



NOAAⁱⁿ the CAROLINAS

National Oceanic & Atmospheric Administration



Report from the 2010 NOAA in the Carolinas Meeting: CLIMATE SCIENCE, SERVICES AND ENGAGEMENT IN THE CAROLINAS

Renaissance Hotel, Asheville, NC
April 21-22, 2010

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NOAA in the Carolinas
Report from the April 2010 Meeting:
CLIMATE SCIENCE, SERVICES AND ENGAGEMENT IN THE CAROLINAS

Executive Summary

The fifth NOAA in the Carolinas meeting was held 21-22 April 2010 at the Renaissance Hotel in Asheville, NC, and was co-hosted by the NOAA National Climatic Data Center (NCDC). There were 71 participants from eight states, and 32 different state and federal agencies, universities and non-profit organizations were represented. The theme for the meeting was *Climate Science, Services and Engagement in the Carolinas*, three closely tied issues of increasing priority for NOAA, individual states, and the nation.

Three keynote addresses set the scene for discussions during the meeting. The first keynote address, presented by Eileen Shea, Chief of the Climate Services and Monitoring Division, NCDC, focused on *Climate Services* and described the NOAA proposal to create the Climate Services Branch. The second keynote address, which focused on *Climate Engagement*, was provided by Ned Gardiner, NOAA Climate Program Office, and Jim Fox, Director, Renaissance Computing Institute (RENCI) Asheville. Mr. Gardiner discussed three different types of engagement opportunities, including the newly deployed NOAA climate portal (www.climate.gov), while Dr. Fox provided an overview of RENCI Asheville and described the lessons learned during the process of developing climate products and services for specific audiences in western North Carolina. Otis Brown, Director, NOAA Cooperative Institute for Climate and Satellites (CICS), provided the third keynote address. Dr. Brown offered an overview of CICS, its partners and research interests while describing CICS *Climate Science* efforts.

Each keynote address was followed by theme-based, moderated breakout sessions to stimulate dialogue amongst participants. The sessions highlighted the fact that climate products and services, outreach and engagement, and climate science are not individual themes but rather are interconnected concepts that must be considered in concert order to put climate into context for any audience. One climate change impact for the Southeast, highlighted within all of the breakout groups, is the possible increased number of prolonged droughts causing reduced access to clean water. Lack of clean water may have adverse affects on human health, agriculture, transportation and energy, and coastal and marine ecosystems. The impacts on these sectors due to drought could be staggering.

An immediate action item is to outline and develop interdisciplinary pilot projects for the Carolinas that are specific to targeted community sectors. The NOAA in the Carolinas Steering Committee will work with CICS, Carolinas Integrated Science and Assessments Program (University of South Carolina), and the Southeast Regional Climate Center (UNC Chapel Hill) to identify pilot projects that address climate concerns stressed during the breakout sessions.

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BACKGROUND

NOAA in the Carolinas (NinC) is a self-initiated engagement effort on the part of NOAA staff, programs and partners in North Carolina and South Carolina. The mission of NinC is to work across agency lines and disciplines to enhance NOAA's value to and impact on the region. NinC objectives are to:

- Identify local to regional challenges, needs and opportunities in North Carolina and South Carolina.
- Mobilize, share, and integrate knowledge and capabilities across NOAA and extramural partners to respond to constituent needs and opportunities.
- Coordinate with NOAA's Southeast and Caribbean Regional Team (SECART) to support regional activities and more effectively engage extramural partners in mission planning and execution.
- Attract new resources to address regional issues and develop initiatives using the OneNOAA approach.
- Create opportunities for outreach that promote NOAA products and services.

To achieve these objectives, NOAA offices and programs in the region 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 web site at <http://www.carolinas.noaa.gov/>.

In 2004, 2005, 2007, and 2008 NOAA representatives in North Carolina and South Carolina conducted meetings in Wilmington, NC; Asheville, NC; Charleston, SC; and Beaufort, 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/>). Highlights from some of the meetings, especially progress on specific projects, have been presented by NinC Steering Committee members to the NOAA Goal Team and Line Office leaders at presentations in Silver Spring, MD.

During the early years of NinC, NOAA leadership endorsed the NinC regional approach to OneNOAA. Recently, NinC has coordinated with the Southeast and Caribbean Regional Team (SECART). The 2008 annual meeting theme was *The Ecosystem-Climate Connection* and was an initial effort, on the part of NinC, to begin considering how climate change will affect the Carolinas region. The 2008 meeting outcomes were presented to SECART to highlight climate-ecosystem research interests in the Carolinas. The work begun in 2008 paved the way to the 2010 NinC meeting theme: *Climate Science, Services and Engagement in the Carolinas*.

2010 NOAA IN THE CAROLINAS MEETING REPORT

The fifth NOAA in the Carolinas (NinC) meeting was held 21-22 April 2010 at the Renaissance Hotel in Asheville, NC (Agenda – Appendix A) and was co-hosted by the NOAA National Climatic Data Center (NCDC), located in Asheville. There were 71 participants from eight states, representing 32 different state and federal agencies, universities and non-profit organizations (Participant List – Appendix B). The theme for the meeting was *Climate Science, Services and Engagement in the Carolinas*, which are three closely tied issues of increasing priority for individual states, NOAA, and the nation. The theme was determined following deliberations by the NinC Steering Committee and NinC Meeting Planning teams (Steering Committee Members and Meeting Planning Team Members – Appendix C) while considering NOAA's objectives for a regional climate service enterprise.

To open the meeting, Aleta Hohn, Director of the National Marine Fisheries Service Programs at the NOAA Beaufort Laboratory, Beaufort, NC provided an overview of NinC, including its mission, activities, and previous meetings. Dr. Hohn identified the purpose of the meeting, including: 1) to identify how the new NOAA Climate Service, especially the NOAA-funded climate programs, can benefit the Carolinas at a relevant scale; 2) to alert these climate programs to the increasing interest for them to focus on local priorities first; and, 3) to ask the NOAA Climate Service what other federal, state and academic institutions can provide to increase its value and effectiveness in the Carolinas. Dr. Hohn also set the stage for the plenary talks and sectoral breakout groups. The attendees were asked to identify growth areas for climate research, data, products and services, as well as problem-focused data needs, communication strategies, technical capacity-building needs, and recommendations for working with NOAA regional climate services.

There were three keynote addresses during the two-day meeting. These presentations, along with the introductory presentation, are on the NinC website (www.carolinas.noaa.gov). A highlight of the meeting was the Carolinas Climate Activities Showcase, which offered an opportunity for participants to submit posters featuring current climate science, services, and engagement activities being conducted by NOAA, State agencies, and academics. Lengthy, fruitful discussions during this dedicated time set the stage for the rest of the meeting (submitted poster abstracts – Appendix D).

The first keynote address was provided by Eileen Shea, Chief of the Climate Services and Monitoring Division, NCDC, who described the NOAA Climate Service Proposal, which was developed to meet the rising demand for climate services. Ms. Shea explained that the NOAA Climate Service would be NOAA's contribution to the multi-agency Federal response to the nation's climate challenges. While planning for the proposed NOAA Climate Service continues, she noted that implementation of the new regional climate service enterprise has started. For example, announcements for six new Regional Climate Service Directors have been posted. It is envisioned that the NOAA Climate Service will connect science, services and people regionally by leveraging the assets of all levels of government, academia, NGOs, and the private sector.

This approach also highlights NOAA's efforts to engage stakeholders in order to better define and understand the "climate/society" connection.

Ned Gardiner, NOAA Climate Program Office, and Jim Fox, Director, Renaissance Computing Institute (RENCI) in Asheville, provided the second keynote address, focusing on Strategies for Regional Engagement. Dr. Gardiner discussed three engagement opportunities: 1) the need to develop and implement communication strategies that are culturally relevant; 2) the NOAA climate portal (www.climate.gov); and, 3) NOAA Regional Assessments. Mr. Fox provided an overview of RENCi Asheville and described the lessons learned during the process of developing climate products and services for specific audiences in western North Carolina. Mr. Fox stressed the need to create decision-support tools that encourage community engagement. In order to do this, the values of the community targeted must be understood since most decisions are values driven. This type of engagement process will provide information needed to create products and services that are relevant to identified audiences.

On the second day, Otis Brown, Director of the North Carolina component of the NOAA Cooperative Institute for Climate and Satellites (CICS), provided the third keynote address. Dr. Brown provided an overview of NOAA cooperative institutes and then of CICS, its partners and its scientific vision. CICS works across oceans and land, and supports multi-institutional projects ranging across the United States. CICS research themes are: 1) Climate and Satellite Research and Applications; 2) Climate and Satellite Observations and Monitoring; and, 3) Climate Research and Modeling. With regard to CICS and the Carolinas, Dr. Brown noted that all 16 of the UNC system schools are CICS partners. CICS climate research will include assessments, impacts, mitigation, adaptation and resilience in our communities. Research projects also will support workforce development in the climate sciences by funding graduate students and post docs from the UNC system campuses. Dr. Brown noted that the NinC region is a prototypical region for which CICS can create test-bed products and services. Examples of near-term CICS projects include increasing high performance computing capability for climate modeling, better monitoring of ocean acidification, better measurements of black carbon, developing a climate model data portal, and increasing access to satellite data for use by modelers and decision makers.

Each keynote address was followed by theme-based, moderated breakout sessions to stimulate discussions amongst participants within each breakout group.

- Breakout session 1 theme – Regional Climate Products and Services
- Breakout session 2 theme – Strategies for Regional Engagement
- Breakout session 3 theme – Regional Climate Science

During the meeting registration process, attendees specified which sector they would like to participate in for the breakout sessions. Sectors followed proposed NOAA Climate Services sectors and included:

- Marine & Coastal Ecosystems
- Energy & Transportation
- Human Health & Society

- Water (Agriculture and Ecosystems)

Participants had the option to stay in one sector or change sectors for each breakout session. The questions used to moderate the discussions within the breakout groups are provided in Appendix E and the outcomes of discussions during the breakout sessions can be found in Appendices F - I.

Synthesis Session: Discussion of Breakout Session Commonalities

During the breakout sessions, participants were asked to emphasize efforts to connect science to stakeholders/users in order to build connectivity between research and the decision-making process. Tim Owen, NOAA's National Climate Data Center, noted that the results of these sessions should be shared with regional climate services directors as they begin to develop programs to meet immediate and anticipated climate information needs. The breakout sessions also highlighted the fact that climate products and services, outreach and engagement, and climate science are not individual themes but are interconnected and must all be considered in order to put climate into context for any audience.

Session 1 - Regional Climate Products and Services

Each sector highlighted the need for the downscaling of climate models and products to the appropriate spatial level (e.g. by county or other management unit), as well as temporally (e.g. seasonal and long-term products and services). Products also need to incorporate data that were collected at varying scales (e.g., combine satellite imagery with *in-situ* data collection). Targeted audiences for products should be engaged early in the product development planning process in order to ensure that communication and product-delivery methods are in line with user needs and recommendations. Also highlighted was the need for education services that promote a better understanding of short-term versus long-term planning related to climate change. Along the same lines, there is a need to increase education efforts on the difference between weather products/services versus climate products/services. Many opportunities for interdisciplinary and cross-sectoral collaboration were identified (e.g., the need to combine public health and climate datasets to better understand how climate change will affect human health).

Session 2 - Strategies for Regional Engagement

A common theme between all breakout sessions was the desire for economic analysis and cost/benefit studies related to climate change (e.g., economic analysis of sea level rise and the costs associated with the loss of coastline). All climate change information needs to be provided at the local and state levels and across socio-economic tiers.

Some additional important commonalities between the sectors included:

- Reduce the focus on the causes of climate change (i.e., human induced changes) and use of the term climate change; instead focus on the possible effects.
- Acknowledge and communicate that uncertainty is normal when analyzing/studying long-term trends related to climate science. Uncertainty in results (e.g., will sea level rise 1 foot or 3 feet) is not an excuse to ignore the situation. Climate products need to provide a range of scenarios in order to be valuable to decision makers.

- Tailor climate products and services to sectors/groups and use the appropriate, user trusted messenger to convey those messages. Not only is there a need to create sector-specific products and services, but also there is a need to move beyond attending weather and climate workshops and attend sector-relevant workshops to discuss possible climate change impacts (e.g., physicians meetings, state-level department of water quality meetings, local planning professionals meetings).
- Build from lessons learned from other sectors when trying to engage audiences.

Session 3 - Regional Climate Science

There is a need for better data/information sharing and observations between NOAA agencies, state agencies and university-based research programs. Amongst sectors there is a need for more climate data, both temporally and spatially; however, such collection efforts require increased funding from state and federal agencies. For example, establishing new climate and weather instrumentation, such as water level stations, is expensive and requires agency commitment to maintain. In addition, data sharing may require increased access to possibly sensitive information, such as health care data. For example, when evaluating the effects of climate change on human health, due to Health Insurance Portability and Accountability Act (HIPAA) privacy laws, it is sometimes difficult to obtain health care information.

There is no single science discipline that can adequately address climate change. A multi-disciplinary, systems-based approach must be used to better understand climate effects on ecosystems and people. As climate research is conveyed to different audiences, there is a strong need to translate the research so that it can be understood at the local levels and incorporated into the decision-making process.

