

# Carolinas Climate Connection

Carolinas Integrated Sciences & Assessments, a NOAA RISA Team

Integrating Climate Science and Decision Making in the Carolinas



Photo Source: George Herron

*Members of the CISA team would like to express our deepest sympathy for those affected by flooding in the Carolinas. We were hit by an extreme rainfall event that resulted in massive flooding leading to loss of life and property. In the wake of this disaster, we are committed to providing information to better understand the weather and climate conditions which led to this event as well as support for communities seeking to rebuild resiliently to decrease future impacts.*

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## SAVE THE DATE

The 2016 Carolinas Climate Resilience Conference will be held September 12-14 at the Hilton University Place in Charlotte, NC. The 2014 event brought together nearly 200 practitioners, researchers, and staff from local, state, and federal agencies to share information about climate-related tools, resources, experiences, and activities in the Carolinas. The conference was designed with a very interactive format geared towards networking and exchange. The 2016 event will build upon these elements to provide an even more engaging event. Keep an eye out for more information in the coming weeks.



## Upcoming Events

UNC Water & Health Conference  
October 26-30, 2015  
Chapel Hill, NC

Winthrop University: Water in the World Conference  
November 6-7, 2015  
Rock Hill, SC

Cape Fear Arch Conservation Collaborative Quarterly Meeting  
November 10, 2015  
Ocean Isle, NC

Social Coast  
February 9-11, 2016  
Charleston, SC

## 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.

## CISA has a new look!

Check out the redesigned website at [www.cisa.sc.edu](http://www.cisa.sc.edu).



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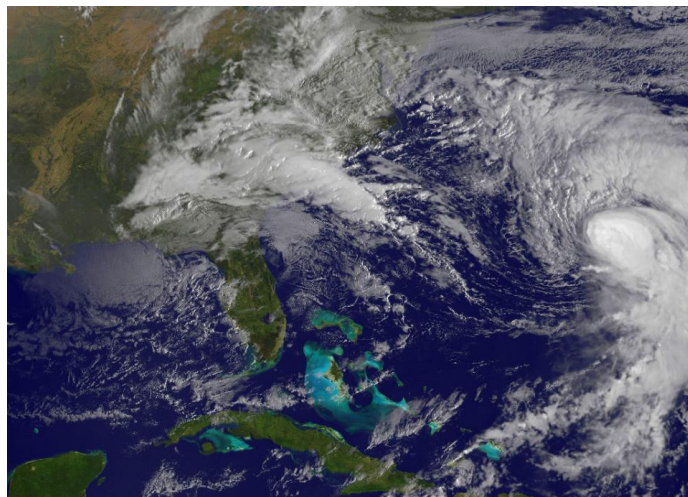
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## October 2015 Extreme Rainfall Event: A Climatological Perspective

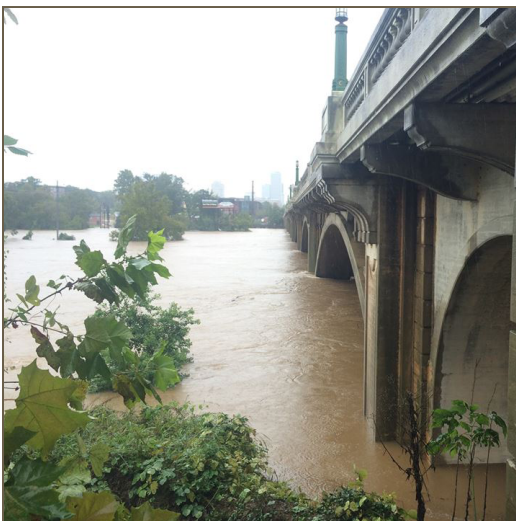
A combination of meteorological conditions contributed to the historic rainfall and flooding events in the Carolinas in early October. The extraordinary rainfall was generated by the movement of very moist air over a stationary front near the coast. The clockwise circulation around a second stationary front located over southern Georgia directed a narrow plume of tropical moisture northward and then westward across the state. On top of this, the outer circulation of Hurricane Joaquin, situated well off the coast, added additional tropical moisture to the system (see satellite image to the right). You can view an animation of the weather systems produced by NOAA [here](#). This trifecta of systems led to record-breaking precipitation totals and devastating impacts. All-time precipitation records were shattered across much of eastern and central South Carolina, with four day totals ranging from 6 to 21 inches. The map below shows the maximum four-day totals that fell across the Carolinas between October 2 -6. Periods of heavy rainfall also played a significant role in the event. Columbia and Charleston received 8.19 and 6.40 inches of rainfall, respectively, over a 12-hour period.



