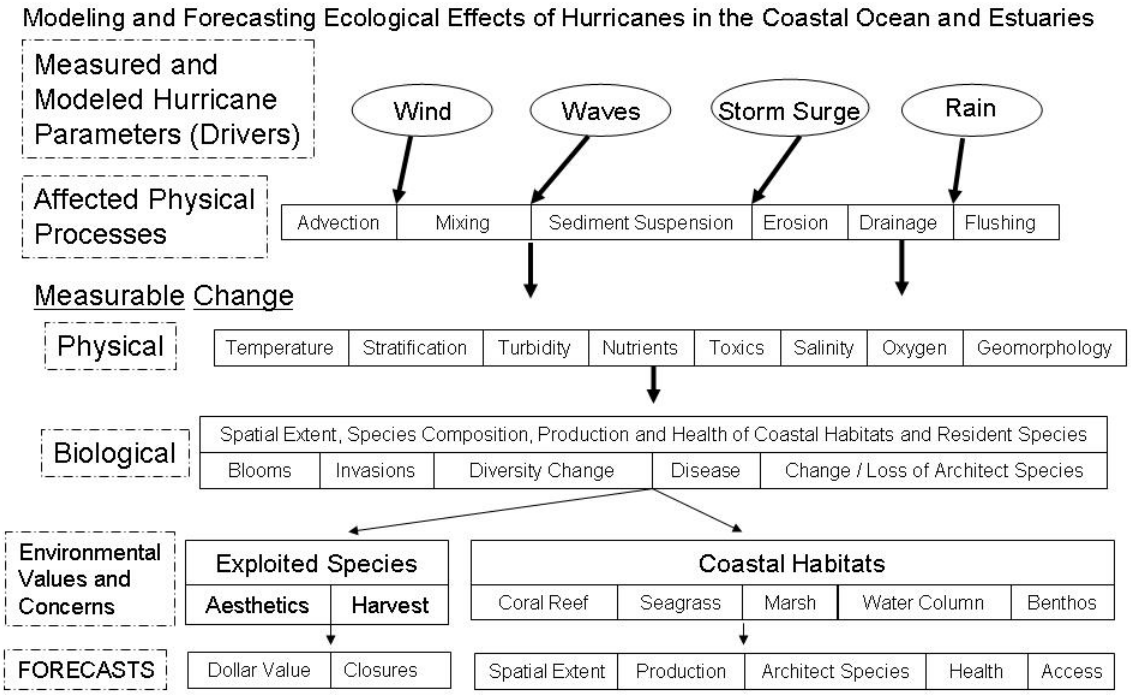
Conceptual models were addressed with three questions.

1. What are the primary drivers of ecosystem change?

- Sea level rise
- Increasing temperature
- Change in precipitation patterns
- Altered freshwater runoff
- Gulf Stream current patterns
- Changing weather patterns
- Change in storm activity
- Altered light spectrum - sunlight
- Atmospheric chemistry
- Ocean acidification
- Increased volatility in all measures

2. What are the attributes of the ecosystem that we place value on?

- Human health
- Ecosystem Health
- Fishable and swimmable waters
- Community (human) resiliency
- Community (human) resiliency



- Fisheries harvest - geographic patterns, socioeconomic
- Patterns of abundance of fisheries stocks and protected resources (biotic community shifts)
- Sediment quality
- Freshwater quantity (availability)
- Habitat stability
- Biological diversity
- Native species
- Species range extension/reduction

3. What can we measure that tells the state of the things that we value?

In this case, we chose to focus on a single region, Albemarle Pamlico Sound, and a single value, the population of harvestable southern flounder as measurable indicators of causally linked changes. The suggested potential indicators were:

- Drought - salinity, dissolved oxygen
- Temperature tolerance
- Freshwater inflow
- Water quality and quantity
- Species that specialize in living in an area with wide swings in habitat
- Habitat shifts - salt marsh, inlets
- Sedimentation
- Nutrient delivery
- Light availability
- Sea grasses
- Human changes in land use - runoff, impervious surfaces, retention ponds
- Hydrological cycle

Additional comments included:

- Ecosystems are "leaky". Boundaries are crossed by all factors
- We need to be prepared for a more dynamic system.
- How can we capture the positive effects of changes?
- Need to consider delivery of ecological services (carbon sequestration, denitrification, habitat) and consider their value in economic terms as a means to gain influence in political and decision making processes.