During each breakout session, participants were asked to discuss cross-sectoral opportunities relative to the other sectors meeting concurrently. Access to water (potable as well as non-potable) was a cross-cutting theme within all breakout groups and sessions. One anticipated climate change impact for the Southeast is an increased number of prolonged droughts. Access to water affects human health, agriculture, transportation and energy and the impacts on these sectors due to drought could be staggering.

OUTCOMES

Meeting participants agreed that the wealth of climate programs based in the Carolinas positions the Carolinas to be a test-bed for development and enhancement of regional climate products and services. Within the two-state region, several NOAA-funded climate programs are available for partnership opportunities: the University of North Carolina-Chapel Hill's Southeast Regional Climate Center (SERCC); the University of South Carolina's Carolinas Integrated Science and Assessments (CISA); and, the Cooperative Institute for Climate and Satellites (CICS), located at the University of Maryland and North Carolina State University.

Science-based information has to meaningfully flow in multiple directions – among researchers, decision-makers and general audiences. SERCC, CISA and CICS, all funded by NOAA, are well

positioned to assist State and Federal agencies with downscaling of products and services and engagement with local audiences. The Renaissance Computing Institute (RENCI) also has several engagement centers within North Carolina that can help serve this role. For coastal climate impact issues, North Carolina Sea Grant and South Carolina Sea Grant offices have outreach staff that are intimately connected to the local communities and have access to stakeholders who can identify climate information needs and provide feedback on climate products and services during development and implementation stages. Both Sea Grant programs are interested in collaborative opportunities with SERCC, CISA, and CICS as well as NOAA's NCDC.

There is a need to outline and develop pilot projects that are interdisciplinary in nature. This meeting provided valuable ideas on next steps. NinC plays a vital role in providing opportunities to bring people together for discussion and planning activities in the two-state region. In this role, NinC will follow-up from this meeting by working with key groups to set up a one-day workshop, potentially during Summer 2010, where interdisciplinary, collaborative pilot projects for each state may be initiated and partnership opportunities highlighted. Based on discussions in the breakout sessions, pilot projects may incorporate water resources and water forecasting as they relate to drought or energy and transportation. Information on the workshops will be shared with the NinC membership and will be posted on the website.

SPECIAL THANKS

The NinC Steering Committee would like to thank the NOAA's National Climate Data Center for co-hosting the 2010 NOAA in the Carolinas Meeting. We would also like to thank the Meeting Planning Team for their contributions to the planning and organizing of this meeting, especially the following planning team members who are not NinC Steering Committee members: Scott Cross, NOAA National Oceanographic Data Center; Rick DeVoe, South Carolina Sea Grant Consortium; Ned Gardiner, contractor for NOAA Climate Program Office; and, Tim Owen, NOAA National Climate Data Center. A full list of the Meeting Planning Team members and their affiliations is located in Appendix C. Finally, a very special 'thank you' goes to Melanie Whitmire of the University Corporation for Atmospheric Research (UCAR), for her logistical support prior to and during the meeting.

Appendix A

NOAA in the Carolinas Meeting Agenda



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National Oceanic & Atmospheric Administration



NOAA in the Carolinas Meeting Agenda

April 21-22, 2010

Asheville, NC

Day 1: April 21 (7:30 am – 4:00 pm)

7:30 am Registration: pick up name tags and meeting materials outside of the Windsor Room

8:00 am **Welcome to NOAA in the Carolinas 2010 Meeting** Windsor Room

Aleta Hohn, NMFS Southeast Fisheries Science Center

- History of NOAA in the Carolinas
- Purpose of meeting
- Introduction of themes
- Expected outcomes

Session 1: Regional Climate Products and Services

8:30 am Keynote address: ***Building Regional Climate Services***

Eileen Shea, NOAA, NCEM Climate Services Division

- Discuss regional climate services model data and information, communication mechanisms used in the delivery of climate products and services, and the role of NCEM data to Carolinas

9:15 am ***Carolinas Climate Activities Showcase***

10:00 am Break

10:20 am Introduction to Breakout Groups and Foci Windsor Room

10:25 am **Introduction to Breakout Session 1**
Tim Owen, NOAA National Climate Data Center

10:30 am ***Breakout 1: Regional Climate Products and Services***

Goals:

- Develop problem-focused products, information services, and decision support tools

Appendix A – NOAA in the Carolinas Meeting Agenda

- Connect users to existing climate products and services while continuing to develop new, authoritative, reliable services

Breakout Groups:

- Marine & Coastal Ecosystems Windsor Room
- Energy & Transportation Cherokee Room
- Human Health & Society Victoria Room
- Water (Agriculture and Ecosystems) Alexander Room

12:00 pm **Joint NADM-NinC Luncheon** **Salon A**

Session 2: Strategies for Regional Engagement **Windsor Room**

1:45 pm Keynote address: **and Ned Gardiner, *Strategies for Engagement* Jim Fox, RENCI at UNC Asheville, and Ned Gardiner, NOAA Climate Program Office**

- NOAA Regional Assessment Strategies
- Regional Engagement Strategies

2:30 pm **Introduction to Breakout Session 2**
Rick DeVoe, South Carolina Sea Grant Consortium

2:45 pm Break

3:00 pm **Breakout 2: Regional Engagement, Education, and Service Delivery**

Goals:

- Build a robust, service-centric program that ensures that users are actively engaged in service development by expanding sustained engagement, dialogue and collaborations with users.
- Improve the integration of climate science and services across the nation’s climate service enterprise by promoting partnerships that leverage the assets of all levels of government, academia, NGOs and the private sector.

Breakout Groups:

- Marine & Coastal Ecosystems Windsor Room
- Energy & Transportation Cherokee Room
- Human Health & Society Victoria Room
- Water (Agriculture and Ecosystems) Alexander Room

4:30 pm Wrap up for the Day

5:00 – 6:30 pm Open House - RENCI at Asheville

Day 2, April 22 (8:00 am – 4:00 pm)

8:30 am Coffee and Informal Conversation

Session 3: Regional Climate Science

Windsor Room

9:00 am Keynote address: ***Cooperative Institute Opportunities***

Otis Brown, NOAA Cooperative Institute for Climate Science

- NOAA Cooperative Institute for Climate and Satellites and relevance to the Carolinas

9:45 am **Introduction to Breakout Session 3**

Ned Gardiner, NOAA Climate Program Office

10:00 am Break

10:15 am ***Breakout 3: Regional Climate Science***

Goals:

- Support decision-making by providing place-based science and information that advance understanding of regional and sector climate impacts and risks.
- Promote scientifically-based adaptation and mitigation support by building and integrating NOAA's climate science capabilities.

Breakout Groups:

- | | |
|--------------------------------------|----------------|
| • Marine & Coastal Ecosystems | Windsor Room |
| • Energy & Transportation | Cherokee Room |
| • Human Health & Society | Victoria Room |
| • Water (Agriculture and Ecosystems) | Alexander Room |

11:45 am Buffet Lunch

Salon A

Session 4: Synthesis, Opportunities, Next Steps

1:00 pm Breakout Reports and Discussion by Breakout Theme

2:00 pm Key Cross-Sectoral Issues

2:30 pm **Meeting Adjourns**

2:45 pm Synthesis session for facilitators/recorders begins – All welcome

Appendix B

Meeting Participant List

Attendee List for NOAA in the Carolinas 2010 Meeting

April 21, 2010 Asheville, NC

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Appendix C

NOAA in the Carolinas Steering Committee

NOAA in the Carolinas Meeting Planning Team

Appendix C - NOAA in the Carolinas Steering Committee & Meeting Planning Team Members

NOAA in the Carolinas Steering Committee Members (listed alphabetically)

Robert Bacon	South Carolina Sea Grant Consortium, Charleston, SC
Richard Bandy	NOAA NWS Office, Newport/Morehead City, NC
Rebecca Ellin	NC National Estuarine Research Reserve, Beaufort, NC
Mike Emlaw	NOAA NWS Office, Charleston, SC
Virginia Fay	NOAA Southeast Regional Office, St. Petersburg, FL
Darin Figurskey	NOAA NWS Office, Raleigh, NC
Aleta Hohn	NOAA National Marine Fisheries Service, Beaufort, NC
Geno Olmi	NOAA SE and Caribbean Regional Team, Charleston, SC
Jeff Payne	NOAA Coastal Services Center, Charleston, SC
Andy Shepard	National Undersea Research Program, Wilmington, NC
Jack Thigpen	North Carolina Sea Grant, Raleigh, NC
Michael Voiland	North Carolina Sea Grant, Raleigh, NC
Susan White	Hollings Marine Lab, Charleston, SC

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Darin Figurskey	NOAA NWS Office, Raleigh, NC
Ned Gardiner	Contractor, NOAA Climate Program Office, Asheville, NC
Aleta Hohn	NOAA National Marine Fisheries Service, Beaufort, NC
Tim Owen	NOAA National Climatic Data Center, Asheville, NC
Andy Shepard	National Undersea Research Program, Wilmington, NC
Jack Thigpen	North Carolina Sea Grant, Raleigh, NC

Support Staff

Jennifer Dorton, NOAA in the Carolinas Program Coordinator

Jeremy Schulz, Webmaster

Appendix D

Abstracts for posters presented during the Climate
Activities Showcase

Stormwater Runoff – Modeling Impacts of Urbanization and Climate Change

Anne Blair, Denise Sanger, A. Frederick Holland, David White, Lisa Vandiver, Susan White
NCCOS Center for Human Health Risk, Hollings Marine Laboratory

Urbanization and associated sprawl are changing our landscape and ultimately affecting ecosystem and human health. As land becomes covered with surfaces impervious to rain, watershed hydrology is altered, most noticeably with increased stormwater runoff. Climate change will likely amplify the impact of urbanization on stormwater runoff, further increasing the quantity of polluted runoff and the incidence of shallow flooding. We developed a method for modeling stormwater runoff for small (< 10 mi²) coastal watersheds in the southeastern U.S. by using algorithms and flow curve number method of the U.S. Department of Agriculture’s Natural Resources Conservation Service and then calibrating the output to reflect regional conditions. U.S. Geological Survey (USGS) gaged data were used for validation. Model applications can be used to explore the impact on runoff of various urbanization and climate change scenarios. Forecasting changes in runoff will ultimately enable better decisions related to minimizing the impacts of stormwater runoff. This modeling method will be developed into tools designed for use by research scientists, engineers, coastal managers, educators, and outreach professionals.

Climate Services Focus on the State: The Role of State Climate Offices

Mark Brooks and Ryan Boyles
State Climate Office of North Carolina, NC State University

State Climate Offices have experienced significantly increased demand for their climate services, driven by concerns of climate change and society's increased vulnerability to climate and weather events. The demand for climate information has reached a record high as public and private agencies seek local expertise to mitigate impacts from both current and future climate patterns.

The purpose of each State Climate Office is to provide its state with climate information, analysis, research, education, and climate-based decision support. Most users want climate science expertise at state and local scales, and State Climate Offices have developed trusted relationships with state and local communities over many years of service. Consequently, state-level expertise is highly desired for identifying and understanding impacts of climate change and variability and to support efforts at the state and local level in adaptation and response planning. Furthermore, climate information must be put into context for each client. State Climate Offices are experts at doing this because they know the local climate, economy and geography. In North Carolina, the State Climate Office has been providing climate services since 1976. The University-based program provides climate information and science to a broad audience through a range of services including:

Collecting local climate data: The NC Environment and Climate Observing Network (NC ECONet) provides routine, automated monitoring of standard and advanced climate variables, including solar radiation, soil temperature, and soil moisture. The network has 37 sites and is growing to cover the entire state.

Decision support tools for crop management: We help growers make timely decisions about when to plant, protect, and harvest their crop. Such tools combine high-resolution climate data with agricultural sciences. In North Carolina, the State Climate Office provides experimental and operational services to

support many growers, including formal programs for production of peanuts, fruits and berries, and cucurbits (cucumbers, squash, melons).

Drought monitoring and water planning: State Climate Office has developed decision support tools to specifically address state- and local-level needs. CRONOS-H2O, developed by our program, is the database driver for DENR Water Resource decision tools and local water managers. This tool has also been adapted to meeting the 7 states in the Tennessee Valley Water Partnership.

Outreach and education to agencies, community groups, and schools: Presentations often involve how climate science is used in our society, discussions about drought and climate impacts, and local impacts of future climates. We also interact with our coastal industries, including recreation and fishing. Many are involved in hazard mitigation, especially with issues of sea level rise and coastal storms.

Tourists' Usage of Weather Data in Travel Decision-Making to Southeastern North Carolina

Crawford, T., Gamble, D., Curtis, S., Long, P., Jessop, S., and Covington, R.
East Carolina University and UNC-Wilmington

Despite the growing recognition of the importance of the tourism sector to the economic well-being of the Carolinas and the complex interactions between climate, weather and tourism, there has been very limited evaluation of the extent to which climate and weather information is used within the tourism sector or how such information is being integrated into the specific decision-making processes of tourists or the tourism industry. With the establishment of the World Meteorological Organization's Expert Committee on Climate and Tourism, the emerging interest of the U.S. National Climatic Data Center in the tourism sector and the recent Climate, Weather and Tourism Workshop sponsored by the Center for Sustainable Tourism at East Carolina University, these complex interactions are now being more fully addressed. This pilot study focuses on the extent to which weather and climate data are used by tourists and recreationists in their decision-making process. Factors addressed included importance of weather and climate data to informed travel planning; required information necessary to make informed decisions; extent of knowledge of the current and longer-term weather and climate decisions of the preferred destination; accuracy of forecasts and access to necessary weather data; and factors considered when making travel plans including temperature, wind, rainfall and humidity. Surveys were conducted with randomly sampled beach tourists at selected beach sites in southeastern North Carolina. Respondents were georeferenced in a GIS to their home zip codes and stratified into three regional groups: (1) Coastal Carolina (n = 140), (2) Non-coastal Carolina (n = 76), and Outside Carolina (n = 23). Results revealed regional differences among the regional groups that often followed a distance-decay pattern. Knowledge of weather conditions was most important for Group 1 and least important for Group 3. The importance of air temperature, wind speed and direction, and chance of rainfall were higher for Group 1 compared to Group 3. All groups reported high levels of access to weather information needed for successful trip planning. While most respondents reported satisfactory access to information, they reported a preference to receive additional information via text messaging, e-mail, and websites.

