4th Quarter 2015

Carolinas Climate Connection

Carolinas Integrated Sciences & Assessments, a NOAA RISA Team

Integrating Climate Science and Decision Making in the Carolinas

Newsletter Contents

Climate Integration and Outreach Associate Position

The Southeast Regional Climate Center (SERCC) is seeking applicants to fill the position of Climate Integration and Outreach Associate. This position will be based at the University of North Carolina at Chapel Hill and will be part of the CISA team. Information about the position and application instructions are available at: https://unc.peopleadmin.com/postings/89442.

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. Sign up for the conference e-mail list to stay informed about requests for speakers and presentations, registration, and travel information. Contact Amanda Brennan with any questions.

carolinas climate resilience conference

Upcoming Events

Social Coast
February 9-11, 2016
Charleston, SC

NC Water Resources Research Institute Annual Conference
March 17-18, 2016
Raleigh, NC

Local Solutions: Eastern Regional Climate Change Preparedness Conference
April 4-6, 2016
Baltimore, MD

Building Adaptive Capacity in the Southeast & Caribbean through a Climate Community of Practice
April 13-15, 2016
Tybee Island, GA

Carolinas Climate Resilience Conference
September 12-14, 2016
Charlotte, NC

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
A NOAA RISA TEAM

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

UNIVERSITY OF SOUTH CAROLINA

Getting to Know Your RISA

Featured Researcher: Liz Fly

Liz Fly is the coastal climate extension specialist with the South Carolina Sea Grant Consortium and CISA. She received her Ph.D. from the University of South Carolina in 2012, studying the impacts of climate change on the distribution and productivity of marine mussels around the world. She spent a year in Washington, D.C., as a Knauss Marine Policy Fellow, working on the 3rd National Climate Assessment with NOAA and the U.S. Global Change Research Program. Her current work focuses on providing science-based information to coastal communities, resource managers, and interest groups in South Carolina and the region, as well as contributing to research motivated by community needs and providing hands-on technical support for coastal climate adaptation issues.

As a CISA PI, Liz leads coastal climate research and adaptation efforts. She is lead PI on a NOAA-funded grant to assess water and wastewater infrastructure vulnerability to sea level rise and storm surge in Charleston, SC, and Morehead City, NC, and develop tools for local practitioners to assess this risk. Liz has helped establish a sea level rise task force in Beaufort, SC, and the Charleston Resilience Network, which is a network of public and private organizations working towards a better understanding of the water-related hazards in Charleston, SC.

Liz is also an avid knitter and DIYer, and always has at least two home improvement projects in the works. She is expecting her first child in early March.

Liz on top of the Cape Hatteras lighthouse during Tropical Storm Beryl in May 2012

Webinar Recap - Facing the Flood: A case study of Charleston's response to and path forward following the SC Floods of October 2015

By: Sean Bath

On December 8, 2015, the Southeast and Caribbean Climate Community of Practice hosted a webinar on the City of Charleston's response to historic flooding in October 2015. In this webinar, the CoP invited four members to speak about the impact of flooding and their organization's response. The speakers were:

- Chip Konrad, Director of the NOAA Southeast Regional Climate Center
- Ron Morales, Warning Coordination Meteorologist, National Weather Service
- Mark Wilbert, Emergency Manager, City of Charleston
- Laura Cabiness, Director, Department of Public Service, City of Charleston

The Meteorological Perspective

Chip Konrad provided the scientific background on the historic flooding. He showed the rainfall patterns, characterized the probability of the event, and described the meteorological factors which caused such extended rains. He also talked about the flooding impacts themselves, including how many channels did not actually experience historic water levels due to mitigating factors such as dams and previously dry conditions. Finally, he characterized the flooding in Charleston, noting that heavy rainfall coincided with a spring tide and persistent onshore winds.

Ron Morales spoke about the role of the NWS, the highest impact areas, and NWS service highlights before, during, and after the flood. When discussing impacts to rivers, streams, and creeks, Ron noted that normally dormant creeks became very active, but a lack of gages hindered forecasting until USGS installed rapid deployment gages. Ron's coverage of service highlights included many communication efforts from conference calls with the Governor to social media postings.

Local Government Response

Mark Wilbert shared a local perspective. He reviewed the goals of the City's emergency management efforts, the geographical challenges they faced, and identified what worked and did not work in their efforts. The city's strategy included successes, such as opening the parking garages for residents to store cars above flood waters, rapid deployment of sand bags, full staff engagement, and ongoing communication across networks. However, Mark also noted that the unpredictability of each tide cycle and the severity of flooding from the rivers posed difficult challenges.

Laura Cabiness complemented Mark's assessment with her discussion of city planning initiatives and her assessment of what is needed to prepare for the next flood event. She observed that the stormwater system was largely a success and city efforts to improve flood maps, improve development standards, and work on capital improvement projects mitigated some of the flood damages. She also noted their weaknesses and the limitations of their ability to control the flood. She called for more mitigation projects, drainage studies, and a better public and scientific understanding of flood risk.

Education: The Key to Reducing Future Impacts

These four speakers provided a great insider sense of what occurred during the historic flooding in Charleston. Their observations provide good reason to be optimistic about the direction of flood preparedness in South Carolina. However, they also highlighted persistent challenges. For example, Laura Cabiness said that there is a misconception among homeowners who live in the floodplain but who did not have any damage that they no longer need flood insurance. Outreach and education needs to be at the forefront of ongoing preparedness efforts. Read on to "***The Many Sources of Coastal Flood Vulnerability***" on page 3 for more information.