Appendix I: Summary of Discussion from Breakout Group 4

Facilitator, Andy Shepard
Recorder, Gregory Zielinski

Group 4 Topic: Investigating SEUSCS-LME hard bottom communities as sentinels of climate change: scales, sampling designs, and environmental parameters including ecology, geography, oceanography, and weather.

Objectives:
1. Identify appropriate environmental parameters
2. Identify appropriate temporal and spatial scales
3. Identify potential sampling program designs

Initial clarifications:

<u>What is extent of LME and geographic "hot spots" for assessing change?</u>
- SEUSCS-LME is from Hatteras to the upper Keys
- Partner with ocean observing systems, e.g., CORMP, SABSOON, SFROS
- Grays Reef National Marine Sanctuary interested in cross shelf transect (aka Latitude 31-30 initiative)
- Studies should span range of shelf widths and tidal regimes
- Minimum transects/study areas may be one in Carolinas, one in GA area, one in FL
- Within major sub-regions, need to define best transect locations based on indicators chosen to assess change (e.g., Onslow Bay at northern end of biogeographic zone, Gulf Stream offshore).

Why are hardbottoms in SEUSCS-LME good choice for this initiative?
- How do we define hardbottom community for purpose of this goal?
    - Inner to outershelf reef environments
    - Paraphrasing definition in Southeast Area Monitoring and Assessment Program (SEAMAP) document -- islands of broken relief in South Atlantic Bight, high to low relief, near shore to beyond continental shelf edge
- Carbonate setting makes SEUSCS-LME unique:
    - Only emergent shallow coral reef system in continental U.S.
    - Live-bottom reefs are oases-- importance or significance based on concentration of species/productivity (reef fish, commercial fish – pelagic fish such as tuna, mackerel, amberjack)?
    - Economic value and importance for coastal communities
    - Refugia for fish species—nurseries, spawning grounds
    - ontogenic life history for many valuable reef species spans from estuaries to shelf break
    - Artificial reef systems not specific focus, except when special management priority (e.g., snowy grouper wreck marine protected area)
    - Carbonate substrate provides paleo-climate history of region
    - Nearshore hard bottoms are under increasing threats from coastal development (in particular beach replenishment efforts that introduce more sand into inner shelf)
    - South Atlantic Fishery Management Council (SAFMC) is getting ready to designate new shelf marine protected areas that center on reefs
    - Historic data related to communities and temperature exist.

<u>Top climatic impacts/stressors:</u>
- Ocean Acidification—especially deep and shallow corals
- freshwater flow—increased flooding, saltwater intrusion with sea-level rise
- North Atlantic Circulation and associated events—upwelling, eddies, heat transfer

    - abrupt and extreme events-- more storms and more intense storms, increased physical disturbance of reef habitats, attribution/correlation with climatic change
    - Gradual temperature change
    - Upwelling threats—relation to incidents of coastal hypoxia uncertain; introduces nutrients to sensitive ecosystems such as hermatypic coral reefs (may encourage algal growth), increased harmful algal blooms
    - Population growth—coastal development, fishing impacts/changes

Objectives:

1. Identify appropriate environmental parameters

- Density and assemblage structure of organisms from multiple trophic levels (biology/ecology)
    - Habitat mapping
    - Fish assessment – non-destructive sampling (e.g., acoustics)
    - Life history—genetic analyses of populations
    - Trophic studies—isotopic analyses, gut contents
    - Benthic cover (algae and invertebrates), infauna and bioeroders
    - Video and visual transects, baited transects (to evaluate those fish that shy away from moving targets): look at different fish species/ages of fish
    - Behavior patterns
    - Conspicuous fish communities such as lionfish; other fish on edges of biogeographic range (tropical reef fish, northern species such as hake and tautog)
    - Plankton
- Physics and chemistry of bottom water
    - Temperature, pH, chlorophyll, nutrients (nitrates, phosphates, carbon as in dissolved organic and other carbon species in cycle (CO_2)), dissolved oxygen, turbidity
    - Signature of groundwater inputs and upwelling events (most of those parameters listed above, but also trace metals)
    - Oceanographic currents modeled by water mass and sub-region
    - Gulf Stream upwelling events
- Meteorological/atmospheric measurements—offshore, satellite and buoys
- Substrate geology
    - Habitat maps
    - Sub-bottom seismic profiles
    - Lithofacies and stratigraphic sampling—paleoclimate data
    - Seafloor roughness/rugosity—need new high resolution maps including < 1 cm-scale acoustic maps and visual groundtruth data
    - Sediment sampling—detect groundwater, benthic microalgae.

