

Carolinians Climate Connection

Carolinians Integrated Sciences & Assessments

Integrating Climate Science and Resource Management in the Carolinas

Draft National Climate Assessment Released

The draft version of the third [National Climate Assessment](#) is now available for public review and comment through April 12, 2013. The assessment provides a status report on climate science and impacts and is part of the US Global Change Research Program. Find out more about the draft report on the [next page](#). Read about key findings from the draft Southeast and Caribbean chapter [here](#).

2012 RISA Annual Report Now Available

This brief [report](#) highlights new projects and emerging research by each of the 11 RISA programs.

Focus on Adaptation

This edition of the Carolinians Climate Connection highlights recent publications related to adaptive capacity in the Carolinians and throughout the Southeast. It provides information on regional efforts to support climate resilience. Supporting improved adaptation to current climate variability and projected climate change impacts is an element that cuts across many of CISA's activities.

Adaptation Research

Climate Adaptations in the Southeast USA

As part of the Southeast Region Technical Report for the National Climate Assessment, this chapter provides examples of adaptation activities throughout the Southeast. ([Dow and Carter, 2012](#))

Engaging Climate-Sensitive Sectors in the Carolinians

This technical report to the third National Climate Assessment assessed capacity to adapt to climate vulnerability and change in the Carolinians. ([Lackstrom et al., 2012](#))

Climate Change Adaptation: Challenges and Opportunities

This synopsis of research by Moser et al. provides information on identifying barriers throughout the adaptation process in order to locate points of intervention to overcome them and provides an example from [CISA's VCAPS project](#).

Resources and Tools

See [page 8](#)

Find more Adaptation Information and Resources on the
[CISA website](#)

Upcoming Events

[North Carolina GIS Conference](#)

Raleigh, NC

February 7-8, 2013

[SC Environmental Conference](#)

Myrtle Beach, SC

March 10-12, 2013

[NC Water Resources Research Institute Annual Conference](#)

Raleigh, NC

March 20-21, 2013

[NOAA Coastal Services](#)

[Coastal GeoTools Conference](#)

Myrtle Beach, SC

March 25-28, 2013

[Georgia Water Resource Conference](#)

Athens, GA

April 10-11, 2013

Announcements

[Climate Funding Opportunities](#)

[DOI Climate Science Center RFP](#)

[Sea Grant Mid-Atlantic Regional Funding Opportunity](#)

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Carolinas Climate Connection

Carolinas Integrated Sciences & Assessments

[Back to Top](#)

Draft National Climate Assessment Released

On Friday, January 11, 2013, the 60-person National Climate Assessment and Development Advisory Committee (NCADAC) released the [third draft National Climate Assessment](#) (NCA) report for public review and comment. A national climate assessment was commissioned through the Global Change Research Act of 1990, which requires a periodic report to the President and Congress that evaluates, integrates and interprets the findings of the US Global Change Research Program. The draft version of the third assessment includes contributions from over 240 authors in 30 different chapters.

The assessment aims to provide a status report on climate change science and impacts. Activities and findings which helped to inform the report include observations, monitoring, modeling, process research, and data management. The report focuses on analysis of seven selected sectors: human health, water, energy, transportation, agriculture, forests, and ecosystems and biodiversity, as well as interactions among them. In addition, regional assessments are included in the report with respect to the Northeast, Southeast and Caribbean, Midwest, Great Plains, Southwest, Northwest, Alaska and the Arctic, Hawai'i and the Pacific Islands.

The NCA report is intended to integrate climate science into broader social, ecological, and policy systems in order to develop an analysis of impacts and vulnerabilities which the United States faces as a result of climate change. Although the assessment is not intended to provide specific policy recommendations to the administration, the report does include chapters on mitigation, adaptation and decision support. These chapters provide an overview of activities being planned or implemented around the country as various individuals, organizations and agencies begin to take action to address climate change.

Southeast Chapter of the NCA

For each of the regional chapters, the authors provide key messages and traceable accounts of supporting evidence. The traceable accounts section of each regional chapter includes a synthesis of the evidence base, new information and remaining uncertainties, and an assessment of confidence based on evidence for each key message. [Table 1](#) on the next page provides the draft version of the three key messages from the Southeast and Caribbean region chapter. The table only includes a

short synopsis of the rich information contained in the full chapter. Be sure to check out the [full text online](#).

