Carolinas Climate Connection

Carolinas Integrated Sciences & Assessments, a NOAA RISA Team

Integrating Climate Science and Resource Management in the Carolinas

Newsletter Contents

CISA PI Dan Tufford checking a monitoring well at a geographically isolated wetland in Marion County, SC. This work was part of an EPA-funded project to better understand the occurrence and ecological functions of this type of wetland.

Learn more about Dan's water resources work in the "Featured Researcher" article on page 2.

About CISA

The Carolinas Integrated Sciences & Assessments (CISA) is 1 of 11 NOAA-funded Regional Integrated Sciences & Assessments (RISA) teams. CISA works in North and South Carolina to integrate climate science into decision-making processes and improve society's ability to respond to climatic events and stresses.

CISA connects climate science and decision making through

- Applied research to produce relevant climate information
- Assessments of climate impacts and adaptation strategies
- Processes to support and inform community planning
- Fostering climate networks and climate communities of practice

Upcoming Events

North Carolina Coastal Conference
Raleigh, NC
April 14, 2015

National Adaptation Forum
St. Louis, MO
May 12-14, 2015

Int'l Symposium on Society & Resource Management
"Understanding and Adapting to Change"
Charleston, SC
June 13-18, 2014

Carolinas Climate Listserv

Subscribe to the Carolinas Climate Listserv to learn about the latest climate research and information, upcoming events, funding opportunities, and other relevant news for the Carolinas.

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USC Department of Geography
Callcott Building
709 Bull Street
Columbia, SC 29208
www.cisa.sc.edu

(803) 777-6875
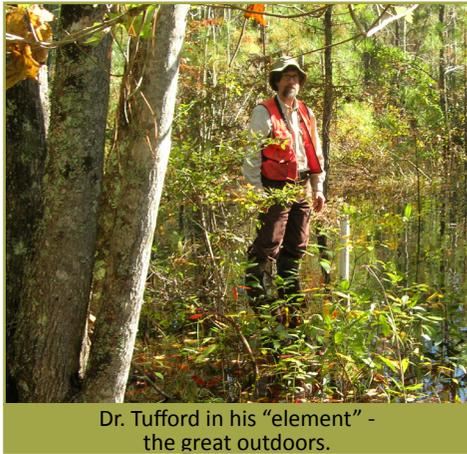cisa@sc.edu
@CarolinasRISA
www.facebook.com/usccisa

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Getting to Know Your RISA

Featured Researcher: Dan Tufford

Dr. Tufford in his "element" - the great outdoors.

Daniel Tufford received his PhD in Environmental Health Science from the University of South Carolina in 1996. He is currently a Research Associate Professor in the Department of Biological Sciences at USC and a CISA Principal Investigator. Dan's main research interests are in the areas of water resources, wetland ecology, and watershed hydrology and water quality.

"I've been fortunate to work on projects that allow me to study natural systems and anthropogenic impacts through many difference lenses including field work, simulation modeling, data analysis, resource management decision-making, and policy implications. From my very earliest research projects it was clear that local and regional climate is a significant driver of system response at many spatial and temporal scales. My work with CISA has been a platform for focusing on that aspect to provide useful information to various stakeholder groups as they think about and plan for the future. I especially enjoy working with the excellent team of researchers, students, and outreach specialists that we have in CISA."

"On a personal note, over the years I've had the unexpected privilege of traveling to many locations in North America and Europe. The usual natural, cultural, and historical aspects are always very interesting and I cannot help but look at many of the features of those locations as analogues to the systems I have studied for years. The concept that everything is connected is true on many levels."

Assessment of Downscaled Regional Climate Models for the Southeast

The ability of a model to replicate historical climate variables (e.g., temperature, precipitation) is an indication of how well the model replicates regional and local scale climate processes. This replication of the observed record is referred to as "model skill" and is an important feature in assessing the relevance of any model's future climate projections which might be used for various types of planning and decision making processes. A new article* by CISA researchers, Erik Kabela and Greg Carbone, presents findings from an assessment of dynamically downscaled regional climate models (RCM) for the Southeast U.S.