2. Identify appropriate temporal and spatial scales

Temporal scales -- paleo to and contemporary:

- Continuous versus episodic events
    - Continuous for temperature, salinity, pH, sentinel species
    - Real time from buoys, especially for certain aspects like hurricanes/events (couple to events), also include eddies, upwelling, spawning events
    - Diurnal sampling for day and night comparisons—observatories with acoustics, diving
    - Seasonal sampling
    - Span critical events such as full El Niño Southern Oscillation cycle
- Interannual variability: >5 year continuous
- Decadal revisitation (10-20 year program)
- Paleo-studies:
    - coral proxies (including deep reefs)

    - Hardbottom reef stratigraphy
    - Taphonomic studies to interpret paleo data

Spatial scales:

- Inner shelf to outer shelf continuum across the region
- How far to expand the study given how sub-regions may respond to climatic change? Potential for different responses cross-shelf and along-shelf, and going north to south across the region.
- New focus on biogeographical transition areas: has been fewer inventories and biogeographic studies near the ends of the LME (Cape Hatteras and Cape Canaveral)
- Need to identify sub-regions and work as a team to promote and develop related program
- Off the shelf -- Gulf Stream habitats, Lophelia (800 m)
- Mapping scales, as in habitat mapping: all targeted MPAs, all target transects, down to centimeter pixel size for habitat type
- Fish studies -- meso-scale (hundreds of meters) and habitat associations

3. Identify potential sampling program designs

- Continuous sampling—partner with ocean observing system
- Long-term paleo record -- cores, grabs, seismic profiles
- New approaches for habitat mapping and characterization:
    - Benthos species
    - Habitat
    - Geology
- New approaches for mobile target species (fisheries):
    - Reef fish (adult/larvae)
    - Shellfish
    - Pelagics
    - Acoustics—passive and active
    - Tagging to assess habitat use and migration
- Hypotheses proposed by Munoz -- how would these be addressed?
    - Will tropical fish species increase/range move to north? Cross-shelf transects, videos and visual, collections at diel to seasonal scale (important as major changes occur with seasons, e.g., changes in algal communities)
    - NCCOS studies ongoing; do we need to look at larger scales?
    - Larval distribution patterns especially difficult-- Hard to sample on reefs, migrate in water column daily; new acoustics (optical plankton recorders on observatories, near-bottom light traps), discrete depth net sampling.
    - Need to include studies on soft-bottoms surrounding hardbottoms -- Transects (acoustic and visual), nets to look at fish.
    - Use AUVs with observatory approach (buoy and real-time connections as with sonar surveys, can get to recruitment dynamics that could be affected by climatic change, so need baseline to get these data, so know where starting from); Single superstation; look at existing buoy locations and those who have/use buoys as place to establish this observatory.

Next Step: Propose to have a one-day session to present to and discuss program.

Appendix J: Comments by the Final Panel

Susan White:

- Value of NinC is grass roots constituency that will help to better coordinate regional activities and reduce redundancy
- CI-FLOW is success story-- classic model for how to develop bottom-up initiative and get into PPBES
- SECART and NinC should co-exist; SECART has distinct mission and should work closely with NinC; NinC is not hamstrung by same administrative constraints as SECART—we can dream about big ideas; NinC should work through SECART to affect PPBES
- Volunteer energy of NinC is very encouraging
- NinC is avenue for engaging extramural partners; NinC should expand to support this engagement—more not less academic and private partners
- Continue focus on education and outreach
- Engage state's coastal programs
- Supports "Summit to the Sea" approach—cross-Line Office, inter-disciplinary, regional/ecosystem scale; make watershed connection to O in NOAA; specific areas of interest should reflect regional and national priorities, e.g., drought, aquaculture; keep several long-term initiatives on-hand, ready to respond to agency opportunities
- Develop a stronger Vision and mission statement and a strategic plan
- Improve diversity of group; invite students to participate; develop initiatives that engage under-represented groups (SE is good place for this activity)