Caught between coastal development and a rising tide: Developing sustainable strategies for estuarine shorelines

Carolyn Currin, Mark Fonseca, Greg Piniak, Duncan Dawkins

NOAA Center for Coastal Fisheries and Habitat Research, Beaufort, NC

The Center for Coastal Habitat and Fisheries Research (CCFHR), located in Beaufort, NC, is currently conducting a number of studies evaluating the response of salt marshes to sea level rise, assessing factors contributing to estuarine shoreline erosion rates, and evaluating alternative approaches to shoreline stabilization. These projects support an overall goal of providing climate adaptation strategies to coastal communities. In particular, CCFHR staff are measuring the relationship between tidal elevation and marsh biomass and sediment accretion rates in both natural and stabilized salt marshes. The Center has installed 48 Surface Elevation Tables (SETs) in salt marsh habitats in Carteret and Onslow Counties. Each SET has been surveyed to provide elevation marks for current and future monitoring of the response of intertidal habitats to SLR. Preliminary data from SETs installed in marshes stabilized with stone sills have demonstrated significantly higher marsh accretion rates than in natural fringing marshes, with concomitant changes in the distribution of marsh habitat. In support of the assessment of shoreline erosion rates, the Center developed a Wave Energy Model (WEMo) which is being applied to both forecast and hindcast wind wave energy experienced on estuarine shorelines. In partnership with the NC National Estuarine Research Reserve and academic scientists, the Center is also conducting a study on the effect of bulkheads on estuarine ecosystem services. The Center is also examining the effectiveness of alternative shoreline stabilization structures, including 'living shoreline' approaches. These projects include a significant outreach and education effort with our partners. CCFHR is also participating in a large interdisciplinary effort to provide Marine Corps Base Camp Lejeune (MCBCL) with an ecosystem management plan to assure sustainability of their training mission. An important component of that effort is predicting the response of the base's coastal wetlands to sea level rise. In addition, we are preparing an analysis of shoreline erosion rates and a shoreline management plan for the Base. Since 2008, using NOAA CO-OPS protocols, we have been operating and collecting data from two temporary tide gauges in the New River Estuary in support of research efforts aboard MCBCL.

Supporting Coastal Adaptation in the Carolinas

Kirstin Dow, University of South Carolina

The coast of the Carolinas face a wide variety of stresses from current development and population growth to the climate change related threats of sea level rise, changing precipitation patterns, and salinity intrusion among others. The Carolinas RISA (CISA) has begun to link our work on climate variability and drought with coastal management issues through several projects and collaboration with North and South Carolina Sea Grant Extension Programs. This poster provides a brief description of the collaboration and focuses on ongoing research into the potential threats of salinity intrusion, mediated modeling approaches to understanding local community vulnerabilities, and drought early warning system needs for coastal ecosystem management.

NOAA’s Southeast Regional Climate Center: Serving the Climate Needs of the Carolinas through User Engagement and Applied Research Activities

Chris Fuhrmann, Chip Konrad, William Schmitz, Maggie Kovach, DJ Perkins

NOAA’s Southeast Regional Climate Center, University of North Carolina – Chapel Hill

The Southeast Regional Climate Center (SERCC) is one of six regional climate centers and, as part of NOAA’s Regional Climate Center program, serves as the hub for climate services, applications, research, and education in the Southeast. The SERCC is housed in the Department of Geography at the University of North Carolina at Chapel Hill. The SERCC addresses societal and user-specific needs in the context of climate variability and climate change.

Currently, the SERCC is focusing its user engagement and research activities in areas where there is a strong need for expertise in the use of climate information. Topically, these areas include public health, planning, tourism, and coastal conditions. A number of outreach activities and research projects are presently under various stages of development. These include collaborative research projects on the health impacts of heat waves and the spatial patterns of winter and summer season precipitation, as well as outreach activities involving professionals in the planning, tourism, and coastal communities across the Southeast. The full scope of these activities and projects, and their planned outcomes, will be described in this poster. The SERCC invites interested individuals and groups in the Carolinas to participate in these projects.

Additionally, the SERCC is anticipating future opportunities for user engagement and research activities in regional climate assessments and adaptation planning. Of great interest and consequence in this realm are the impacts of extreme weather events and how their frequencies are changing. In response to this, the SERCC has initiated a research program, in collaboration with experts and professionals in other fields, to explore both the socioeconomic and public health impacts of extreme events in the Southeast and the associated large-scale atmospheric circulation patterns. The ultimate goal of this research program is to provide extended range weather and climate forecasts that are tailored to specific user groups. These forecasts would provide valuable climatological context and more specificity with respect to the character and probability of extreme events.

Adaptation to Sea Level Rise – Allowing for Coastal Marsh Migration

Steve Gilbert and Norm Brunswig, Audubon South Carolina

South Carolina has vast amounts of coastal marsh (approximately 400,000 acres) composed of salt, brackish and tidal freshwater marshes. All three forms provide vital habitat for an array of migratory birds, wading birds and small mammals, as well as nursery habitat for numerous commercially and recreationally important species. They also provide many other essential ecological functions and environmental services such as filtration of upland runoff and removal of sediments and toxins from the water column, carbon storage and mediation, buffers from storm surges, and aesthetic coastal vistas. Primary productivity created by coastal marshes drives a huge web of coastal and marine life. While typical anthropogenic impacts to marsh functions are somewhat controlled by existing regulatory processes, the insidious effects of sea level rise present a new challenge in an altered landscape which could present blockages to natural marsh inland movement responses.

As part of Audubon’s Eastern Atlantic Flyway Conservation Initiative, Audubon South Carolina (ASC) is working on developing a program involving numerous conservation partners to: (1) map coastal marshes and rank them on a matrix developed to encompass marsh functions, ecosystem values, sensitivity to sea level rise, and potential for migration; and (2) develop and create coast-wide, site specific plans and strategies to maintain and enhance their migration potential including conservation of appropriate landward migration areas and opportunities for migration barrier removal.

Technical needs for progress in this endeavor include:

- Accurate coastal lidar data
- Reconciling the predictive models for sea level rise along the Atlantic Coast
- Methodologies and/or modeling to determine the “tipping point*” of existing marsh platform elevations.

*The point at which relative sea level rise (sea level rise + subsidence) overwhelms marsh sediment accretion and productivity limits of marsh flora.

Understanding Relationships Between Evolutionary History of Sea Oats (*Uniola paniculata*) Poaceae, and Adaptations to Environmental Conditions

Eva Gonzales, Appalachian State University

In spite of the fact that coastal systems are especially vulnerable to the effects of storms, little information is available about the regional distribution of coastal plants' genetic diversity, the relationship between their genetic diversity and morphological adaptive traits, and how climate change will affect vegetation in these areas. Predicting responses to climate change is particularly difficult as plants in these habitats are facing a multitude of challenges (e.g., rising sea level, increased frequency of severe weather, increased CO₂ concentration and rising temperatures). The objective of our research is to provide new tools and science-based knowledge for long-term and sustainable dune restoration using sea oats, *Uniola paniculata*, a native dune-building grass. The study incorporates the evolutionary history of the species with morphological adaptations to both current and predicted future environmental conditions. Here, we present our initial results documenting that there is only partial concordance between evolutionary history (inferred from neutral chloroplast DNA sequences and nuclear markers) and morphological traits. Thus, in sea oats, neutral genetic structure alone cannot be used as a proxy for distribution of adaptive variation. Additionally, we outline our approach to understanding potential changes in sexual reproduction and vegetative biomass production in response to predicted rise in temperatures and CO₂ fertilization. Studies of economically important grasses document that high temperatures result in pollen sterility, and CO₂ fertilization result in lower below-ground biomass. Such consequences (if detected in sea oats) would be highly detrimental to sand dune habitats, as it would lead their destabilization and loss of genetic diversity of sea oats.

Preparing for Climate Change: Helping Small Coastal Communities Develop Adaptive Strategies

Jack Thigpen, Gloria Putnam, and Jessica C. Whitehead

North Carolina Sea Grant and South Carolina Sea Grant Consortium

Climate change adaptation is becoming a topic of interest to many North Carolina coastal communities as discussion at both the federal and state level increases. It is becoming evident there is a strong need

to build capacity within local governments to better understand and assess the vulnerabilities and risks they might face from climate change impacts, and develop strategies to deal with them. There is also a need to further build capacity within our NC Sea Grant Program to meet these needs. Fortunately, there is a rapidly-increasing body of literature dealing with adaptation, vulnerability assessment and decision-making in communities that we can rely on in our extension efforts. This project will utilize this array of materials to work with an Inner Banks town that has expressed interest in: assessing its risks from climate change, identifying ways to reduce its vulnerabilities; and involving the community in this process. As a result of this project, we will increase the understanding of what information our coastal communities might need and use to make decisions; what understanding might exist in a coastal community about climate change; and the willingness and ability for a small town to take action. The case study would hopefully provide a useful and flexible example for other small coastal communities interested in conducting similar work. It is anticipated the flexible protocol could be developed that would direct communities on how to gather information on their specific climate change-related issues; understand how to assess their residents' knowledge and attitudes towards adapting to changes; and incorporate this knowledge into climate change adaptation strategies that would be continuously evaluated and adjusted.

Adapting to Climate Change: A planning Guide for State Coastal Managers

Sarah van der Schalie, Office of Ocean & Coastal Resource Management, NOAA

NOAA's Office of Ocean and Coastal Resource Management (OCRM) is developing climate change adaptation guidelines for U.S. state and territorial (state) coastal managers: *Adapting to Climate Change: A Planning Guide for State Coastal Managers*¹. The guide is in response to a request from coastal states for national level guidance on adaptation planning in the coastal zone. It is designed to help state coastal managers develop and implement adaptation plans to reduce the risks associated with climate change impacts in their purview. A climate change adaptation plan identifies and assesses the impacts that are likely to affect the planning area, develops goals and actions to best minimize these impacts, and establishes a process to implement those actions. While an adaptation plan for the coast or the larger state may stand alone, planning to adapt to climate change should be incorporated to varying degrees in all statewide planning efforts (as well as regional and local planning efforts). However state coastal managers choose to move forward, the ultimate goal is coastal states and communities that are organized to take action, have the tools to take action, and are taking action to plan for and adapt to the impacts of climate change. When released, OCRM will distribute the guide to state coastal zone programs as an electronic file via e-mail and post it on OCRM's web site. The anticipated release is in the summer 2010. Users will also be directed to the NOAA Climate Portal and CSC's Coastal Climate Adaptation web site for additional planning resources.

¹ This guide is only one of a number of guides to adaptation planning. It is not intended to be definitive, and NOAA encourages states to explore and use other guides and frameworks as they see fit to best meet their individual needs.

Collaborating Within NOAA

Leonard Vaughan¹, William Schmitz², Joseph Calderone³

¹NOAA/National Weather Service Forecast Office Columbia, SC, ²NOAA/Southeast Region Climate Center Chapel Hill, NC, ³NOAA/National Weather Service Forecast Office Charleston, SC

NOAA/National Weather Service (NWS) offices in Columbia and Charleston, South Carolina and the NOAA/Southeast Regional Climate Center (SERCC) in Chapel Hill, North Carolina have collaborated on a number of projects that have enhanced climate information available to the public. Examples of these projects include: climatologies of the Masters Golf Championship; the Cooper River Bridge Run; and the St. Patrick’s Day Celebration in 5 Points; NWS Public Information Statements regarding daily, monthly and seasonal climate data; and holiday climatologies. Data retrieved from the SERCC, which includes NOWData, xmACIS and ThreadEX queries, have been used for NWS product statements and in local case studies. The information shared between these two entities of NOAA has provided valuable information to the public, media, NWS and SERCC, and has enhanced the visibility of NOAA within the community

Appendix E

Breakout Session Questions

Session 1 - Questions prepared by Tim Owen, NOAA NCDC

Session 2 - Questions prepared by Rick DeVoe, South Carolina Sea Grant
Consortium

Session 3 - Questions prepared by Ned Gardiner, NOAA Climate Program Office

The questions used to moderate the discussions during the three breakout group sessions are provided below.

Session 1: Products and Services

Session Lead: Tim Owen, NOAA National Climatic Data Center

- Spend 10 minutes capturing responses to the plenary given by Eileen Shea. Not everyone needs to respond, but capture responses of people who feel compelled to share.
- Who are the key stakeholders for your focus area?
- What are the top three information service needs for your focus area?
 - What climate products and services do you use? Discuss strengths and suggestions for improvements.
 - Can you suggest new products to be developed?
 - Are there vulnerabilities or opportunities that climate products could highlight?
 - What NOAA data and products need to be developed to meet your needs?
- Discuss opportunities relative to the other sectors meeting concurrently.
 - Within the Carolinas, what are the most important organizational connections relevant to your focus area?
- With 10 minutes left during the session, rank and prioritize the highlights from the discussion.