The study assessed nine models from the North American Regional Climate Change Assessment Program (NARCCAP), looking at how well the models replicate minimum and maximum temperature and mean precipitation for the historical period 1970-1999. NARCCAP models are run at a resolution of 50 km, or about 31 miles. The study area included Alabama, Mississippi, Tennessee, Georgia, and the Carolinas and was broken into two sub-regions, east (Georgia and the Carolinas) and west (Alabama, Mississippi and Tennessee).

The study used four different statistical metrics to assess model skill in order to provide information about how closely the models' output replicates the historical record. All nine models did fairly well in replicating observed minimum and maximum temperature records; although, the models did slightly better in replicating minimum temperature. Model skill was mixed in replicating monthly mean precipitation, some statistical metrics showing a higher skill score than others. The authors note that these findings underscore the need to use multiple statistical metrics in assessing model skill.

In addition to their analysis of model skill, the authors also include findings from their assessment about why some models perform better than others with respect to reproducing the historical record. The authors note that the global climate model (GCM) used to develop the downscaled RCM is the largest contributing factor to biases in RCM output (too wet or dry, too hot or cold). For example, if a GCM has a cold bias (i.e., produces colder temperature output than the observed record) that bias is transferred to the RCM and can be intensified through the downscaling process, producing an even greater bias in the downscaled model.

For more information on climate models and their use to inform decision making, check out CISA's newsletter, "Focus on Climate Modeling."

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[1] Kabela, E.D. and Carbone, G.J. (2015) NARCCAP Model Skill and Bias for the Southeast United States. American Journal of Climate Change, 4, 94-114. doi: 10.4236/ajcc.2015.41009

Research in Congaree National Park

As described by David Shelly in a new National Park Service video, the Old-Growth Bottomland Forest Research and Education Center at Congaree National Park is fundamental to making science part of the visitor experience. Research conducted at the Center also helps resource managers and park partners make informed decisions about the park. The following two articles describe some of the work CISA researchers and collaborating investigators are conducting to help understand the unique aspects of the park and to inform resource management decisions.

Floodplain Ecosystems in an Old-Growth Bottomland Forest

By: Aashka Patel, CISA Graduate Research Assistant & Chris Kaase, USC Dept. of Geography Graduate Student

Old-growth floodplain forests were once found throughout much of the southeastern United States. Congaree National Park (NP) protects one of the few large tracts remaining today. This ecosystem is shaped by periodic inundation of the floodplain, resulting from high streamflow in the Congaree and Wateree Rivers. Varying levels of exposure to flooding gives rise to distinct habitat types across the floodplain that support specific plant and animal species suited to these flooding regimes. In addition, the hydrologic connections established through flooding transport sediment and nutrients, allow for seed dispersal and seasonal movement of fish between the main river channel and the water bodies that surround it. The processes through which hydrological connectivity is established depends on the level of upstream flow in the Congaree and Wateree Rivers and the elevation of various land features in the Congaree NP floodplain. CISA collaborating investigator John Kupfer (USC Dept. of Geography) leads the project team researching the hydrological processes that affect Congaree NP.

Understanding relationships between river flows and floodplain ecosystems

To understand these complex water flow patterns, the team used a 2D flood inundation model that simulates the rise, fall and distribution of water across the floodplain. This model allows users to produce high resolution maps showing the depth and extent of floodplain inundation for a range of river discharge levels. These maps can be used in conjunction with ecological information to assess surface water connectivity of different habitat types for varying upstream discharge levels. For example, the project team used this approach to conduct an analysis examining the patterns of connectivity of cypress-tupelo

Dr. John Kupfer kayaking at Congaree National Park.
Photo source: NPS video

(*Taxodium-Nyssa*) swamps to flooding[*]. The researchers found that habitat connectivity between cypress-tupelo stands relies not just on high magnitude river flows that flood and overtops levees and banks; rather, more frequent, lower magnitude events initiate connectivity by pulsing shallow flood waters through distributary channels (i.e., sloughs and creeks) in the lower-lying areas of the floodplain. This research provides valuable findings about streamflow levels that are critical for maintaining suitable habitats for flood-dependent species and can inform management initiatives focusing on regulation of flood processes in the Congaree River watershed. You can also learn more about this work in the Congaree in this National Park Service video.