Suzanne Van Cooten:

- Supports growth and large-scale inter-disciplinary initiatives, but have to balance with capacity—scope may kill good volunteer program
- NinC is about both outreach and "in-speak"; synergy is strength
- Continue to improve internal communications, collaborations, and education
- Thrust or "collaboratory"-- to provide open and easy access to information; no proprietary use repository of critical data and knowledge needed by stakeholders; modular, distributed, accessible
- Diversity is not just about people; need to emphasize and encourage diversity of ideas; focus on innovations including new approaches for engaging under-represented groups
- Thrust—work-force enhancement; developing next generation of NOAA scientists and managers
- NinC is a unique service as "community of knowledge and spirit to support NOAA mission."

Rick DeVoe:

- SECART and NinC—latter is opportunity to extend beyond NOAA infrastructure; like Susan, he support building this role; engage state managers; engage representatives from other regional programs
- Work with state delegations
- Link activities with other regional partners, perhaps even merge meeting activities; e.g., developing SE Ocean Alliance, Sea Grant regional assessment effort, COSEE-SE
- Perhaps use IPCC approach on regional level: "*The IPCC was established to provide the decision-makers and others interested in climate change with an objective source of information about climate change. The IPCC does not conduct any research nor does it monitor climate related data or parameters. Its role is to assess on a comprehensive, objective, open and transparent basis the latest scientific, technical and socio-economic literature. . .*" (http://www.ipcc.ch/about/index.htm).
- Primary role of NinC should be outreach -- to shed light on critical issues unique to region.

Appendix K: Meeting Evaluation Results

Participants were asked to complete a survey evaluating the meeting. The survey questions and scores are noted below. Written comments follow.

Topic	Mean Response	Response Level 1	2	3	4	5	6	Blank
		Poor	Fair	Satisf.	Good	Very Good	Excel-lent	
Meeting Objectives								
Enhance your awareness of select NOAA programs in the Carolinas region	**4.53**	0	2	3	8	11	6	0
Explore new cross-cutting collaborative projects between organizations	**3.83**	1	2	8	10	8	1	0
Provide Opportunities/Increase overall knowledge about the One NOAA vision	**4.34**	0	4	3	5	13	4	1
Meeting Agenda								
CIFLOW Update	**4.34**	0	0	7	10	7	5	1
Keynote speakers	**4.73**	0	0	1	13.5	5.5	7	0
Climate-Ecosystem Plenary	**4.46**	0	0	3	14	6	5	2
Climate-Ecosystem Breakout	**4.41**	0	0	2	9	11		8
Wed. Reception & Poster Session	**4.37**	1	0	4	10	7	5	3
SECART Plenary Sessions	**4.12**	1	0	6	10	6	3	4
Meeting Logistics								
Workshop format & process	**4.38**	0	1	5	9	10	4	1
Rate facilities & meals	**4.50**	0	0	5	11	8	6	0
Overall Impression								
Overall rating of annual meeting	**4.50**	0	3	1	7	16	3	0
Involvement w/ new projects as result of this meeting	**4.00**	3	1	3	11	4	5	3

Additional Questions	Yes	No
Support meetings	**21**	**1**
Expand to include Georgia	**8**	**3**
Expand to include Florida	**3**	**6**
Expand to include Georgia and Florida	**5**	**3**
Expand to include neither Georgia nor Florida	**2**	**3**

Written Comments on the Evaluation Forms

MEETING OBJECTIVES

- Means a lot of work ahead to develop an initiative to be executed for the region.
- I struggled to find a climate-ecosystem connection/focus. Not much climate discussion at all.
- Keep the long discussion/fewer speakers format. This allows a fuller discussion and greater participation component to the meeting.
- Might be useful to have a NinC starter ppt
- Was more of a report out on individual's research projects vs. actually exploring new collaborative projects.