Session 2: Regional Engagement, Education, and Service Delivery

Session Lead: Rick DeVoe, SC Sea Grant Consortium

- Spend 10 minutes capturing responses to the plenary provided by Jim Fox and Ned Gardiner. Not everyone needs to respond, but capture responses of people who feel compelled to share.
- How do you assess stakeholder needs/wants for climate information?
 - What new/innovative methods should we be using?
 - In what real-world contexts (e.g., national security, human health, public safety, economics, politics, etc.) do you/can we engage audiences and extend climate information?
- What methods do you/should we use to disseminate climate information?
- How do you/should we address the issues related to the uncertain nature of climate?
 - How do/should we deal with the uncertainties related to the science of (and predictions related to) climate phenomena?
 - How do/should we deal with skeptical audiences when extending climate information?
- What are your sources of climate information?
 - Has this information “informed” decision-making?
 - What information seems to be lacking?

Appendix E – Breakout Session Questions

- Discuss opportunities relative to the other sectors meeting concurrently.
- With 10 minutes left during the session, rank and prioritize the highlights from the discussion.

Session 3: Regional Climate Science

Session Lead: Ned Gardiner, NOAA Climate Program Office

- Spend 10 minutes capturing responses to the plenary provided by Otis Brown. Not everyone needs to respond, but capture responses of people who feel compelled to share.
- Discuss ecosystem services and processes. Discuss these in relation to climate variability and change and impacts on your sector.
- Discuss winners and losers under varying and changing climate regimes. Consider resilience and restoration efforts.
- Applied science: are decisions made using scientific input?
- Rank issues, list unknowns and impacts
- Discuss opportunities relative to the other sectors meeting concurrently.
- With 10 minutes left during the session, rank and prioritize the highlights from the discussion.

Appendix F

Energy and Transportation Sector Breakout Notes

Moderator: Karsten Shein, NOAA NODC

Recorder: Jake Crouch, NOAA NODC

Energy and Transportation

Session 1: Products and Services

Session Lead: Tim Owen, NOAA NCDC

- Spend 10 minutes capturing responses to the plenary given by Eileen Shea. Not everyone needs to respond, but capture responses of people who feel compelled to share.
 - Regional Transportation Plan – Adaption. User needs and granularity of data.
 - Who needs to be involved? Energy providers. Connect energy and water.
 - Data needs similar across sectors. Value added information to meet specific needs of user. Who is using information?
 - Separation of transportation and energy.
 - Bridge gap between what NOAA currently does to what it needs to do.
 - Difference between climate and weather services/data. We need to make a strong decision between climate and weather to address each individually. Weather Service vs. Climate Service and products. Is current downscaling sufficient of climate information?

- Who are the key stakeholders for your focus area?
 - Who? State government, energy providers (Duke, Progress Energy), energy consumers, city/coop energy providers, petroleum, wind/solar, independents.
 - Build model at grass roots level then address individuals. Common denominators of entire group to create general plan. Currently create products for specific users and then back out to bigger picture. Statewide consortium? FERC? State energy commission?.
 - Statewide transportation?
 - Utilize statewide organizations already in place.
 - Local generation of energy. Transportation of energy to local levels. Separate transportation, transportation of energy, and energy.
 - Insurance companies and risk issues. IBHS.
 - Transportation stakeholders? Local and regional stakeholders (RPOs, MPOs).
 - Specific example: days (5-8) in advance of winter weather, cooperation between power companies and current NOAA offices (NWS and regional offices). Use a similar plan to initialize longer/larger term (season, yearly, regional) products. Allow users to understand how variability will affect them.
 - Currently: I-40 closure and need for weather/climate data.
 - Construction companies and other infrastructure companies. Use of weather data to reference specific events and the lack of progress. Planning for best conditions for construction.
 - Climate considerations for future and long-term sites of energy, evacuation routes.
 - Difference between climate and urban/suburban development. In and out migration of people and planning for development. We need to account for societal changes as well as climate change. What data is needed to make these decisions? Changes need to happen before future scenarios are in the present.
 - Current transportation needs: Understanding statistical flood referencing (100-, 1000- year floods) in terms of climate and weather. Important for long range plans.
 - Real world problem focused products needed. Any given location that needs a product is not entirely unique.

Appendix F – Energy and Transportation Sector Breakout Session Notes

- Need mapping and spatial information included with climate and weather data for affective products. Incorporate spatial data with current products to improve them. Provide risk profiles for specific region/location.
- How to reach out to users and engage them? Need to identify and reach out to key decision makers.
- Politicians as a stakeholder group. MPOs=decision making officials present. Work with both staff and elected officials to put together package. Identify officials and planners and address each in ways to make information understandable.
- What are the top three information service needs for your focus area?
 - What climate products and services do you use? Discuss strengths and suggestions for improvements.
 - Difference between climate outlooks and weather forecasts. Many requests for short term (3-5 days, 8-10 days) climate outlooks. Need translation of these products.
 - Users cannot find data efficiently and need additional information which is not currently provided. Adapt what is already present to meet this shortcoming. Make sure users can get to what they need. Logical and understandable by user. Package data and information depending on user questions.
 - Can you suggest new products to be developed?
 - Longer term climate predictions? Decadal timescales? Need to understand uncertainties of model predictions. Prediction needs to be downscaled.
 - **Education products to inform user of what we are actually communicating (ie. What El Nino means to user). Include public awareness section in NCS Climate Portal. This information is also needed for public decision makers and their staff. Climate education and context. Use a portal to address different levels of user interest and provide appropriate education and context. A one-stop website to provide this information.**
 - **Need more intuitive sites that are appropriate for mobile devices – apps.**
 - Reanalysis products of how climate events impacted societies and the economy. Applied climate science – how climate phenomenon impacted other sectors.
 - Issue based products.
 - Are there vulnerabilities or opportunities that climate products could highlight?
 - What NOAA data and products need to be developed to meet your needs?
- Discuss opportunities relative to the other sectors meeting concurrently.
 - Within the Carolinas, what are the most important organizational connections relevant to your focus area?
- With 10 minutes left during the session, rank and prioritize the highlights from the discussion.
 - Improve data access and data education
 - Weather vs. climate: short term vs. long term planning
 - On-going product engagement – Public vs. private services and products
 - Engage stakeholders by going outside weather-climate meetings.
 - Engage stakeholders early on in product development and improving our current products.
 - Value added products?

- Reanalysis of economical and societal impacts due to climate events.
- Education products to inform user of what we are actually communicating (ie. What El Nino means to user). Include public awareness section in NCS Climate Portal. This information is also needed for public decision makers and their staff. Climate education and context. Use a portal to address different levels of user interest and provide appropriate education and context. A one-stop website to provide this information.
- Need more intuitive sites that are appropriate for mobile devices – target younger audiences.

Session 2: Regional Engagement, Education, and Service Delivery

Session Lead: Rick DeVoe, SC Sea Grant Consortium

- Spend 10 minutes capturing responses to the plenary provided by Jim Fox and Ned Gardiner. Not everyone needs to respond, but capture responses of people who feel compelled to share.
 - Lack of emphasis on commerce.
 - What is the impact on business because of transportation disruption due to climate events. Direct impacts on tourism due to movement of people. Better forms of transportation to meet tourism needs with respect to environment.
 - **Need to understand diversity of users to better communicate climate information and education to all socio-economic groups. Differentiate users to better serve needs.**
 - Water resource education with respect to climate change and population growth needs to be accounted for and better understood for product development.
- How do you assess stakeholder needs/wants for climate information?
 - What new/innovative methods should we be using?
 - Communicate with state climatologists to understand user needs. Important relationship between geography and climate.
 - Increase in sensitivity and vulnerability of sectors to climate and weather. Climate and extreme events weren't accounted for with creation business plans.
 - Recognizing how future climate changes will affect commerce.
 - Ways to adapt to change – change in viticulture, fishing,
 - Issue experienced by everyone, need to frame information in way everyone can use it.
 - Impacts bigger than single event – Rita and economic impacts felt far away from storm. Lack of warehousing and lack of transportation impacts felt thousands of miles away.
 - **We have become less resilient. Driven more by efficiency currently.**
 - Need to educate stakeholders .
 - Localize supply chain to limit the complications with transportation. Reduces vulnerability and decreases energy demands to transport goods. Increase local access.
 - Examine connected stakeholders – neighbors. Some things are more regional, especially transportation.
 - Railroad role in both transportation and transportation of energy
 - Is general public a stakeholder? Increase use of alternative transportation. Decision and policy makers are driven by public. Educating general public will increase people pushing for change.
 - Pitch information at different levels. Tailor information for user. Better communicate information.

- **Frame information in way that is important for the time and user – currently economic woes. Show consequences which are important to the user to encourage adaptation/mitigation.**
- In what real-world contexts (e.g., national security, human health, public safety, economics, politics, etc.) do you/can we engage audiences and extend climate information?
 - **Use range of future scenarios to demonstrate uncertainty in climate models. Need to incorporate population changes as well as climate change to address directly transportation issues.**
 - Integrative planning – see point above. Need comprehensive plan. Everyone needs to be involved.
 - Find a way to communicate importance of resilience to cross ideological lines. Short term vs. long term investment.
- What methods do you/should we use to disseminate climate information?
 - **Visualization of information.** People can better understand visualization. Don't always need the most advance technology. Technology secondary to information.
 - Find ways to keep interest of user and general public.
 - **Have a local source of information to convey message and impart the importance of information. Is this local source present in transportation/energy? Showcase someone that 'speaks the same language'. Find local champions/leaders willing to put resources forward.**
 - **Form relationships and have actual conversations with people and decision makers. Get feedback and incorporate what you hear. Be willing to change product.**
 - Gear message so that it is understandable.
 - Web 2.0 resources to deliver information – twitter, facebook, etc. Important for reaching next generation.
 - How to address resources?
 - Need to upscale as well as downscale services.
- How do you/should we address the issues related to the uncertain nature of climate?
 - How do/should we deal with the uncertainties related to the science of (and predictions related to) climate phenomena?
 - Political ramification by showing uncertainties. Be sensitive to distortion by politicians.
 - **Relate how past weather-climate events will relate to future events.**
 - Frame conversation by addressing changes that are currently happening and have already happened. Discuss potential and current impacts. The word 'change' makes things political.
 - Mitigation – top down. Adaptation – bottom up. By framing discussion in this way, we get things happening without as much politicization.
 - Need to be sensitive to outside impacts of certain decisions.
 - How do/should we deal with skeptical audiences when extending climate information?
- What are your sources of climate information?
 - Has this information "informed" decision-making?
 - **NOAA incorporation on state planning boards.**
 - Sea level rise information utilized in NC bridges.

Appendix F – Energy and Transportation Sector Breakout Session Notes

- Greater levels of requests of data for decision making due to state-wide legislation. Need to plan for future information delivery – be prepared for increase in data requests.
- Survey users to understand how data is currently used to better meet future needs. Are users correctly interpreting data? How is the data being interpreted? How is data misused?
- What information seems to be lacking?
 - Products addressing changes in return frequencies of snow, floods, rain, temperatures. Great uncertainty still exists.
- Discuss opportunities relative to the other sectors meeting concurrently.
- With 10 minutes left during the session, rank and prioritize the highlights from the discussion.
 - Incorporation with and support of state climatologists.
 - Need to understand diversity of users to better communicate climate information and education to all socio-economic groups. Differentiate users to better serve needs.
 - We have become less resilient for the sake of efficiency. This leaves us vulnerable.
 - Frame information in way that is important for the time and user. Make information relevant. Show potential consequences which are important to the user to encourage adaptation/mitigation.
 - Use range of future scenarios to demonstrate uncertainty in climate models.
 - Need to incorporate population growth as well as climate change to address directly transportation issues.
 - Visualization of information. People can better understand visualization. Don't always need the most advance technology.
 - Have a local source of information to convey message and impart the importance of information. Showcase someone that 'speaks the same language'. Find local champions/leaders willing to put resources forward.
 - Form relationships and have actual conversations with people and decision makers. Get feedback and incorporate what you hear. Be willing to change products.
 - Relate how past weather-climate events will relate to future events.

Session 3: Regional Climate Science

Session Lead: Ned Gardiner, NOAA Climate Program Office

- Spend 10 minutes capturing responses to the plenary provided by Otis Brown. Not everyone needs to respond, but capture responses of people who feel compelled to share.
 - Need for coordination among current CI's and other research programs. Need to account for repetition. Look at what outside groups are doing – private industry, research-development groups.
 - Integrate science from SC. Appears to be more of a focus on North Carolina. Focus in NC due to concentration of NOAA staff.
 - Satellites future of data for validation. Make sure going towards CDRs doesn't eliminate-limit previous observation platforms (in-situ instruments).
 - Need to make sure data is kept neutral between raw data and data given to users. Transparency is key.