CISA Contributions to the NCA

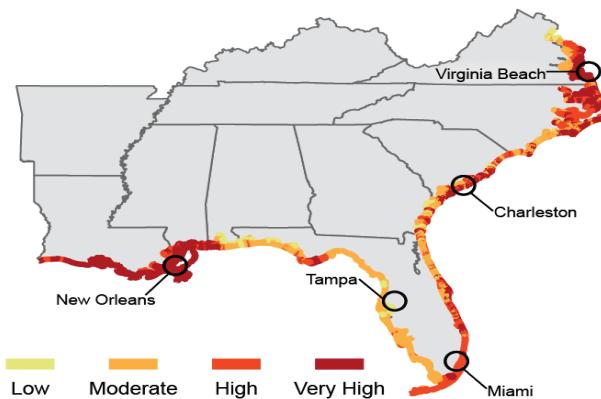
CISA and its regional partners have been actively engaged in the assessment process. Kirstin Dow was the lead author on the adaptation chapter in the Southeast Region Technical Report. Chip Konrad and Chris Fuhrmann were lead authors on the climate chapter in the same technical report. CISA research associates also contributed a technical report entitled [Engaging Climate-Sensitive Sectors in the Carolinas](#) with respect to climate-related decision-making and information use, mitigation and adaptation efforts, and adaptive capacity.

Opportunities for Public Comment

The public review and comment process will run through April 12, 2013. Public comments are encouraged and will be reviewed individually by chapter authors and third party reviewers. Anyone may contribute suggestions for revised content and additional sources which should be cited. The authors of the report will use the comments to revise the report before submitting it to the federal government for consideration. All comments must be submitted through the [online comment process](#).

NCA net, a network of organizations working with the NCA to engage producers and users of assessment information, has developed a '[Partners Toolkit](#)' which includes fact sheets and PowerPoint slideshows that provide an overview of the NCA process and key findings from the draft assessment. Information about opportunities for engagement with the NCA, to include regional meetings, can be found [here](#).

Vulnerability to Sea Level Rise



Threats to both natural and built environments caused by sea level rise represent one of three [key findings](#) in the Southeast and Caribbean regional chapter of the draft NCA. The degree of vulnerability varies throughout the Southeast. Source: Draft National Climate Assessment, Southeast and Caribbean chapter

Carolinas Climate Connection

Carolinas Integrated Sciences & Assessments

[Back to Top](#)

Draft NCA Southeast and Caribbean Chapter Key Findings

Sea level rise poses widespread and continuing threats to both natural and built environments, as well as the regional economy.

- The chapter discusses vulnerabilities of both human and natural environments to sea level rise and details examples of observed impacts in addition to exacerbated future impacts as sea levels continue to rise.
- The authors state that the three viable adaptation options to rising sea levels are to protect against them (e.g. sea walls), to accommodate for them (e.g. adaptive infrastructure design) or to retreat, noting that all three strategies are being implemented throughout the region.
- Uncertainties regarding the rate of sea level rise include differences in projections between different climate models, natural climate variability, uncertainties in melting rates of land based glaciers and ice sheets, and future rates of fossil fuel emissions. Land subsidence and the degree of adaptive management planning and actions add additional layers of uncertainty.
- The confidence level of the key message is rated as being ‘very high’ based on consistency of published peer-reviewed literature that sea levels will continue to rise and on both observed and projected impacts to natural and human systems due to sea level rise.

Rising temperatures and the associated increase in frequency, intensity, and duration of extreme events will affect public health, natural and built environments, energy, agriculture, and forestry.

- Anticipated human health impacts caused by rising temperatures include increased hospital admissions due to heat-related stress, bacterial infections caused by increased water temperatures which result in contaminated shellfish and harmful algal blooms, higher contraction rates of vector-borne disease, and respiratory illness from increased ground-level ozone.
- Wildfires are expected to increase in frequency, intensity and size, resulting in air pollution, and loss of property and life.
- Increasing temperatures are also expected to reduce yield from crops and livestock and cause damage to transportation infrastructure such as roadways, bridges and railroad tracks.
- The scope and magnitude of these impacts will be influenced by the ability of the different sectors to adapt and respond to changing climatic conditions and the implications of multiple stressors, such as water demand.
- There is ‘high’ confidence this key message and in documentation which projects increases in air temperature, although not the precise amount of increase, as well as the associated higher risk of negative impacts to human health, agriculture, forestry, natural systems, the built environment, and energy.
- There is a ‘low’ confidence level in knowing the magnitude of impacts because of the lack of information on how systems will adapt and the limited knowledge base on the wide diversity of climates and systems that exist in the region.