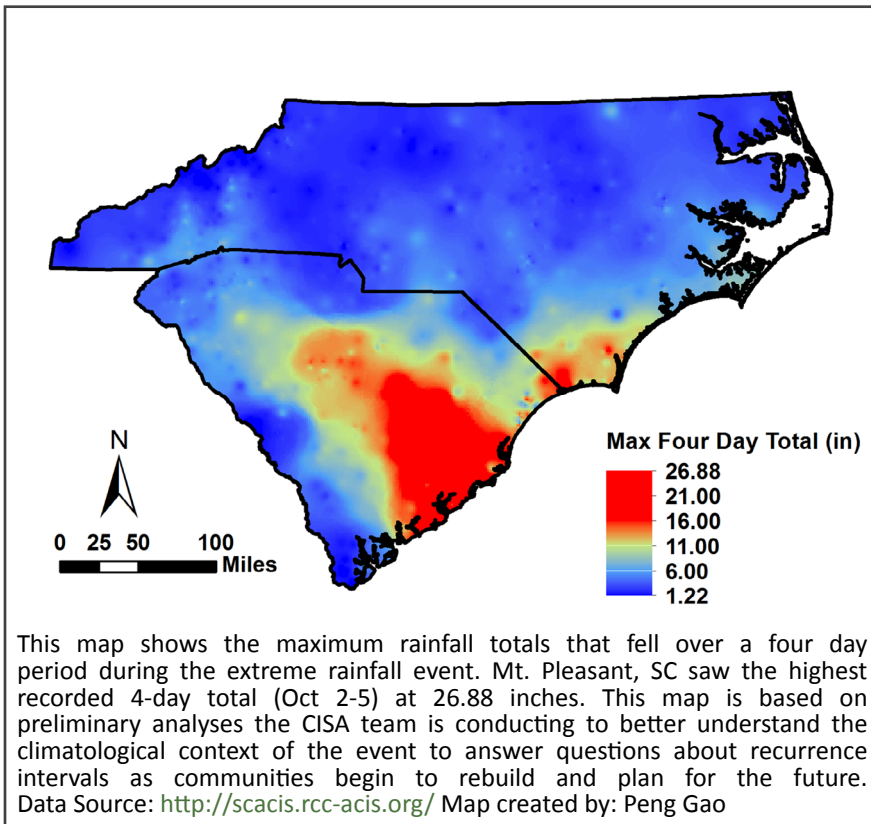
NASA/NOAA GOES East satellite image, October 4, 2015

Infrastructure failures also played a significant role in the impacts felt by this extreme event. Flooding in the Gills Creek watershed in Columbia left an unprecedented path of destruction when three dams were breached in the early morning of Sunday, October 4. This cumulatively released a large pulse of water which was a major cause of the spatial extent and depth of the flooding in this part of Columbia. Flood waters crested downstream in the days following the extreme rainfall event leading to coastal flooding impacts and record streamflows through October 11, when the peak flow was recorded on the Little Pee Dee near Galivants Ferry, SC.

In the coming weeks and months, CISA team members will work with stakeholders throughout the Carolinas to respond to information needs about the climatological elements and societal impacts of the recent historic rainfall and flooding events. If you have specific questions we might help to answer, please contact us at [cisa@sc.edu](mailto:cisa@sc.edu).



The Congaree River in Columbia crested on October 4 at 185,000 cubic feet per second (cfs). The record high flow for this gage occurred in 1936 at 231,000 cfs; although, higher peaks occurred before the Lake Murray dam was built. Gages where new record peak discharges were recorded were mostly in the central to eastern part of the state where the precipitation amounts were substantially greater. Image Source: Christopher Powell





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## Getting to Know Your RISA

### Featured Researcher: Kirstin Dow

Kirstin Dow is a nature-society geographer and Professor at the University of South Carolina in Columbia. She received her Ph.D. from Clark University in Worcester, Massachusetts in 1996. She has been at USC since then except for a 2 year leave to work for the Stockholm Environment Institute in Sweden. Her research focuses on understanding vulnerability and adaptation to climate variability and change. She was a lead author in the 2014 IPCC Report on Climate Impacts, Adaptation, and Vulnerability.

As a CISA principal investigator, she is leading research on adaptation. Over the past several years, she has collaborated with Seth Tuler and Tom Webler (Social and Environmental Research Institute), Jess Whitehead (North Carolina Sea Grant); Nate Kettle (formerly RISA, now Univ. of Alaska- Fairbanks); Liz Fly (CISA/ SC Sea Grant) and others to develop the Vulnerability, Consequences, Adaptation Planning Scenarios (VCAPS) process. VCAPS is designed to help integrate scientific and local knowledge and identify potential climate impacts and adaptation strategies specific to the community.