Appendix F – Energy and Transportation Sector Breakout Session Notes

- Otis talked about plans, but not the end product. Current assessments are how the information will be utilized.
- CICS will focus on coasts and impacts on infrastructure – sea level rise. Needs to focus on other statewide transportation needs.
- Discuss ecosystem services and processes. Discuss these in relation to climate variability and change and impacts on your sector.
 - Energy sectors relationship with ecosystems. Transportation also has relationship with ecosystems.
 - Ecosystem services – forests and wetlands clean our waters. Example: hemlock trees provide shade and keep water cold and preserve habitat for trout. What is being used that threatens these services.
 - Transportation needs to understand stream mitigation and restoration. Sector needs to account for ecosystem site preservation.
 - Increase in transportation corridors can lead to additional development which leads to storm water mitigation needs and flooding issues.
 - Intimate link between transportation and land use. Need to think ahead with land use policies. Put land use policies in place where there aren't currently policies.
 - Energy sector uses water systems with input and output of water resources. Impacts of changes in future drought of differing magnitude and how these will affect the energy sector.
 - Energy sector should encourage energy users to take responsibility.
 - Energy providers will have less capacity to create energy while energy use rises.
 - What ecosystem services do we need to tap into?
 - Pavement type changes to affect runoff and heat storage. Plant more trees around roads. Initial and maintenance costs. Trees falling on roadways. Planting a tree can cover parking lot, but power lines could be impacted.
 - Change in agricultural land to foster bio-fuels. Bio-fuel production can drive up price of corn for eating.
 - Need to account for transportation of bio-fuels.
 - Use of road salts to clear ice from roadways. Environmental impacts are present. Climate science can help understand future salt usage. Knowledge of more immediate weather can change the amount of salt needed to clear roads – timing very important.
 - Air quality is an ecosystem service with ties to transportation and energy. Science needs to be included. Rain and trees important ecosystem services to improve air quality. Hurricanes as an ecosystem service?
- Discuss winners and losers under varying and changing climate regimes. Consider resilience and restoration efforts.
 - Ski resorts long term losers. Tourism impacted – sea level rise impacts beaches. Eco-tourism could be positively or negatively impacted.
 - Use of mitigation of Vehicle Miles Traveled (VMT) has correlation with economy. VMT mitigation used to improve environment. Widening roads and building new highways to improve congestion used in past, instead of alternative transportation development. Need to change how we view the problem and solutions. Need transit oriented development for viable transportation alternatives. Changes in land use to increase population density. Municipalities should plan for sustainable growth – meeting in Eastern NC.

Appendix F – Energy and Transportation Sector Breakout Session Notes

- Oil companies losers due to less use of traditional transportation. Less demand for road building, automobiles, and fossil fuels. Oil companies investing in renewable energy sources to account for future demand. Could lead oil companies to be winner? When does public become loser? Public has increased costs to cover less usage and decreased income for municipalities.
- The public is the ultimate loser. Impacts are adverse to public, public money used to correct wrongs. Public education important to limit the need for future adaptation. Not currently cheap to be 'green'.
- Industry will become winners by making changes proactively. Upfront costs inhibitive for energy sector to make changes.
- Energy costs will go up by not being prepared.
- Extreme events are sometimes unexpected and impacts everyone.
- Applied science: are decisions made using scientific input?
 - Account for pushback against science. Uncertainty plays role in pushback. Need more communication to user of uncertainties.
 - Costs big issues.
 - Decisions made by NCDOT uses scientific input currently but has to account for range of uncertainties. Generalities are needed.
 - For practitioners
 - Belief/Disbelief in climate change impacts decisions made by policy makers. The choice of path of least resistance often chosen by policy makers.
 - Society makes decisions based on values not always science.
 - Is resilience affordable?
 - Education important.
- Rank issues, list unknowns and impacts
 - No single science. Issues determining each to choose. Get people to deal with the uncertainty.
 - Payment for change. Short term versus long term benefits. Reconcile competing interests.
 - Personal decisions and impacts. Climate change needs to be integrated with drivers in personal decision making. Education plays important role in personal decision making.
 - Impacts on and use of ecosystem services should come more to the forefront for energy and transportation decisions. Use of city ordinances to make these changes.
 - Environmental impacts of wind farms. More important to reduce carbon dioxide or not impact environments. Transportation impacts of wind farms. Unintended consequences of making changes to mitigate carbon emission.
- Discuss opportunities relative to the other sectors meeting concurrently.
 - Planning not isolated to transportation or energy. Municipalities have to account for other sectors when making decisions. System thinking incorporates several areas.
 - Relationship between transportation and tourism. Regional transportation needs to be tied into statewide transportation systems.
 - Transportation, tourism, and water resource management tied together in coastal regions.
 - Air quality issues from energy and transportation impacts health sector.
 - Water is unifying factor.
- With 10 minutes left during the session, rank and prioritize the highlights from the discussion.

Appendix F – Energy and Transportation Sector Breakout Session Notes

- No single science. Issues determining each to choose. Get people to deal with the uncertainty.
- Payment for change. Short term versus long term benefits. Reconcile competing interests.
- Personal decisions and impacts. Climate change needs to be integrated with drivers in personal decision making. Education plays important role in personal decision making.
- Impacts on and use of ecosystem services should come more to the forefront for energy and transportation decisions. Use of city ordinances to make these changes.
- Environmental impacts of wind farms. More important to reduce carbon dioxide or not impact environments. Transportation impacts of wind farms. Unintended consequences of making changes to mitigate carbon emission.

Appendix G

Human Health and Society Sector Breakout Notes

Moderator: Anne Blair, Hollings Marine Lab

Recorder: Jennifer Dorton, NOAA in the Carolinas

Human Health and Society

Session 1: Products and Services, Human Health and Society

Session Lead: Tim Owen, NOAA NCDC

- Responses to the plenary given by Eileen Shea. Not everyone needs to respond, but capture responses of people who feel compelled to share.
 - Pearl slide is good way illustrate/communicate science.
 - Need to learn more about the connectivity between NOAA and FEMA. How do we get NOAA and FEMA to work more closely in areas such as hazard mitigation? After a disaster we need products and services from both organizations to assist with mitigation and adaptation (how to rebuild, where to rebuild, etc).
 - Ex: After a disaster FEMA has large sums of \$ used to help rebuild communities. Need a better understanding of where to rebuild based on climate mitigation – NOAA has tools that can assist with this and they should be engaged.
 - Issue: How does DOC work with Homeland Security
 - Climate change variability is a global issue that must be addressed locally. SRCC is trying to provide prospective on climate variability. Observational records can be used to inform decision makers and policy makers to help inform them of what might be important for the future.
 - Models haven't worked out all of the details. Need to establish a dialogue so that we know what products need to be developed as well as what has been developed.
- Who are the key stakeholders for *Human Health and Society*?
 - Internal users: NOAA CSC, Hollings Marine Lab
 - External (non-NOAA) agency users: FEMA, Public Health Officials,
 - External (non-NOAA): non-profits and public service groups, hospitals, nursing homes, university researchers (need data and metadata), city planners, politicians
 - E.g. Swannanoa flood risk management project: projects can be accomplished to help with mitigation in the future. Developments need to be planned in such a way that they are not placed near flood plains or points of pollution
 - Flood puts people's lives at risk – however, once home is rebuilt have to deal with mold and other health hazards that may be in the home. Need politicians to keep development out of areas that are flood prone and work with planners to determine where development should occur. Ex: Charlotte construction projects
- What are the top three information service needs for your focus area?
 - Human health forecasting mechanism. How does weather affect human health (not always "disaster" events)?
 - E.g. tailored heat forecasts
 - Link climate data with the health data
 - Develop tools to help people determine what their options are and help prepare organizations.
 - E.g. heat wave – hospitals need to be aware that they may have more heat related health issues during a specific period of time.
 - This will allow us to reach two communities: the individual and local health care providers
 - It is sometimes difficult to access health data. Need access to health data and integrate it to weather and climate data.
 - This will help a community be more prepared.

Appendix G – Human Health and Society Sector Breakout Session Notes

- Need to create scales/indices that better represent the conditions (or probability of an event). These scales may be different between urban/rural areas.
 - Global scales are not helpful to individuals. Scales have to be tailored regionally, and even better, locally.
 - E.g. Buncombe County Multi-Hazard Risk Tool (located at RENCI Asheville)
 - Needs to be done spatially and temporally
- Need better visualization tools
 - These have to be audience specific
 - E.g. Geodome videos on floods target 5th graders since they are studying floods. Includes info they need for end of year testing.
- What climate products and services do you use? Discuss strengths and suggestions for improvements.
 - Monthly or seasonal outlooks from Climate Prediction Center
 - L3MTOs: Local 3-month temperature outlooks were initially too difficult to understand and did not reach the intended user. The products were retooled and are now being used by agricultural and construction communities. Precipitation outlooks are being developed.
 - Sea level rise projects and inundation products from Coastal Services Center
- Can you suggest new products to be developed?
 - Certain populations are more at risk (urban v/s rural) and products need to differentiate between the two.
 - Products need to be regionalized/localized.
 - E.g. Buncombe County project, when pushed out to a four county area, had to be localized for each county.
 - Media products that convey the information that needs to reach the public.
 - Direct outreach: training and workshops targeted to specific audiences (information may be the same, but how it is presented differs based on the audience)
- Are there vulnerabilities or opportunities that climate products could highlight?
 - Opportunities to use the medium to long range forecasts
 - Understanding the different product needs for rural and urban areas
 - SC DHEC has developed a forecast tool related to precipitation that provides beach and shellfish warnings. Not certain if that is being done in NC which could be an opportunity.
- What NOAA data and products need to be developed to meet your needs?
 - A new product may actually be provided by taking an old product and tailoring it for different audiences.
 - Need to do research to determine how people are interpreting the product and how does the product influence their behavior.
 - Extreme weather event predictions/products.
 - Communication products/strategies that help connect with individuals and increase their understanding of climate.
 - How is risk communication provided for episodic events (e.g. hurricane) vs slow onset events (e.g. sea level rise)
 - Storm water run-off and land use plans need to incorporate possible climate change impacts.
 - Need products that provide a range of possibilities.
 - E.g. storm surge visualizations based on actual hurricanes – provide several “what if” strategies. This might be too complex.

Appendix G – Human Health and Society Sector Breakout Session Notes

- Discuss opportunities relative to the other sectors meeting concurrently.
 - Sea level rise – limit development in areas that are flood prone.
 - Limiting infrastructure in areas of natural hazards.
- Within the Carolinas, what are the most important organizational connections relevant to your focus area?
 - Did not get to.
- With 10 minutes left during the session, highlight major points from the discussion.
 - Local and regional scale products are needed
 - E.g. heat index products need to be scaled that are regionally and population specific
 - Tailor climate change communication products and services to specific audiences
 - E.g. hospitals, nursing homes
 - Find out what products people need by initiating dialogue with the end user and then tailor products based on expressed need and local knowledge. Have community members involved as the tool is developed to ensure acceptance. This blends the bottom-up with the top-down approach.

Session 2: Regional Engagement, Education, and Service Delivery, Human Health and Society

Session Lead: Rick DeVoe, SC Sea Grant Consortium

- Spend 10 minutes capturing responses to the plenary provided by Jim Fox and Ned Gardiner. Not everyone needs to respond, but capture responses of people who feel compelled to share.
 - Identified the problem/gap between products developed and how people use the products for decision making. Need a better understanding of the products and services needed by the user as well as the technology that they use.
 - The Weather Forecast Office does not get the input/feedback about climate issues/climate change. Information has not flowed down to the operational entities.
 - Climate.gov website is useful, well designed and has good products and articles.
- How do you identify stakeholder needs/wants for climate information?
 - Ask them – can't use a top down approach.
 - Climate office is trying a bottom up approach so that products will be used by stakeholders.
 - Must have an iterative dialogue.
 - People have questions about climate data, not just about climate products. Need to make certain that people can understand the data and put it in context.
 - Larger companies, such as Duke Power, are thinking 10-30 years into the future. Smaller companies are not considering the future.
 - Have to be careful that we don't cross the public/private line (i.e. pay for products/services vs free products/services).
 - HIPA laws make it difficult to access needed healthcare data. We need greater access to healthcare data in order to couple human health and climate.
 - Bring in health care professionals for workshops to learn more about their wants/needs.
 - Go to sectoral workshops and listen to what the sector requires (e.g. health care professionals).
 - Allows for identification of needs
 - What new/innovative methods should we be using?