Decreased water availability, exacerbated by population growth and land-use change, will continue to increase competition for water and impact the region’s economy and unique ecosystems.

- Water demand will increase in the region due to population and industry growth and increases in irrigated agriculture.
- Water supply is projected to decrease due to shortages caused by a projected increase in frequency and duration of drought in parts of the region, effects to freshwater availability caused by sea level rise and salinity intrusion, and higher rates of evaporation due to anticipated higher air temperatures.
- Uncertainties regarding water availability result from both current and projected variability in precipitation throughout the region, a lack of reliable evapotranspiration projections, a need for more accurate information on drought projections, and a better understanding of future competition for water supply among urban agricultural and environmental sectors.
- ‘High’ confidence is given to the increase in anticipated water demand due to population growth trends, although additional studies are needed to better understand the resilience and adaptive capacity of socio-economic and environmental systems.

Table 1: Key findings from the Southeast and Caribbean chapter of the draft NCA

[Back to Top](#)

Carolinas Climate Connection

Carolinas Integrated Sciences & Assessments

[Back to Top](#)

Climate Adaptations in the Southeast USA

In their chapter, “Climate Adaptations in the Southeastern USA,” for the Southeast Region Technical Report to the National Climate Assessment, Dow and Carter outline a conceptual process of adaptation and give examples of projects at different stages in the process underway throughout the Southeast.

The chapter discusses climate variability in the Southeast and related threats to include extreme heat, drought, heavy rain, ice, tropical storms, hurricanes, flooding, and wildfires. The additional stresses of population growth, sea level rise, land subsidence, and increasing demands on water resources add to the complexity of these elements in the face of climate variability and change.

Adaptation, refers to “the adjustment in natural or human systems to a new or changing environment that exploits beneficial opportunities or moderates negative effects.” The adaptation process includes 6 steps: 1) identification of current and future climate changes, 2) assessments of risks and vulnerabilities, 3) development of adaptation strategies using risk-based prioritization schemes, 4) identification of opportunities for co-benefits and synergies across sectors, 5) implementation of adaptation options, and 6) monitoring and evaluation of implemented options.

The authors found that adaptation efforts in the Southeast are being conducted at all scales, to include local communities, NGOs, states and federal agencies through support of both broad efforts and individual projects. Coastal areas throughout the region are home to the most activity due to the risks associated with sea level rise and severe storms.

The chapter reports that, currently, adaptation activities in the Southeast fall into early stages of the adaptation process, to include identifying relevant climate impacts, assessing significant risks and vulnerabilities, and creating partnerships to support planning. Mainstreaming, or incorporating adaptation planning and strategies into existing organizational responsibilities and procedures, plays a major role in incorporating these efforts into related, ongoing efforts. The adaptive capacity of the region (tools, information, knowledge, etc.) has increased through monitoring, research, and outreach.

The chapter also provides examples of programs designed to support adaptation efforts across multiple sectors while addressing specific types of needs. These include groups such as the [EPA's Climate Ready Estuaries](#) program, the [DOI's Climate Science Centers](#), state [Sea Grant](#) Programs, and the three [NOAA Regional Integrated Sciences and Assessments teams](#), including CISA.

The ability of these groups to link efforts across different organizational structures will further enhance the adaptive capacity of the region. The authors note that future adaptation efforts will require more information on cost, benefits and co-benefits of adaptations, and support for evaluation of efforts to make future products more efficient. Find the full text, which is part of the larger Southeast Regional Technical Report for the National Climate Assessment, [here](#).

Dow, K. and L. Carter. 2012. ‘Climate Adaptations in the Southeastern USA.’ Southeast Regional Technical Report to the National Climate Assessment. 283-310

[Back to Top](#)



[Alligator River National Wildlife Refuge](#), location of an adaptation project of the US Fish and Wildlife Service in partnership with The Nature Conservancy.