Incorporating future climate change into the analysis

In addition to understanding the relationship between current river flows and floodplain processes, the research team is also interested in future impacts of climate change on these processes. Climate change is expected to affect river flows through increased temperatures (leading to increased evapotranspiration) and changing precipitation patterns. Changing upstream flow patterns have the potential to affect ecosystems at Congaree NP through alterations in the timing, extent and level of flooding. In order to better understand the nature of these sequential effects, CISA researchers, Dan Tufford and Aashka Patel have calibrated watershed models for the Congaree and Wateree River basins to be used in combination with the flood inundation model (mentioned above). These watershed models are used to simulate streamflow under different climate change scenarios, developed by CISA researchers Greg Carbone and Peng Gao, which serve as inputs to the flood inundation model. Ultimately, the information about changes in floodplain processes will be used to assess corresponding effects on the quality and extent of habitats for key species in Congaree NP.

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[2] Kupfer J.A., Meitzen K.M. and Gao P. (2014), Flooding and Surface Connectivity of Taxodium-Nyssa Stands in a Southern Floodplain Forest Ecosystem, River Res. Applic.. doi: 10.1002/rra.2828

Reaching a More Diverse Audience in National Parks
By: Janae Davis, CISA Graduate Research Assistant

For her Master's thesis, CISA graduate research assistant Janae Davis is working to understand how wilderness management at Congaree National Park (NP) impacts local African Americans' traditional fishing activities and how fishers perceive those impacts and the implications for visitation.

Local environmentalists and the Sierra Club led efforts to protect one of the last tracts of bottomland hardwood forests, what is now Congaree NP, in the 1970s. In 1976 the Congaree Swamp National Monument was established, and in 1988 the Monument received wilderness designation. In 2003 the area was designated as Congaree National Park. Privately owned until the 1970s, the land historically had been used by the local African American community for subsistence fishing and social activities, where each stage of the fishing process – traveling to fishing sites, finding bait, fishing, cleaning fish, and cooking – was performed with others and often conducted at the fishing site.

Capers Stokes and Janae Davis fishing at Congaree National Park
Photo Source: NPS Video

However, the Wilderness Act of 1964 limits acceptable activities in federally designated wilderness areas to those associated with leisure, scenic viewing, education, and scientific inquiry. These delineations are a legacy of early environmental movement's elite white leaders' views and continue to inform wilderness management in national parks. As such, they discount the environmental perspectives of diverse groups who may value different uses of wilderness areas and contribute to a legacy of exclusion and low visitation rates among African Americans in national parks.

The objective of the research was to examine how these changes in land ownership and management have affected local African American fishers' perceptions of the park and their visitation patterns. Through participant observation, semi-structured interviews of 25 local African American fishers and four Congaree NP staff, and document analysis, Davis discovered that what was once an unrestricted landscape supporting the livelihoods and social bonding of community members is now one of numerous regulations imposed by wilderness management. As a result, traditional fishing practices have been banned or severely limited. While fishing is no longer a subsistence activity for the fishers interviewed, it continues to be an important part of social life.

Participants described a gradual accumulation of restrictions beginning when Congaree Swamp National Monument received its wilderness designation in 1988 and continuing after it gained national park status in 2003. Wilderness policies banned or limited uses valued by community members such as driving motor vehicles to reach remote fishing sites, biking, cooking in backcountry areas and digging for bait. Sanctioned activities like canoeing, bird watching and camping led most participants to believe the park was created for white outsiders at the expense of the African American community. Reduced access to traditional fishing holes along with perceptions of discrimination prompted fishers to adjust their recreation behaviors. While some chose to fish elsewhere, others continued to fish on park property. None participated in other activities at the park beyond fishing. Many stated that Congaree NP does not offer activities of interest to them or accommodate the kinds of outdoor activities preferred by the African American community.