Appendix G – Human Health and Society Sector Breakout Session Notes

- In what real-world contexts (e.g., national security, human health, public safety, economics, politics, etc.) do you/can we engage audiences and extend climate information?
- What methods do you/should we use to disseminate climate information?
 - Currently climate information focuses on sea level rise and storm intensity, not human health. We need to make the connection between climate and human health.
 - United Kingdom Meteorological Office ties their products food production and health issues. This is a good model to use when we think how we should create similar products/services.
 - At present, info is posted on webpages and linked to other sites. Stakeholders are not being actively engaged.
 - The other issue is that data may be available, but we then have to figure out how to get the data out.
 - Workshops that invite targeted sectors to discuss the data, products and services that are now available are key. This provided a two-way feedback mechanism for data/product users and the people that developed the products.
 - “Ask the climate question” (ITL workshop)
 - Establish literacy
 - www.climatechange.nc.gov
 - NC DENR is beginning to develop a Climate Action Plan that includes mitigation and adaptation. This is a good way to reach state agencies and universities as well as municipalities.
 - *DENR needs NCDC data for this action plan and other communications*
- How do you/should we address the issues related to the uncertain nature of climate? How do/should we deal with the uncertainties related to the science of (and predictions related to) climate phenomena?
 - Talk about climate and find out where the uncertainties lie.
 - When communicating uncertainty, provide a answers based on historic data and provide a answers within a certain range.
 - E.g. how many days will be above 100°?
- How do/should we deal with skeptical audiences when extending climate information?
 - Provide information in context of something that people can relate to instead of probabilities.
 - E.g. relate back to hurricanes or other events.
 - People do not want to admit that climate change is primarily human induced.
- What are your sources of human health and climate information?
 - There is climate and human health data available (at least in NC) that the Southeast Regional Climate Center is starting to link.
 - One of the first projects the SRCC is undertaking is heat related health issues by zip code.
 - State Climate Offices (Climate data based on CO-OP data provided in every county)
 - Regional Climate Offices
 - NCDC
 - CoCo-RAHS – Community Collaborative Rain Hail and Snow Network for precipitation
 - Leadership teams within the NC Dept of Health and Human Services
 - Collaborative partnership with the UNC Dept of Emergency Services
 - NC Detect (Epidemiological data) – Compile info on hospital admissions
- What information seems to be lacking?

Appendix G – Human Health and Society Sector Breakout Session Notes

- It is difficult to get access to the level/amount of health care data needed.
 - NC Detect is overcoming some of these issues; however, this is only for emergency room visits and poison control centers. Trying to push out to urgent care facilities as well.
- Difficult to get access to data related to chronic illness that could be exacerbated by changes in climate (e.g. asthma, allergies).
- Need to develop linkages between climate change, variability and human health.
- NC DENR needs climate to be integrated with air quality and, in turn, how this intersects with health.
 - *Conduct modeling studies to quantify/examine regional impacts on air quality based on predicted climate scenarios and map at risk areas.*
- Discuss opportunities relative to the other sectors meeting concurrently.
 - Water: related to flooding, provides the environment for mosquitoes to breed which has human health impacts.
 - Energy and Transportation: travelers bring diseases home related diseases.
 - West Nile Virus
 - Energy and Transportation: air quality as it relates to energy production.
 - E.g. instead of state receiving funds to put in new roads or upgrade roads, the money is earmarked for development of mass transportation systems.
- With 10 minutes left during the session, list highlights from the discussion.
 - Need to coordinate and integrate health care data with climate data (e.g. morbidity rates and temperature data)
 - Build off of what is already available (e.g. UK Met applications <http://www.metoffice.gov.uk/health/>)
 - Must proactively engage the health care community to identify climate impacts on health (chronic and emergency health care risks).
 - Host sectoral (health professional) workshops and attend health care professional meetings.
 - Public Health's connection to climate is still in the early stages compared to other sectors such as Water and Coastal Ecosystems. We need to incorporate lessons learned in other sectors as we work with health officials.

Session 3: Regional Climate Science

Session Lead: Ned Gardiner, NOAA Climate Program Office

- Spend 10 minutes capturing responses to the plenary provided by Otis Brown. Not everyone needs to respond, but capture responses of people who feel compelled to share.
 - Interested to see if the CI will work with research institutions in South Carolina.
 - Lack of a human health side of the CI; however, the CI will draw in social scientists so health and society may be incorporated.
 - Obviously still trying to determine what the CI is going to do. Researchers need to be proactive in reaching out to the CI and help shape the social science focus.
- Discuss ecosystem services and processes. Discuss these in relation to climate variability and change and impacts on human health and society.
 - Cultural services: provisioning (food water and timber) recreation

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- Ecosystem: soil, water and air quality
- E.g. cryptosporidium outbreak due to run-off into the Milwaukee water supply.
- Aging infrastructure (drainage systems, sewage plants, etc) will be taxed due climate change – large storm events with heavy rainfall.
- Access to water will be a major problem in the southeast.
- Hydro-climatic changes will tie to vector borne diseases (such as diseases carried by mosquitoes).
- Impacts on wildlife due to prolonged drought.
- Pollutant accumulation on impervious services in drought regions. Not always pollutants (e.g. pollen accumulation will have chronic health impacts).
- Dry periods juxtaposed with wet periods will have a major effect on pollutant runoff.
- Warming climate – more air stagnation and weed population increases will cause more problems with asthma and other chronic respiratory problems.
- Still a small group working on climate and public health. Epidemiologists are starting to work with applied scientists to look at climate impacts on health.
 - There is a real research gap here. Right now it is hard to determine the links due to the complicated nature of the system. No simple relationships – coupled systems.
- Early warning systems for vector borne diseases. Being done internationally (WHO) in areas where malaria is endemic.
- CDC is starting to establish warning systems for water borne diseases and heat.
 - Social side: Dengue fever in Texas vs Mexico (few cases on US side but thousands in Mexico). Same climate but social systems are very different.
- Discuss winners and losers under varying and changing climate regimes. Consider resilience and restoration efforts.
 - Winners/losers are regionally based
 - Climate will influence crop availability and may change where crops are viable.
 - In North, warmer winners mean less snow and ice. Cost less to heat during winter, fewer auto accidents.
 - Currently see this during El Nino winters.
 - Winners: Invasive species
 - Resilience goes down for our native ecosystems as invasive species move in.
 - Invasives and natives may expand their territories
 - E.g. fire ants
 - Increasing allergens (e.g. ragweed)
 - Drought affects plants/trees in ecosystems by slowing growth rates. Even after the drought, it takes a while for the plants and trees within the ecosystem to start growing again.
 - Reforestation isn't keeping up with urbanization.
 - Scarcity of water will negatively affect people on the lower end of the economic scale.
 - During drought, water districts have a lot of variability
 - E.g. Cary, NC had water during drought due to access to Jordan Lake; however, Raleigh relies on Falls Lake and it had nearly dried up.
 - Rapid urbanization in Piedmont (NC) and coastal areas (NC and SC) will increase water issues.
 - Increase in major storms mean that non-coastal areas have a higher risk of being affected by these storms (not just a coastal issue).
- Applied science: are decisions made using scientific input?
 - UNC RCC is working on heat related morbidity and water borne diseases
 - Respiratory distress exacerbated by ecosystem changes.

Appendix G – Human Health and Society Sector Breakout Session Notes

- Changing demographics – lots of people are relocating to the Carolinas which creates a more diverse population.
 - Power demands in the Carolinas will increase due to increases in population. Companies have to determine how to meet demands as temperatures increase.
- Largely decisions haven't been made in regards to human health.
- Decisions for hazard mitigation have been instituted in NC and SC
 - E.g. evacuation procedures for severe storms
 - Need to review lesson learned from NC and SC in regards to storm evacuations and apply those lessons to other human health and society climate related decisions.
- Early notifications for heat and air quality warnings by NWS
 - UNC RCC: Impacts in rural areas are hypothesized to be very distinct from impacts in urban areas. Ozone also plays a major role in heat and air quality.
 - Need to be careful with warning systems since you don't want to have false alarms. NWS is a good example of over warning. Have to revamp warnings.
- Rank issues, list unknowns and impacts
 - Access to water (states & municipalities)
 - Heat waves and morbidity – NC Detect data sets
 - NC Detect data has time that person was admitted that can help determine if people are affected by day or night temps.
 - Public health data is not too rich and it is difficult to get the few data sets together.
 - Economic impacts
 - Drought on agriculture
 - Hurricanes affects on tourism/recreation
 - Power supply (hydroelectric or water cooled)
 - Increased need for health services due to increased number of heat waves, poor air quality, etc.
 - Increased need for services in underserved areas
 - Understanding impacts on the insurance industry of climate variability and change and climate driven weather events.
 - This relates to property and health insurances
- Discuss opportunities relative to the other sectors meeting concurrently.
 - Climate related water impacts and how lack of access to water will affect public health.
 - Water access issues as related to hydroelectric and water cooled energy producers.
 - Must have a systems perspective (interdisciplinary) to understand how the sectors fit together and them move forward with a systems approach.
 - More funding needs to be provided to learn and understand how climate affects ecosystems.
- With 10 minutes left during the session, list the highlights from the discussion.
 - Still a small group working on climate and public health.
 - Research and data gap.
 - It is hard to determine the climate/human health links due to the complicated nature of the system. No simple relationships – coupled systems.
 - Water issues – what are the societal impacts of hydroclimatic variability.
 - Vector borne diseases
 - Water supply
 - Energy consumption problems
 - Must have a systems perspective (interdisciplinary) to understand how the sectors fit together and them move forward with a systems approach.

Appendix G – Human Health and Society Sector Breakout Session Notes

- More funding needs to be provided to learn and understand how climate affects biogeochemical and socioeconomic systems.
- Communications: Need ongoing dialogue to determine how to best communicate human health and climate impacts.

Appendix H

Marine and Coastal Ecosystems Sector Breakout Notes

Moderator: Aleta Hohn, NOAA NMFS

Recorder: Jessica Whitehead, SC Sea Grant and NC Sea Grant

Marine and Coastal Ecosystems

Session 1: Products and Services

Session Lead: Tim Owen, NOAA NCDC

- Spend 10 minutes capturing responses to the plenary given by Eileen Shea. Not everyone needs to respond, but capture responses of people who feel compelled to share.
 - For a regional approach, make sure we have leadership & incorporate all of the right people. Right now many people doing many things, so duplication and “stepping on toes” occurring. Need to think about it critically, ensure it makes sense, and use our resources efficiently. We need more coordination.
 - Regional approach assures resources will be available regardless of politics on the national level.
 - Question: is the same effort being applied in other regions? Are similar meetings occurring in other regions? (Answer: this is a grassroots movement. NOAA’s Regional Collaboration Teams are tasked formally with identifying needs, including climate. SECART scope greater than NinC, but we coordinate closely).
- Who are the key stakeholders for your focus area?
 - Local, state, and regional planners
 - Planning/zoning boards
 - Water and sewer utilities
 - Elected officials (municipal, county, state, national)
 - Other federal agencies
 - DoD
 - USACE
 - EPA – including NEPs
 - DOI – including Refuges, NPS, USGS
 - DOE
 - CDC
 - Homeland Security (FEMA)
 - HUD
 - DOT
 - Commerce (including other NOAA)
 - Labor
 - White House CEQ
 - State agencies:
 - Transportation
 - Public health
 - Environment & natural resources – including NERRs, CZM
 - Commerce
 - Tourism
 - Agriculture (coastal)
 - Aquaculture
 - Energy
 - Insurance
 - Sea Grant
 - State divisions of emergency management

Appendix H – Marine and Coastal Ecosystems Sector Breakout Session Notes

- Port Authorities
 - NGOs involved in climate adaptation – TNC, Audubon, NCCF, Coastal Conservation League, Ocean Conservancy, Environmental Defense Fund, SC Wildlife Federation, Conservation Fund, other local climate study groups
 - Intergovernmental partnerships/agreements – MARPOL, LMEs, USGCRP,
 - Commercial and recreational fishers (individuals and organized groups)
 - Seafood industry
 - Developers
 - Realtors
 - Information brokers who can provide stakeholders with access to data and the data creation process
 - Academia
 - Climate communicators
 - Regional partnerships – Alliances, SARRP, SARP (Southeast Aquatic Research Partnership), Coastal Ocean Observing Associations, SAML, MAFMC, SAFMC, state fishery management commissions, SENRLG (Southeast Natural Resource Leadership Group), SALLC, SERPPAS, CSO, GCRC
 - Marine labs
 - International partnerships/collaborations: Environment Canada
 - K-12 schools – Education Departments, COSEE-SE
 - General public
 - Tourists
 - Think thanks and lobbying groups
 - Energy companies
 - Volunteer networks
- What are the top three information service needs for your focus area?
 - What climate products and services do you use? Discuss strengths and suggestions for improvements.
 - Communications tools
 - Documents and synthesis reports – ensure clarity & accessibility to non-climate experts, but improve scale, annual or biannual addendums to keep up with science
 - IPCC synthesis reports
 - USGCRP synthesis report
 - Visualizations
 - Regional sea level rise maps
 - Sea level rise visualizations
 - Audience focused viz
 - Technical and process assistance
 - Training materials & services
 - Facilitation services
 - Climate adaptation planning guidebooks
 - Climate adaptation strategies
 - Raw data
 - Coastal LIDAR data
 - Tide gauge & water monitoring stations

Appendix H – Marine and Coastal Ecosystems Sector Breakout Session Notes

- Sea elevation tables
- Wave exposure models
- Wave, current, ocean observations
- SST
- Soil water content, salinity, temperature
- Saltwater well intrusion monitoring
- Other remote sensing data
- Water quality data
- Socioeconomic data (US Census, economic census, surveys, etc.)
- Health data (human, wildlife, ecosystem, ocean)
- Agricultural data
- Tourism data
- Transportation data
- Weather (T, P, wind speed/direction) data – marine & terrestrial
- Predictions and models
 - SLAMM
 - Hurricane predictions
 - Weather forecasts
 - Tide predictions
 - Drought forecasts, US drought monitor
 - Risk and vulnerability assessments
 - CI-FLOW
- Can you suggest new products to be developed?
 - One stop data shop – including links to non-climate data that can be used to answer questions about sectoral impacts, archived data sets converted to similar formats
 - Compiled data set for marsh elevation & sea level rise
 - Visualizations of ALL sorts. Interactivity a plus.
 - Downscaled climate scenarios
 - Training/educational program for local decision-making under uncertainty.
 - Verification & validation of models
 - Finer scale data collection
 - Improvements of existing products: seafloor mapping for sand resource management, subsidence, tide gauges, synthesized socioeconomic & SLR projections
 - Marsh LIDAR data at low tide
 - Cost/benefit analysis of adaptation strategies
 - Risk prioritizations at fine scales
 - Coupled biological & physical models for risk assessment
- Are there vulnerabilities or opportunities that climate products could highlight?
 - Vulnerabilities
 - Potential outmigrations (species, people, habitats) from estuaries and wetlands
 - Critical infrastructure (water & sewer, stormwater, transportation)
 - Destabilization of coast
 - Marsh loss

Appendix H – Marine and Coastal Ecosystems Sector Breakout Session Notes

- Habitat fragmentation
 - Invasive species
 - Disease outbreaks
 - Fisheries vulnerabilities
 - Economic vulnerabilities
 - Opportunities
 - Undeveloped areas needed for habitat migration (prestorage)
 - Improved land use planning, coastal & marine spatial planning
 - Improved zoning
 - Fisheries opportunities (changing habitat, species distribution)
 - Economic opportunities
- What NOAA data and products need to be developed to meet your needs?
 - See above
- Discuss opportunities relative to the other sectors meeting concurrently.
 - Within the Carolinas, what are the most important organizational connections relevant to your focus area?
 - See above
 - Human health and society: opportunities to understand environmental justice & equity
 - Integrated water resource planning (streams, estuaries, and coastal ocean)
- With 10 minutes left during the session, rank and prioritize the highlights from the discussion.
 - There's a lot going on, and we need leadership and a mechanism for coordination.
 - We need information brokers who coordinate their message and can communicate it effectively to multiple audiences.
 - The Carolinas are highly vulnerable, and we have the opportunity and the expertise to be a national leader.
 - Data and information need to be at temporal and spatial scales that are appropriate to the issues we are addressing. Uncertainties and caveats need to be communicated clearly.