Photo Source: The Nature Conservancy, Nags Head Woods Chapter

Carolinas Climate Connection

Carolinas Integrated Sciences & Assessments

[Back to Top](#)

Engaging Climate-Sensitive Sectors in the Carolinas

As a contribution to the third National Climate Assessment, CISA researchers developed a technical report, [Engaging Climate Sensitive Sectors in the Carolinas](#), an assessment aimed at improving our understanding of the Carolinas' capacity to adapt to climate change. The five sectors studied for the report, Forestry, Government Administration, Tourism, Water and Wildlife, were selected because of their sensitivity to climate variability and change and the significant role each plays in the regional and local economies in the two states.

Through document analysis, online questionnaires and telephone interviews with over 100 decision makers, information regarding climate concerns and information use, responses to climate change, factors that both facilitate and constrain these responses, and needs and recommendations to enhance adaptive capacity were identified. Noted climate concerns across sectors included sea level rise, increasing temperatures, increased variability and change in precipitation patterns, and impacts caused by extreme events such as floods, drought, hurricanes and tropical storms. Activities to address these concerns fell into several broad categories of climate-related data collection and monitoring, adaptive management experiments in coastal land use, emissions reductions, education and outreach, risk and vulnerability assessments for emergency management purposes, and habitat protection and conservation.

Although climate concerns and related activities were often found to be sector-specific, issues related to water use, land use management and coastal zone management provide a nexus among various sectors and organizations. Through adaptation efforts which address these shared interests and overlapping responsibilities, opportunities for networks, partnerships and collaborations are emerging.

CISA's report is cited in several chapters of the draft version of the third National Climate Assessment. In addition, several manuscripts based on further data analysis focus on climate change framing strategies, and the role of social and information networks. These adaptation research efforts focus on identifying and communicating climate change concerns and impacts to decision makers and stakeholders in the Carolinas, furthering adaptive capacity in the region.

Climate Change Adaptation: Challenges and Opportunities

Adaptation Barriers

While the Carolinas are accustomed to considerable climate variability, activities to address the potential impacts of climate change can be found at various stages of planning and implementation throughout the region. As adaptation activities develop and evolve, many lessons will be learned through experience. One way to improve understanding of how to support climate adaptation is to systematically assess the barriers at various stages throughout the process. Such information can assist decision makers in determining opportunities to circumvent, remove, or lower these barriers (Moser and Ekstrom 2010).

Many barriers consistently appear throughout the adaptation process. Factors important to the success or effectiveness of adaptation activities include:

- leadership to initiate and sustain the process
- financial, technological, and information resources as well as staff expertise and time
- communication to increase understanding and awareness and to constructively engage policy makers about the adaptation effort
- the inclusion of different values and beliefs when actors consider problems and potential solutions

[Table 2](#) conceptualizes the adaptation process as entailing three primary phases (Understanding, Planning, and Managing) and different steps within each phase. While real-world decision processes are not as linear and neat as portrayed here, this framework highlights the different types of barriers that decision makers may face at different stages of an adaptation project.

Identifying and understanding the scale and scope of the barrier can help to locate points of intervention to overcome that barrier (Ekstrom et al. 2011). The temporal elements of a given barrier may either be contemporary (occurs in the current context) or legacy (affected by decisions made in the past). An established law or regulation which prevents a specific adaptation activity would be considered a legacy barrier, while proposed legislation which would do the same would be considered a contemporary barrier. In terms of spatial or jurisdictional dimensions, the barrier may either be proximate (within the context or scope of a project) or remote (beyond the control of the decision maker).

Carolinas Climate Connection

Carolinas Integrated Sciences & Assessments

[Back to Top](#)

For example, budget cutbacks at the federal level may negatively impact non-profit or local activities by removing grant opportunities. These budget cuts are remote because they are outside the scope of those agencies' jurisdictions.

References: Moser, S. and J. Ekstrom. 2010. A framework to diagnose barriers to climate change adaptation. Proceedings from the National Academy of Sciences of the United States of America. 107(51):22026-22031.