Kirstin also works in ceramics making hand-built and thrown pieces. She loves experimenting with textures and colors in her work. Rio, a standard poodle puppy, is the newest addition to her home.



## Stakeholder Engagement to Inform the Development of a Heat-Health Vulnerability Tool for North Carolina

CISA PI Chip Konrad is leading efforts to develop a heat-health vulnerability tool for North Carolina that translates weather and climate conditions into useful information regarding the probability of emergency department visits for heat-related illness. The tool is intended to help inform heat warnings, planning, and preparedness. In collaboration with Climate Ready NC, the CDC Building Resilience Against Climate Effects (BRACE) program led by Lauren Thie, an in-person stakeholder meeting was held Tuesday, September 1, in Fayetteville, NC to solicit feedback on the first iteration of the tool. Participants represented county health and emergency management departments, the NC Department of Health and Human Services, and healthcare systems. These public health officials see potential use for the tool to help them prepare for high heat days. One participant noted that having advance warning of an increase of only 3 to 4 patients on any given day would help a hospital emergency room or first responders prepare for treatment. For instance, they might set up a cooling station so that it was ready to treat patients as soon as they arrived at the hospital or they might provide additional ice packs or other treatments to paramedics who are responding to 911 calls.

Meeting participants also provided feedback on how the tool might be improved to better inform their decision making. For instance, the tool currently correlates emergency room visits with maximum daily temperature. There was a consensus that incorporating the daily heat index would add value to the tool because this is the metric by which they currently assess potential risk. Conducting a pilot study with a hospital during heat season in 2016 was also suggested in order to provide guidance to CISA team members as they work to improve the next iteration of the tool.

Additionally, attendees noted the potential to use the tool to raise public awareness about the risks of heat-related illness, particularly to those populations which are most vulnerable. Research to assess the vulnerability of different demographic groups and geographic regions in North Carolina were recently published in the *Journal of International Biometeorology*. This study examined the relationship between maximum temperatures and morbidity due to heat-related illness in North Carolina for warm seasons from 2007 to 2012. Through statistical analyses, the researchers found that heat-related illnesses are more prevalent in rural, agricultural areas and for males aged 15-44. Unexpectedly, their data show that heat affects more people between 31 °C (87.8 °F) and 38 °C (100.4 °F) than temperatures above 38 °C. This suggests that people do take precautionary measures after heat advisories are issued, but should do more to accommodate for medium heat levels. Furthermore, the disparate impact on middle-aged males, likely more involved in outdoor activities, requires more attention from public health officials. Individuals can substantially reduce their risk of heat-related illness through hydration, rest breaks, and limiting physical activity.

Find more information and resources about CISA's health related research at [www.cisa.sc.edu](http://www.cisa.sc.edu).

**Citation:** Sugg, Margaret M., Charles E. Konrad, and Christopher M. Fuhrmann. "Relationships between Maximum Temperature and Heat-Related Illness across North Carolina, USA." *International Journal of Biometeorology*. doi:10.1007/s00484-015-1060-4

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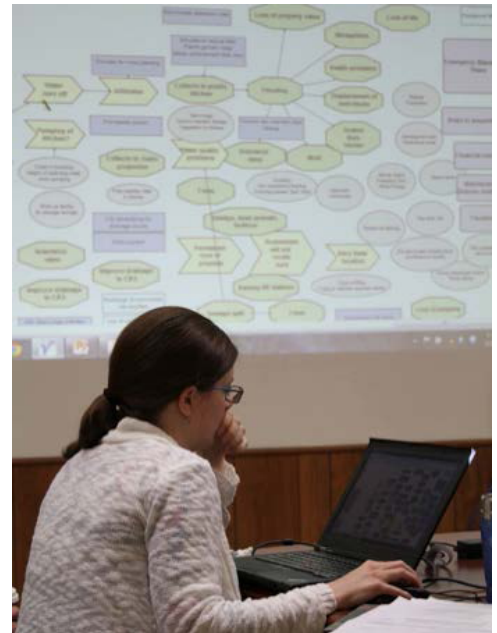
## Adaptation Planning Process Serves and Assists Communities

By: Sean Bath

When coastal communities ask CISA for help with resilience planning, we employ a tool called the **Vulnerability, Consequences, and Adaptation Planning Scenarios (VCAPS)** process to start a conversation about climate-related hazards and local impacts. VCAPS is an engagement tool that involves a dialogue among a small group of local decision makers and scientists. This dialogue focuses on how hazards affect the community and what actions can be taken to intervene. The personal and professional experiences of the participants bring both local and scientific knowledge to bear on the problem, allowing everyone to leave with an enriched perspective and a list of actionable responses.