Session 2: Regional Engagement, Education, and Service Delivery

Session Lead: Rick DeVoe, SC Sea Grant Consortium

- Spend 10 minutes capturing responses to the plenary provided by Jim Fox and Ned Gardiner. Not everyone needs to respond, but capture responses of people who feel compelled to share.
 - Is there a need for these tools from the local level perspective (or is it a whizz-bang thing that doesn't have a lasting impact)?
 - What alternatives are easily employed for communities/groups who don't have capabilities to produce these visualizations (ex. small towns without GIS capacity) or who don't accept information in this format (ex. audiences who don't use new technologies)?
 - Take advantage of portable Science on a Sphere
 - Requires established credibility for people to buy into it – need local level trust!
 - Intending these to stand alone on a web site, or would they be in a presentation?

Appendix H – Marine and Coastal Ecosystems Sector Breakout Session Notes

- NOAA CSC gets a good reaction from the ones they produce, but are very careful about the context. NOAA can't go too far off message, so have disclaimers, context, etc.
- Like any other outreach method, you need to know your audience and how they receive information to be effective.
- Like Jim's notion that developing tools need to be tied, grounded in local knowledge. Need to engage the community to help build the tool.
- How do you assess stakeholder needs/wants for climate information?
 - Audience characterization
 - Needs assessment (ex. CSC online course)
 - Distinguish between needs and wants
 - Develop partnerships with trusted individuals who have a long history in the region (helps with info outside of formal/traditional information gathering methodologies)
 - Need to rephrase more technical questions: ex. "What's bothering you in your community today?"
 - Partner NOAA scientists and outreach people with others who have credibility with decision-makers (ex. people who fishermen already trust)
 - What new/innovative methods should we be using?
 - Movie makers have power – is there some way to send a message through storytelling?
 - UNC-CH partnered with PlanIt Now (Morgan Freeman and others) – will provide the science and they distribute message
 - Science Café initiative in eastern NC
 - Embed decision-makers in NOAA to bring perspectives together (ex. Scott Shuford and the Planning guidebook)
 - Engage decision-makers/stakeholders and make them feel valued... bring them into the planning process (as opposed to just listening to them at public hearings)
 - Kitchen Table Climate Study Group model – contact local community leaders and engage with them, enable new groups to form
 - In what real-world contexts (e.g., national security, human health, public safety, economics, politics, etc.) do you/can we engage audiences and extend climate information?
 - Look for opportunities to add climate to the conversation – ex. fisheries management councils
 - Putting climate in the context of something else may resonate more than approaching climate as the primary issue
 - Know the audience's WIIFM (What's In It For Me)? Then add climate to the WIIFM.
 - Address climate change by addressing its component parts without mentioning climate change. Works for CSC, Sea Grant interactions.
 - Local and state hazard mitigation plans. Involves convincing state hazard managers that it's a problem (happening on state level in NC, but not local level)
 - Adaptation in a sustainability framework vs. climate change as a driver. Redirect toward "no regrets" strategies
 - Tourism – use tour guides, partner with Center for Sustainable Tourism
 - Seafood industry – ex. MD initiatives
 - Social marketing
 - Real estate industry, developers – disclosure initiatives.

Appendix H – Marine and Coastal Ecosystems Sector Breakout Session Notes

- SC Shoreline change report included recommendation for real estate disclosure, but it's very controversial
 - Water & sewer infrastructure, stormwater infrastructure, septic replacement
 - Roads and bridges
 - Fishing tournaments and boat shows
- What methods do you/should we use to disseminate climate information?
 - Need to adapt dissemination strategies to public perceptions and how they want to receive information – including who the messenger should be!
 - Media outlets... online and on camera meteorologists
 - Use current outreach/extension network at local level
 - Film & entertainment
 - iPhone apps
 - NCDC working with Wal Mart on fisheries, energy... other opportunities?
 - Clearinghouse explaining which agencies focus on what (ex. NOAA does this, EPA does that, USFS does this...)
 - National AND regional
 - Informal education centers (aquaria, science centers)
 - Formal education (K-12), including teacher training opportunities (NCCAT)
 - Get university students involved in helping w/ outreach
- How do you/should we address the issues related to the uncertain nature of climate?
 - How do/should we deal with the uncertainties related to the science of (and predictions related to) climate phenomena?
 - Recognize that people don't understand percentages.
 - Present scenarios & ask people what they can live with or what they can reasonably do given their resources
 - Relate to people how much in life is uncertain, draw parallels to how you plan for those events (ex. insurance)
 - Understand uncertainty is normal, not a weakness.
 - Simplify how you present it – ex. cone of uncertainty (OK) vs. spaghetti plots (too complicated)
 - Get people who already provide services to community to present the information (ex. power companies and power lines when buying a home)
 - Pay attention to how people interpret visual cues (using colors, shapes that reflect people's associations)
 - How do/should we deal with skeptical audiences when extending climate information?
 - Don't mention climate change
 - Understand their motivations for being skeptical
 - Find what appeals to the audience and work in as improvements/efficiencies that tie into their motivations
 - Overcoming the "show me" mentality by giving some kind of meaningful confidence that there are legitimate concerns
 - Be realistic that some skeptics will not accept the information because it threatens their values.
 - Work with those who will accept the information and use that to demonstrate to skeptics that their peers are doing it...

Appendix H – Marine and Coastal Ecosystems Sector Breakout Session Notes

- People’s eyes glaze over with facts, fear doesn’t last long... but feelings (appealing to commonalities with audience) help receptivity
- Show them the benefits (especially financial)
- What are your sources of climate information?
 - Inland hurricane impacts report – presentations became NWS training
 - NASA
 - IPCC & Copenhagen Diagnosis
 - Various government organizations
 - State government agencies
 - Keep in mind your audience’s perception of your source’s credibility
 - General public – from popular media outlets
 - Has this information “informed” decision-making? i.e., are there outcomes?
 - Ex. Hawaii – relocating evacuation centers outside of floodplain
 - Audubon SC marsh migration project started based on info
 - Freeboard on Pivers Island lab raised for storm surge
 - Biofuels requirements put in place
 - Shoreline management changes recommended based on climate change (estuarine shoreline & marsh migration)
 - What information seems to be lacking?
 - Much of information is there – the information’s credibility varies with audience’s perceptions
 - Need more specific information on state, local scales
 - Communication about effective hazard mitigation, land use
- Discuss opportunities relative to the other sectors meeting concurrently.
 - Did not get to.
- With 10 minutes left during the session, rank and prioritize the highlights from the discussion.
 - Focus on the negative impacts and benefits of climate change and adaptation, rather than climate change itself.
 - Know your audience! Scale the information to the level needed for decision-making (spatial and temporal scale). Generate information at a local and state level in addition to the regional and national level (downscale).
 - Use the appropriate messenger.
 - Uncertainty is normal.
 - Get beyond the attribution of climate change (human vs. natural... doesn’t matter!).

Session 3: Regional Climate Science

Session Lead: Ned Gardiner, NOAA Climate Program Office

- Spend 10 minutes capturing responses to the plenary provided by Otis Brown. Not everyone needs to respond, but capture responses of people who feel compelled to share.
 - Wow!!
 - Set the stage very well.

Appendix H – Marine and Coastal Ecosystems Sector Breakout Session Notes

- Emphasized opportunity for NC, SC coastal components
- Heard him saying what we've been saying – potential support for on the ground efforts
- NC DENR Climate Change Initiative Climate Action Plan... CICS focus is essentially what NC DENR needs to form this plan.
- So new that it hasn't gelled yet, so there aren't standard operating procedures. We have the opportunity to get in and mold how we want it to work – we can help influence decisions
- Focus on PhD and postdoc aspect – concerned that our users don't fit that criteria. May be challenging to get user- or sector-oriented partners involved.
- NOAA could reach out to other partners who “get it” at the local level but can also be advocates & spread the word.
- Could there be different levels of partnerships established? Huge financing in the private sector to develop these sorts of things as philanthropic efforts. Are we missing out? What's the financial mechanism?
- Nice existing models – a lot of basic important research questions come out of partnerships with decision-makers, so use-inspired work would fit in with research institute agenda
- Discuss ecosystem services and processes. Discuss these in relation to climate variability and change and impacts on your sector.
 - Protecting natural systems & role they play in protecting built environment (wetlands, barrier islands, dunes, etc)
 - Need to be cognizant of scientifically based natural functions of systems that enable ecosystem services. Translate impacts of climate on structure to impacts on services
 - Coastal management – wetlands home for marine fisheries; a huge economic driver for NC (and SC).
 - Decisions will need to be made about hardening estuarine shorelines... research needed to inform
 - Connect ecosystem services – natural areas are habitat, water storage, etc – make sure we are aware of linkages
 - Relating to stakeholders/decision-makers: provide them with reasons why they would want to preserve (sense of place, buffers, etc)
 - Keep in mind peoples' value systems and how their values influence their perspective on ecosystem values. Ex. conflict over turtles and fishing.
 - Economic impacts of ecosystem services
 - Role of human and ecosystem adaptation. Systems are dynamic and we must allow them to change (ex. roads in the way preventing marsh migration)
 - Barrier island dynamics: SLR, enhanced erosion, hurricane intensity, possible collapse of OBX
 - What do we need to know about shifting salinity boundaries?
 - Offshore commercial/recreational fisheries & reefs
 - Coastal impacts of drought – research in SC, but is there any in NC?
- Discuss winners and losers under varying and changing climate regimes. Consider resilience and restoration efforts.
 - Human winners and losers
 - Tourism loss (beach recreational activity, golf courses) – but then opportunities (longer shoulder season)
 - Coastal property owners

Appendix H – Marine and Coastal Ecosystems Sector Breakout Session Notes

- Economy as a whole has both winners and losers – there will be tradeoffs.
- Scuba diving and boating – shift in reef fish diversity may be more appealing to some divers
- Crop loss (not tolerant of high CO₂, drought) & lack diversity for adaptation
- Sea islands of SC use freshwater wetlands for water – may need to take actions that could impact wetlands negatively to preserve access to water
- Ecosystem winners and losers
 - Some plants may win
 - Loss of freshwater wetlands, but increase in salt water wetlands
 - Invasive species – but can we make the loss into a win?
 - Invasive species more plastic – adapt faster
- Question is how people interact with ecosystems and how we perceive that as a win or a loss
 - We know we'll have change – but we don't know if we'll experience that as a win or a loss
 - A teachable moment that we can be more resilient/adaptable – we tend to resist change, but is change inherently bad? Can we learn to live with it?
 - Caution: we have a history of taking advantage of teachable moments (ex. post-Katrina reconstruction of barrier islands)
 - Natural hazards are part of natural environment – how do we tie it to climate adaptation?
- Systems will have to adapt on a short time scale – science not there to really tell us wins/losses when it has to happen so quickly (as opposed to time for natural evolution)
 - Monitor what occurs and the rate at which it occurs
- Applied science: are decisions made using scientific input?
 - Audubon SC marsh migration project: prioritizing land to allow marshes to migrate. Idea was to use science to develop a marsh matrix, but science not there. Have to proceed without it because if we wait the prime areas may be developed! Will need to adaptively manage as science becomes available.
 - Some science is there – range of global SLR estimates. Can't pick a number so have to go with scenarios/ranges.
 - Missing marsh stability info based on production, sedimentation, etc.
 - Part of what's missing is scale
 - GCRC has worked with GA DNR to do some management projects (not climate yet specifically, but have discussed SLR).
 - GCRC located close to DNR & this enables collaboration. How to scale this up or out?
 - NC Floodplain mapping and UNC-CH IMS storm surge modeling – need to apply to SLR, policymaking, then scale out to other areas (including reaching out to other partners in SC, GA)
 - Some happening in hazards/disaster recovery, but it's a yes and no... sometimes it happens, sometimes it doesn't
 - No, science not there and coordination between researchers & partners not there. Ex. sea oat restoration – groups don't search the scientific literature for the “and this can be used in sea oat restoration” conclusions when doing restorations. Lesson applies to climate!
 - Making localized decisions less time consuming than looking at the whole picture – decision-makers may not have time to do this before they have to make the decision