Ekstrom, J., S. Moser, and M. Torn. 2011. Barriers to Climate Change Adaptation: A Diagnostic Framework. California Energy Commission. Publication Number: CEC-500-2011-004.

Phases and Stages of the Adaptation Process	Barriers (examples)
<i>Understanding Phase</i>	
Detect Problem	<ul style="list-style-type: none">• Is there a climate signal?• Has a threshold of concern, or a specific need to respond, emerged?
Gather/use information	<ul style="list-style-type: none">• Is there available, relevant, and credible information to address the problem?• Are actors receptive or willing to use information?
(Re)define problem	<ul style="list-style-type: none">• Do actors agree about the climate signal?• Do actors agree about the need for and feasibility of response?
<i>Planning Phase</i>	
Develop options	<ul style="list-style-type: none">• Is there leadership or a structure to guide the process?• Do actors agree on project goals, criteria, and feasible options?
Assess options	<ul style="list-style-type: none">• Are the data, information, and methods needed to assess options available and usable?
Select option(s)	<ul style="list-style-type: none">• Do actors agree about the process and criteria to select option(s)?• Is there agreement and clarity about who has responsibility and authority to select option(s)?• Have actors considered potential negative consequences and the feasibility of option(s)?
<i>Managing Phase</i>	
Implement option(s)	<ul style="list-style-type: none">• Are there sufficient resources (financial, technical, staff time)?• Does the plan provide clear guidance?• Is there a clear authority to implement the selected option?• Do legal and regulatory options exist?
Monitor outcomes	<ul style="list-style-type: none">• Has a monitoring plan been developed?• Are there sufficient resources (funding, technical staff) to conduct monitoring?• Is there capacity to collect, organize and analyze data?
Evaluate effectiveness	<ul style="list-style-type: none">• Has an evaluation plan been developed?• Are appropriate expertise, data and methods available?• Are actors willing to learn from an evaluation or new information?• Is it feasible (legally, socially, politically) to reopen previous decisions?

Table 2: Examples of barriers that occur at different stages of the adaptation process
(adapted from Moser and Ekstrom 2010)

Carolinas Climate Connection

Carolinas Integrated Sciences & Assessments

[Back to Top](#)

Opportunities: The Vulnerability and Consequences Adaptation Planning Scenarios Process (VCAPS)

While barriers can be overcome, they often require concerted efforts to support new management practices, coordination and collaboration across jurisdictions, and changes in thinking. Furthermore, opportunities to intervene are more likely if the barrier is within an actor's sphere of influence (i.e. contemporary and proximate rather than legacy and remote).

CISA, with the [South Carolina Sea Grant Consortium](#) and [Social and Environmental Research Institute](#), has developed the [VCAPS process](#) to assist local governments and communities explore the potential consequences of climate variability and change. The process integrates local and scientific knowledge, facilitates structured and efficient dialogue about the consequences of climate impacts, and allows participants to explore possible strategies and pathways to respond. The process enables users to discuss and build causal pathways that link climate stressors, vulnerabilities, and consequences with local adaptation options (see Figure A below). The process helps participants clarify their understanding about climate risks and adaptation challenges for their

communities as well as provide an opportunity to identify ways to integrate adaptation measures into existing activities. The following are several participant comments:

- "VCAPS provides the structure that allows for a focused discussion."
- "This is good because you pull global issues into a local context."
- "Surprising how much agreement we found."
- "It was an opportunity to get everybody together and get information out on the table in a format that was easily digestible."
- "Even though we did not focus the discussion on climate change, we ended up addressing all the key issues that are relevant to planning for it."

Since 2010 exercises have been conducted in Sullivan's Island and McClellanville, SC; Plymouth, NC; Boston and Plymouth, MA; and Orange Beach, AL. Future VCAPS projects are scheduled to occur in Beaufort, SC; Columbia, NC; South Thomaston, ME; and Wellfleet, MA.

For more information, contact CISA at cisa@sc.edu.