These findings expose a larger challenge for the National Park Service (NPS) related to exclusion and non-visitation among African Americans and other minority groups. As U.S. population demographics continue to shift, the viability of environmental organizations like the NPS may partly hinge on its ability to redefine wilderness in ways relevant to people of color.

Davis is featured in a new National Park Service video about Congaree. Check it out here.

The boardwalk at Congaree National Park.
Photo Credit: Amanda Brennan

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CISA at the 2015 NC WRRI Conference

Each year, the North Carolina Water Resources Research Institute (WRRI) hosts an annual conference to support water research and inform water-related decision making in North Carolina. WRRI, which is supported by the US Geological Survey and the University of North Carolina System, provides funding for water research and works to advance water resources knowledge statewide through various workshops, trainings and outreach activities.

This year, WRRI celebrates 50 years of work in North Carolina. The annual conference, held March 18-19 in Raleigh, was peppered with celebration of this golden anniversary. Key note speaker Dr. Bill Ross opened the conference with a look back at 50 years of achievement in addressing priority water resource needs in the state. Looking forward to the next 50 years, Mr. Tom Earnhardt charged conference participants with the responsibility of being stewards of water resources and the natural environment during his key note address.

CISA team members Amanda Brennan and Aashka Patel at the 2015 NC WRRI annual conference

The North Carolina Water Resources Association (WRA) annual symposium is held in conjunction with the NC WRRI conference. This state chapter of the American Water Resources Association (AWRA) facilitates interaction among water resources researchers, practitioners and policy makers, fostering a collaborative network throughout North Carolina. The symposium theme for 2015 was "Resiliency in Water Resources: What does it mean to you?"

In order to showcase ongoing work in the Carolinas that supports water resources resilience to climate variability and change, CISA helped to organize several sessions and presentations for the conference. Presenters included CISA staff, collaborating investigators, research associates and graduate research assistants working to provide decision-relevant climate information. Session topics included "Climate Implications for Water Supply Planning", "Drought and Hazards for Coastal Communities" and "Drought Planning and Preparedness in North Carolina." Presentations in these sessions shared research and resources tailored to water-related planning and management in the Carolinas. Work with citizen scientists to improve drought impacts monitoring and reporting was shared during the "Education and Engagement" session and a participatory approach to assessing water resources vulnerability to climate impacts was discussed during the "Planning for Resilient Communities" session.

CISA is pleased to have helped organize these sessions for the 17th annual NC WRRI conference and to facilitate discussion about resilient water resources in the Carolinas. A list of the presentations CISA helped to organize can be found here. Links to presentation slides for CISA-supported projects are available below.

CISA Affiliated Projects Presented at the 2015 NC WRRI Annual Conference

Poster Presentation
Developing a Drought Early Warning Information System for Coastal Ecosystems in the Carolinas
  Amanda Brennan, CISA

Climate Implications for Water Supply Planning
Climate Change Information for Long-term Water Supply Planning
  Aashka Patel, CISA

Education and Engagement
Improving Understanding of Drought Impacts through Citizen Science
  Amanda Brennan, CISA

Planning for Resilient Communities
Improving Coastal Water Resources Resilience to Climate Variability and Change through Participatory Dialogue
  Jessica Whitehead, NC Sea Grant

Drought and Hazards for Coastal Communities
Multi-Hazard Vulnerability of Coastal Water Infrastructure to Sea Level, Storm Surge and Riverine Flooding
  Burrell Montz, East Carolina University
Development of a Coastal Drought Index Using Salinity Data
  Paul Conrads, USGS South Atlantic Water Science Center
Needs Assessment of Coastal Land Managers for Drought Indicators in the Southeastern U.S.
  Casey Nolan, East Carolina University

Drought Planning and Preparedness in North Carolina
Determining Climatological Patterns of Dryness and Drought at the Regional to Local Scale Across the Carolinas
  Jordan McLeod, UNC Chapel Hill and Southeast Regional Climate Center