MEETING AGENDA

- Too many acronyms used in talks; I'm still not familiar with these acronyms that people toss around. (I'm a non-NOAA person)
- Interesting, but the comparison of two alternate approaches not clear. Also not clear how NinC fits in or wants to fit in.
- May want to drop posters from reception
- Need more time for break out sessions and identifying/discussing potential collaborative projects/ideas.

MEETING LOGISTICS

- I was expecting more break-out discussion and work group time.
- Beaufort Lab and staff were outstanding in their organization and hospitality.
- Recycle and cease using Styrofoam.
- Lunch was so-so.
- Outstanding. Great organization by organizing committee.
- Although need more interaction of attendees mixed in with talks.
- By the time of the breakout group, many people (esp. non-NOAA) folks had left.

OVERALL IMPRESSION

What went really well?

- Overall everything went well. Smooth meetings, logistics, hotel, meeting facility are great.
- Closeness of facility and accommodations, opportunity to see connection to other fields in marine community that I was not familiar with before.
- Meeting other agencies.
- Breakout groups (mentioned 3 times).
- Communication! Discussion.
- Organization allowed meeting to flow yet change with time changes of talk and lunch length.
- Time management, hospitality and accommodations. Presentation scope and diversity of presentation.
- Discussions after presentations.
- Questions and interactions.
- Logistics – no problems – everything went smooth.
- Presentations – for most part – all were well prepared
- Quality of presentations.
- Good information presented.
- Keynotes were great!
- Good presentations over gamut of mgt and research.

What part did you learn the most from?

- CI-FLOW – great application to my locale and office.
- Dr. Riggs talk/CI-FLOW.
- As I'm new to NOAA I appreciated learning about NOAA culture, initiatives and benefited from interacting with folks from other NOAA offices.
- Steve, Stan, Chris, Roldan, Mike P's talks. Break-out session.

- Stan Riggs presentation on history and human dimension of shoreline/ecosystem changes (mentioned 5 times) .
- Thurs morning presentation.
- NOAA mission. Need for changes
- One-on-one conversation.
- Better understanding of IEAs (and challenges)
- IEA presentations.
- Science talks – headquarters organizational talks not that helpful.
- Presentations.
- Even more about what NOAA is doing in area but more or less talking to ourselves vs. state folks.
- Hats off – great meeting.

If you could change one or two things about the meeting, what would it be? In addition, how would you change it?

- First day went quite late. After 4:30 the energy level in the room really dropped off (and so did attendance).
- Not go to 6pm with presentations.
- More discussion about vision/goal of project and what/how our agency can participate.
- Longer breakout group discussions! The momentum of this meeting came to an abrupt halt at the 2nd talk. Establishment of the regional context within NOAA really was far too long and not especially relevant to those not in the steering committee. In addition, it led to a "closed" – NOAA only atmosphere, which was not at all conductive to keeping the few new external academia attendees interested or participatory. Most left early and did not participate unfortunately. This was a profound loss to idea development.
- Need more interaction of members/attendees (mentioned 2 times). Maybe 3-day session w/ 2nd day have break-outs but with randomly assigned folks to topics w/ 3rd day as plenary wrap-up. Summary speaker someone notable.
- Don't give me an overview of what you are doing. Let's talk about what you are not doing or want to do and how it relates to meeting theme.
- More time to interact.
- Consider bringing in other federal partners and state agency representation
- Rick DeVoe's talk would have been more appropriate earlier in the day rather than sandwiched in between two science talks. Also, by cutting his talk short (15 minutes ?) the participants were unable to learn about actual and relevant regional projects, which I saw as a major goal of the meeting.
- I was very surprised and disappointed that NOAA used Styrofoam cups! Please discontinue.
- More time for discussions. Discussion seemed very science focused maybe more linkages between science and management?
- More time for break out sessions. Good brainstorming was cut short.
- Less project-based sessions and updates and more time for discussions regional issues/collaborative opportunities.
- Time management – stop presentations when over time; allow for more time for questions. In breakout groups, have a real facilitator vs. someone with preconceived answers / stick to topic.

Should we expand the program regionally?

- Would have to figure out interest in Georgia. NOAA in the Carolinas has a great name recognition and changing it could be confusing.
- Work within broader SE LME context.
- Why not SC (Charleston) (2010)