[Back to Top](#)

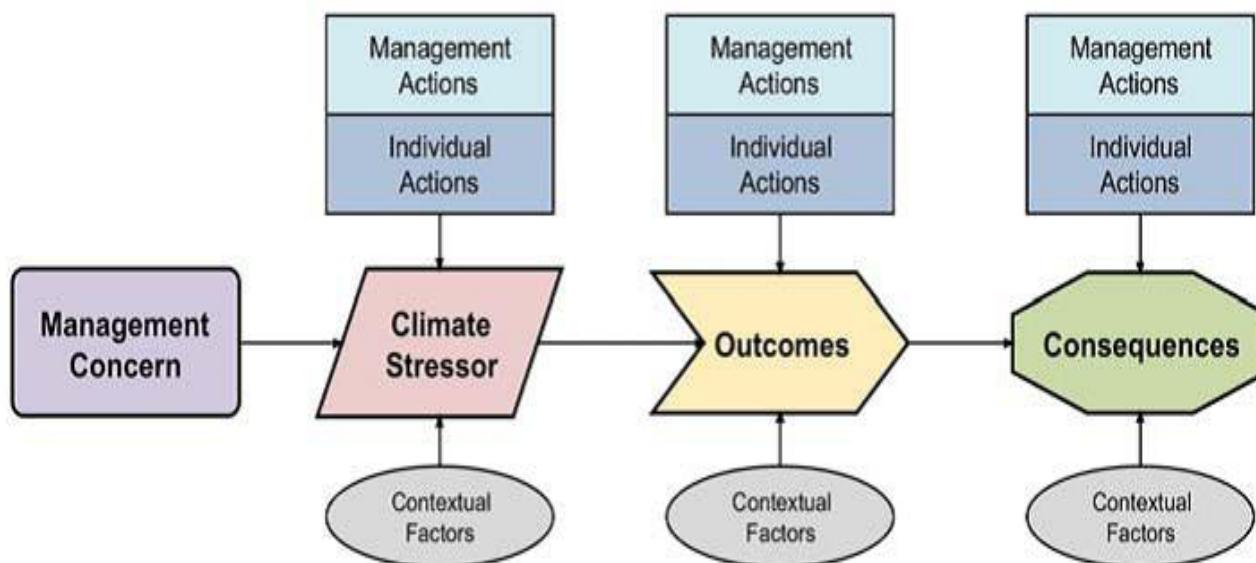


Figure A: The VCAPS diagramming process highlights vulnerabilities and management interventions that can be taken to adapt to or mitigate consequences.

Carolinas Climate Connection

Carolinas Integrated Sciences & Assessments

[Back to Top](#)

Resources and Tools

Observed Climate Change Indicators

The EPA recently released a report, [Climate Change Indicators in the United States](#), which includes 26 indicators identified with the help of partner organizations and based on peer-reviewed data from various government agencies, academic institutions, and other organizations.

The [EPA website](#) for the report includes a slide show of key findings in the report and links to additional information.



The slide show of key findings from the EPA Climate Change Indicators report provides links to additional information about each indicator.



NERRS Coastal Training Program

The [National Estuarine Research Reserve System's Coastal Training Program](#) is designed to provide up-to-date scientific information and skill-building opportunities to decision makers who manage coastal lands and waters.

Each of the 3 NERRS programs in the Carolinas, the [North Carolina Coastal Reserve/NERR](#), the [ACE Basin NERR](#), and the [North Inlet-Winyah Bay NERR](#), have Coastal Training Programs and provide many opportunities for engagement with local planners, managers and decision makers. Click on the name of each NERR above for more information about each program.

Sustainable Tourism Newsletter

Tourism in the Carolinas is driven by seasonality from the mountains to the coast. In order to remain successful, seasonal tourism operators must find ways to prepare and adapt to changing climate and weather patterns.

The [East Carolina University Center for Sustainable Tourism](#) produces a quarterly newsletter which contains seasonal forecast maps and discussion of the implications and impacts that these forecasts have on tourism.

Click [here](#) to join the Center's e-mail list to receive future editions of the newsletter.



The Center for Sustainable Tourism is also a partner in the The Renewable Energy in Tourism Initiative (RETI). Click [here](#) to access the RETI webinar series.

About CISA

The Carolinas Integrated Sciences & Assessments is 1 of 11 NOAA-funded [Regional Integrated Sciences & Assessments](#) teams. CISA works with a variety of stakeholders across North and South Carolina to incorporate climate information into water and coastal management and related decision-making processes. For more information, visit our website at www.cisa.sc.edu.