CISA, with the South Carolina Sea Grant Consortium and the Social and Environmental Research Institute, designed the VCAPS process in 2011. Since then, it has been used by CISA or its partners in at least 14 communities, including Hyde County and Plymouth, NC, and McClellanville, Sullivan's Island, and Beaufort County, SC. Other projects have occurred in Alabama, Georgia, Maine, and Massachusetts. To learn more about VCAPS and each community's experience with the adaptation planning process, visit [www.vcapsforplanning.org](http://www.vcapsforplanning.org).

One of VCAPS' great advantages is that it can be customized to serve each community's particular needs. The five VCAPS projects listed below show the evolution of VCAPS in the field.



Jess Whitehead creates a VCAPS diagram during a workshop in St. Marys, GA.  
Source: GA Sea Grant

### Hyde County, NC, & St. Marys, GA: VCAPS with Benefit/Cost Analysis

CISA collaborating researcher Jess Whitehead facilitated VCAPS processes in Hyde County, NC, and St. Marys, GA, as part of a partnership between Georgia Sea Grant, North Carolina Sea Grant, and the University of Georgia. Both projects blended the VCAPS expertise of North Carolina with the benefit/cost modeling expertise of Georgia. The St. Mary's workshop, conducted in March 2014, focused on the impact of short and long-term flooding to storm water and wastewater treatment planning and to private property. The Hyde County workshop, conducted in July 2014, focused on the vulnerability of structures to storm surge, the effect of salinity intrusion on agriculture, and impacts to the seafood industry. The project team is currently refining the benefit/cost assessments for response actions identified in both projects.

*"I think that having these kinds of meetings and dialogues elevates everyone's perspective and creates more sensitivity to the issues. I think that is probably the most significant thing that I gained."  
~ Beaufort County VCAPS Participant*

### Beaufort County, SC: VCAPS, Learning, and Engagement

The VCAPS process also includes inviting participant feedback through pre- and post-workshop surveys and follow-up interviews. During summer 2015, CISA Graduate Research Assistant Sean Bath analyzed feedback data collected during a 2013 VCAPS workshop in Beaufort County, SC. Through this analysis, CISA and its partners can draw conclusions about what and how participants learn and whether that motivates them to engage on local planning issues. In the surveys, a significant number of participants reported learning about actions they can take to reduce their vulnerability. Altogether, the feedback suggests that VCAPS participants learn how to be leaders on climate planning in their community. These types of "champions" are a critical component in moving communities forward with climate adaptation planning.

### What's Next: VCAPS with New Partners

Liz Fly and Jess Whitehead will work with the Eastern Shore Land Conservancy and Maryland Sea Grant to conduct a VCAPS exercise in Kent County, MD. Liz and Jess will train their partners in November 2015 and help conduct the workshop in spring 2016. Kent County faces similar impacts as other coastal project sites. VCAPS is also the central component of several new grant proposals to work with communities up and down the east coast.



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## Understanding the Impacts of Drought on Blue Crabs in South Carolina

Blue crabs are one of the most important commercial fisheries in South Carolina, with annual landings averaging 5.5 million pounds. Variations in landings from year to year are known to be correlated with the amount of freshwater discharge flowing downstream into coastal rivers and estuaries. During drought freshwater flows decrease, leading to higher salinity levels in coastal water bodies which, in turn, impacts the number of crab landings. Michael Childress, a collaborating investigator with CISA, is an evolutionary behavioral biologist at Clemson University who is particularly interested in how external factors, such as climate, influence blue crab fisheries in SC.

### Development of the SC Blue Crab Regional Abundance Biotic Simulation (SCBCRABS) Model

Childress led a four year study (2008 – 2012) in the ACE Basin National Estuarine Research Reserve (NERR) to better understand the correlation between salinity levels and crab abundance. The research team collected information about water quality; crab density; crab size, sex, maturity; and rates of disease infections. They found that, during the study period, crab populations decreased in the Combahee River, where streamflow levels were lower than normal due to the 2008 to 2011 drought. More specifically, they identified parasitic infections as the primary cause. Conversely, in the high flow Edisto River, crab populations increased over the four year period which they linked to decreased predation by freshwater predators (e.g., alligators).