Appendix H – Marine and Coastal Ecosystems Sector Breakout Session Notes

- NERRs monitoring provides good impacts data (accretion) etc. – challenge is how to get it to a point where it can be used to make management decisions on impacts.
- Science used as a reference rather than a guide as we make decisions – people know what happens on the coast and build there anyway.
 - Can CICS help?
 - Take advantage of existing partners with this capability: NERRs CTP, NCDC outreach, cooperative extension, Sea Grant extension, NWS climate focal points, state climatologists, CSC
 - Need to do a better job of communicating on time scales people relate to
- The mechanisms in how decisions are made aren't a good fit to what's available – we need more research on how to align science with DM processes
 - Need to take lessons from risk communication literature and apply it to climate
 - Decisions are being made despite the science
- Decisions can be made using precautionary principle
- Rank issues, list unknowns and impacts
 - Coastal drought impacts
 - Ocean acidification
 - Gaps in coastal LIDAR data (including locations, tide considerations)
 - Data sharing issues (archiving, accessibility, formatting, cost, types)
 - LIDAR
 - GIS data
 - Estuarine shoreline data
 - Current wetlands inventory
 - Near-shore info (turbidity, currents, waves, pH, HABs, chemical contaminants, etc)
 - Much has been project-specific... need sustained monitoring over broader areas
 - Water quality, quantity data
 - Relative SLR projections (multiple scenarios, possibly including abrupt climate change scenarios, & decision-relevant time frames)
 - Downscaled GCM data (climate scenarios –i.e., yes, we want the climate model portal that Otis mentioned)
 - Downscaled near-term climate data (outlooks, etc)
 - Guidance for data providers on user needs
 - Note that SECOORA improving some data management & protocol development for ocean observing data. Data gaps due to temporal/spatial coverage of sensors
 - Preparation for rapid response post-disaster data collection (Todd Davison with CSC in Gulf, develop partnerships w/ FEMA, etc.)
- Discuss opportunities relative to the other sectors meeting concurrently.
 - Development
 - Water
 - Economic tradeoffs (including energy)
 - Coastal health and human health seem to be linked! Shellfish sanitation, wastewater, HABs, wildlife & oyster disease
- With 10 minutes left during the session, rank and prioritize the highlights from the discussion.

Appendix H – Marine and Coastal Ecosystems Sector Breakout Session Notes

- Need better data sharing and data standards, sustained data observations, and on varying downscaled temporal and spatial scales. Data have different strengths and weaknesses, and we need comparisons. We also need to pay attention to data transferability.
- Need for more research on basic systems and ecosystem responses to climate impacts.
- Need someone to translate research to local levels.
- Decision-makers use science as a reference, not as a guide. Science needs to be decision-relevant if we want them to use it despite broader political and socioeconomic contexts.
- We need to clarify relationships with the private sector.

Appendix I

Water (Agriculture and Ecosystems) Sector Breakout Notes

Moderator: Jack Thigpen, NC Sea Grant

Recorder: Michael Voiland, NC Sea Grant

Water (Agriculture and Ecosystems)

Session 1: Products and Services

Session Lead: Tim Owen, NOAA NCDC

- Spend 10 minutes capturing responses to the plenary given by Eileen Shea. Not everyone needs to respond, but capture responses of people who feel compelled to share.
 - Will Reg. CS Directors/Offices have support/resources? How will support network/structure look?
 - Concern with reporting relationship of the RCS Director. To NESDIS? To NWS Reg Director?
 - Is definition of “climate” clear? Temporal vs. Episodic aspects? Relationship between climate, weather, and water?
 - Climate change should drive folks out of their own silos into more cooperative partnerships

- Who are the key stakeholders for your focus area?
 - See NCDC Sector doc list
 - Plus tribal governments
 - Plus public health officials (water-borne disease issues)
 - Plus state envir. agencies
 - Plus wildlife agencies (state and local)
 - Plus Drought-focused groups
 - Plus private water suppliers
 - Plus TVA, power/energy generation/development entities
 - Plus Bureau of Reclam and FERC

- What are the top three information service needs for your focus area?
 - Projections of future water availability; seasonal outlooks.
 - SLR predictions vis-a-vis saltwater intrusion
 - Accurate water demand forecasting (as affected by popul. growth); will human water use change with climate variability (e.g., for irrigation, watering)?
 - How will more frequent acute storm events affect an area’s flash flood potential?
 - **SUMMARY: detailed climate projections from seasonal to long term at high temporal and spatial resolution**

 - What climate products and services do you use? Discuss strengths and suggestions for improvements.
 - MPE (multi-sensor precip. estimates). Archival data exists. Higher resolution would help.
 - USGS stream gauge data. More gauges!
 - NCDC climatological summaries. Could be better organized, made easier to use

 - Can you suggest new products to be developed?
 - Clearinghouse(s) focused by sectors of use/interest.
 - Informational searches need filtering capabilities, customizable by user
 - Introductions/primers on how to find specific climate info; a “user toolbox”
 - standardized formatting of data formats, as well as standardized request protocols
 - **SUMMARY: Easier searchability/access to assist users (both experienced and not-so-experienced)**

Appendix I – Water (Agriculture and Ecosystems) Sector Breakout Session Notes

- Are there vulnerabilities or opportunities that climate products could highlight?
 - Opportunity to integrate among disciplines/sectors
 - Improve public communications re: why continuous data/observations are important. Make the “business case” to appropriators and the public
- What NOAA data and products need to be developed to meet your needs?
See above
- Discuss opportunities relative to the other sectors meeting concurrently.
 - Within the Carolinas, what are the most important organizational connections relevant to your focus area?
 - SLR with Marine & Coastal (saltwater intrusion, inundation of below-ground facilities, septic, etc). Coastal ocean acidification. Effects on rec. and tourism infrastructure?
 - Energy and Water inter-relationships
 - Ag—irrigation needs and run-off concerns
 - Human Society: population growth as affected by climate shifts
 - Transportation and water quality, flooding impacts
 - **SUMMARY: Good opportunities exist for inter-disciplinary and cross-sector collaborations**
- With 10 minutes left during the session, rank and prioritize the highlights from the discussion.
See “**SUMMARY**” sections above

Session 2: Regional Engagement, Education, and Service Delivery

Session Lead: Rick DeVoe, SC Sea Grant Consortium

- Spend 10 minutes capturing responses to the plenary provided by Jim Fox and Ned Gardiner. Not everyone needs to respond, but capture responses of people who feel compelled to share.
 - Do we need staff “navigator” positions who help them move through available information/data (like a dispatcher who pulls info needs from callers and route them to the answers)
 - Need to listen to needs/concerns, but also need to inform them of needs they may not see or want to address
 - Seek to create a “multiplier effect” among community members (people informing people)
- How do you assess stakeholder needs/wants for climate information?
 - What new/innovative methods should we be using?
 - Apps, social networking, Google earth, “survey monkees”
 - Work with/through “early adopters” or those esteemed in the community (holding credibility with others) to influence, teach, others)
 - Multi-lingual approaches
 - Youth/school programs to bring the message home to parents/adults
 - Collaborating with hydropower entities
 - Partner with land-grant programs to reach ag audiences

Appendix I – Water (Agriculture and Ecosystems) Sector Breakout Session Notes

- In what real-world contexts (e.g., national security, human health, public safety, economics, politics, etc.) do you/can we engage audiences and extend climate information?
 - Future use of icecap seabeds (to be ice-free) for defense/exploration purposes
 - Water quantities/flow info for power production, irrigation, recreational uses (e.g., kayaking)
 - NEPA EISs now require SLR be addressed
 - NFI policies/maps/insurance
 - Have stakeholder/interest groups understand cross-cutting ecosystem benefits/services
 - statewide meetings of key water resource groups
- What methods do you/should we use to disseminate climate information?
 - newest IT approaches, web/email, podcasts
 - more graphic, multi-media products
 - “buffets” of info, so that people can find/use what they are most interested in
 - methods need to be sustainable over time
 - use VIPS holding high credibility to move your message (Jeff Gordon example)
- How do you/should we address the issues related to the uncertain nature of climate?
 - How do/should we deal with the uncertainties related to the science of (and predictions related to) climate phenomena?
 - Behave/build/act responsibly ANYWAY (beyond climate issue). “No regret” policy/approach.
 - Educ. programs for local officials and decision makers
 - Speak to the ranges of understanding, of outcomes, of future scenarios, and of risks
 - Use economic/financial investment/insurance analogies
 - Admit uncertainty when it exists, including the uncertainty of downscaling
 - How do/should we deal with skeptical audiences when extending climate information?
 - shift the topic/issue/conversation to something they do believe in and care about
 - build a sustainable dialogue
 - utilize credible peers to help deliver the message
 - educate about response to acute weather events, not climate change per se
- What are your sources of climate information?
 - climate info/data vs. climate opinion?
 - state climate office, NCDC, ESRL, EPA listserves, NHC, USGS, Pielke Sr. blog, “Skeptical Science” app, google maps,
 - Has this information “informed” decision-making? Yes! e.g., it’s informing debate re: a \$450B water pipeline in OK
 - What information seems to be lacking?
 - The actual issue may be info overload, and determining trusted sources of info
 - Need more economics-based info/analyses and “risk-ranking” for decision makers
- Discuss opportunities relative to the other sectors meeting concurrently. (Group did not get to this one)

Appendix I – Water (Agriculture and Ecosystems) Sector Breakout Session Notes

- With 10 minutes left during the session, rank and prioritize the highlights from the discussion.

PRIORITIES:

- Economic analyses, cost-benefit studies;
- tapping credible peer messengers/key leaders;
- how to creatively sustain the dialogue with skeptical audiences;
- use of new IT/social media;
- educating decision makers on making decisions in context of risk/uncertainty

Session 3: Regional Climate Science

Session Lead: Ned Gardiner, NOAA Climate Program Office

- Spend 10 minutes capturing responses to the plenary provided by Otis Brown. Not everyone needs to respond, but capture responses of people who feel compelled to share.
 - Is CICS only satellite data collection-based? What about interpretation/validation/application?
 - Need to make linkages with the new CICS, especially if not in NC
 - Is there a link between CICS and NCA&T's NOAA center (ISET)? The Carolina climate community shows an absence of involvement of people of color and ethnic origin
 - NinC can facilitate making connections within NOAA
- Discuss ecosystem services and processes. Discuss these in relation to climate variability and change and impacts on your sector.
 - Need to consider market and non-market valuation of eco. services with climate variations/trends
 - What is the impact on business/industry/water supplies wrought by climate variability?
 - Population growth pressures and climate variability may exacerbate pressures on NC water resources.
 - Effects of local regulations/restrictions/choices on water use need to be better understood
 - Would ecosystem resiliency be affected, and how, with climate variation/shifts? Do people understand the concept/value of ecosystem resiliency?
- Discuss winners and losers under varying and changing climate regimes. Consider resilience and restoration efforts.
 - Municipalities may suffer from higher stormwater infrastructure costs due to more intense rainfall events (at reservoirs and in supply systems)
 - Adverse impacts on tourism industry due to effects of climate variability on lakes/streams
 - Poorer, smaller communities may be less able to adapt
 - Ag industry impacts may be adverse...or beneficial? There could be shifts in types/varieties of crops.
- Applied science: are decisions made using scientific input?
 - Yes, e.g., Coop Extension/Landgrant programs
 - No, if climate data and institutes like CICS doesn't advance the interpretation and distribution of info that can be understood by local/individual stakeholders
 - Need top-down and bottom-up partnerships and educational efforts
 - better application of science can occur by incentivizing "great behavior" and decision-making

Appendix I – Water (Agriculture and Ecosystems) Sector Breakout Session Notes

- Science can better applied if the human dimension of water resource use is studied and taken into account
- Rank issues, list unknowns and impacts
 - Advice to CICS: consider all stakeholders, including critics of CICS goals; prioritize science strategies; inventory existing programs/centers/activities; need more accurate satellite-based assessments/trend reports so as to capture changes in landuse, vegetation, impervious surfaces, etc., to derive evapo-transpiration variables (so as to set an accurate measure of the availability of water)
 - Advice to managers/municipalities: Should water providers re-examine future needs/goals under both a higher-demand and a lesser-demand scenario? Inter-state water issues may become more intense, and demand multi-state/regional initiatives. Further explore the water-energy nexus: will non-traditional sources of energy added to grids result in less water demand? Should there be “water sharing grids” like existing in the electric power industry, such that inter-state or inter-watershed conflicts do not develop?; explore competition between flood control, water supplies, ecosystem flows, and recreational use
- Discuss opportunities relative to the other sectors meeting concurrently. (See above)
- With 10 minutes left during the session, rank and prioritize the highlights from the discussion. (See above)