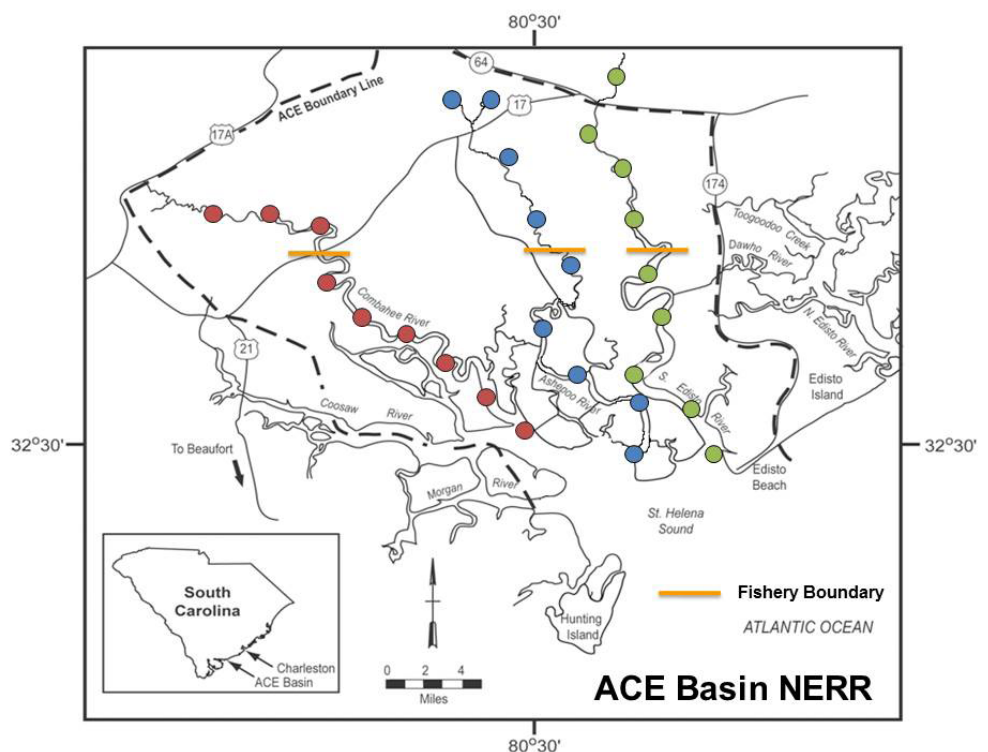
Since drought can have both positive and negative effects on blue crabs, there is considerable interest in understanding how future variation in river discharge, influenced by changing rainfall patterns in the region, will impact commercial blue crab landings. In order to improve understanding of these relationships, the data collected during the ACE Basin study were used to develop a spatially-explicit, individual-based population model referred to as the **SCBCRABS model**. It allows users to follow individual crabs as they settle, grow, migrate, reproduce, and enter the fishery. The model incorporates different water conditions (temperature, salinity, dissolved oxygen), predators, crab pots, and parasites which influence crab population abundance in order to predict how changes to these conditions (e.g., increased salinity) affect the population. This allows users to compare the relative importance of each of these factors in influencing the size of the SC blue crab population to assess how changes in future environmental and management conditions might impact the fishery.

### The Future of the SC Blue Crab Fishery

Model simulations indicate that future projections of crab landings would increase statewide if Edisto River annual average discharge remained at or above a critical minimum level (1250 cfs annual average) for three consecutive years. However, when river discharge dropped below this critical minimum, crab landings decreased. Childress notes that, because blue crabs occupy a large portion of the SC coastline, when populations decline due to drought in the southern portion of the range, populations may increase in the northern portion due to elevated river discharge levels. Future work will attempt to expand this forecast to examine the stability of blue crab populations under future climate change and river discharge across their entire geographic range. Collaboration with CISA PIs Greg Carbone and Dan Tufford will produce future streamflow projections in the Edisto River as input for the model. Additionally, Childress is working with Paul Conrads (USGS South Atlantic Water Science Center) to utilize a real-time coastal drought index as a metric for estimating critical minimum flow conditions for blue crabs along the SC coastline. This information can be used to inform best management practices for the fishery.

### For More Information

This project is part of the National Integrated Drought Information System (NIDIS) Carolinas Drought Early Warning System (DEWS). Learn more about this and other NIDIS Carolinas DEWS projects [here](#). For more information about the SCBCRABS project, visit the [SC Blue Crab Forecast web blog](#).



This map shows the location of 21 sampling stations which were part of a four year study of blue crab populations in the ACE Basin NERR. (Source: Michael Childress)