*Interested? Watch a recording of the webinar by clicking **here**.*

More Flood Information Resources:

- FEMA Flood Map Service Center
- NOAA Tides and Currents
- NWS Charleston Forecast Office
- Weather Underground Coastal Storm Surge Models
- Photos of Coastal Flooding

The Many Sources of Coastal Flood Vulnerability

By: Sean Bath

Fall 2015 has provided a crash course in flood vulnerability across South Carolina. Historic rainfall levels described as a 1-in-1,000 year *precipitation* event drenched the state on October 1-5. However, as we learned in a special CISA report, this was not a 1,000 year *flood* at most locations. Water levels at many river channels and lake basins did not even break records. This distinction has created some misunderstandings, especially on the coast. Some coastal residents believe they have weathered a 1,000 year flood. Why then, do they need flood insurance?

Coastal flooding was occurring in the days before the historic rainfall. Charleston harbor was at flood stage during high tide for 13 consecutive days (Sept. 25 – Oct. 7). Contributing to these water levels were both tidal (astronomic, e.g., moon phase) and non-tidal (weather) factors.

Coastal flooding on Pawley's Island, SC. September 28, 2015. Image courtesy of SC DHEC, http//mycoast.org/sc.

Tidal factors influencing the flood

The tidal signal was stronger than normal. Late September featured a perigean spring tide. A spring tide has wider tide fluctuations due to the alignment of the moon, earth, and sun. These occur during the full and new moon, twice monthly. Perigee occurs when the moon is closest to the earth. Combined perigee and spring tides occur only 3-4 times a year. The gravitational attraction of the moon is the single largest contribution to the tidal signal, and the increased proximity during a perigean spring tide creates strong tidal variability (higher high and lower low).

Non-tidal factors

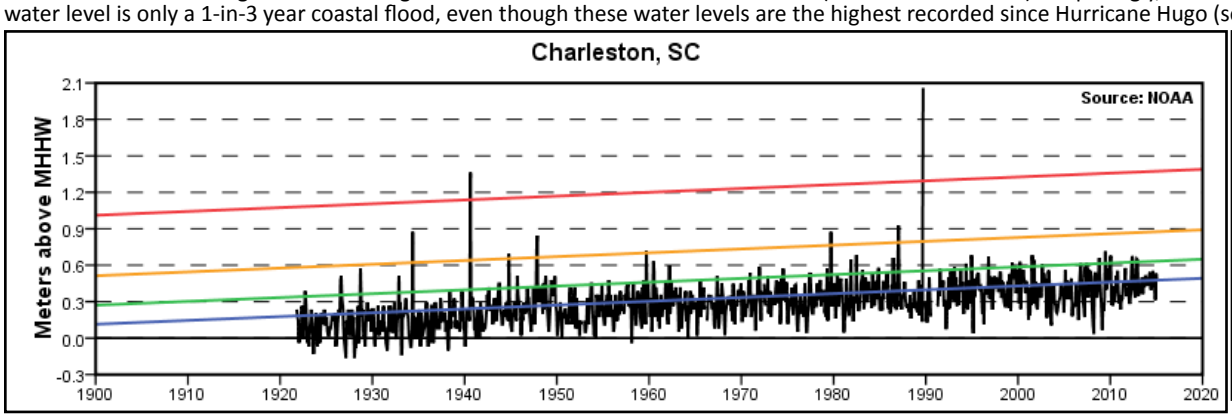
The non-tidal contributing factors were also well above normal. These included precipitation, river discharge, atmospheric pressure, onshore winds, the Gulf Stream, and wave setup. Logically, the historic rainfall played a role. Parts of Charleston County experienced more than 20 in. of rain. Much of that flowed directly into Charleston harbor. The rest of it saturated the ground. Upstream rainfall drained out through the Ashley, Cooper, and Wando Rivers, causing significant flooding along their banks. The increased fresh water flow into Charleston Harbor added water volume to the harbor and it could not fully drain out during low tides.

Atmospheric patterns contributed, too. The low pressure system exerted less force against the surface of the water, allowing it to rise slightly. Onshore winds piled up water against the coast. The wind effects were exacerbated by a slower-than-normal Gulf Stream that caused an extra accumulation of coastal water. More distant winds from Hurricane Joaquin produced large ocean swells that eroded local beaches.

A convergence of forces

These factors combined to produce a particular kind of coastal flooding resulting from three different forces. Rainfall can cause flooding in upland areas where the water pools up. River flooding often features flash floods and rapid flow, but is limited to a river and its floodplain. Coastal flooding requires a direct physical connection to the ocean, whether that connection is over land or via storm drain. Coastal South Carolina experienced all three. However, the coast rarely experiences extreme flooding via rivers or rainfall. This lack of past experience and data makes it difficult to predict the impacts of an event like the October floods. Furthermore, urban development contributes to the severity of rainfall flooding by altering drainage patterns. Consequently, much of October's flooding may have occurred outside of designated flood zones.

Unlike river and rainfall flooding, extreme water levels caused by coastal flooding are familiar in the Charleston area. The peak water level recorded in Charleston harbor during historic flooding was 8.68 ft. above mean lower low water (0.8 m above MHHW). Surprisingly, based on a century of data, this water level is only a 1-in-3 year coastal flood, even though these water levels are the highest recorded since Hurricane Hugo (see figure below).



The highest monthly water level in meters above mean higher high water with recurrence intervals. Water levels peaked at 0.8 m on Oct. 3, 2015, an event expected about every 1 in 3 years. Exceptional peaks in 1940 and 1989 are major hurricane landfalls. Source: NOAA Tides and Currents.

Why the discrepancy? The answer relates to the true driver of coastal flood risk: storm surge. The calculated probabilities of small coastal floods are skewed, or biased towards, higher values by the periodic occurrence of hurricane landfalls. Hurricane Hugo set the record in Charleston harbor at 12.52 ft. (3.82 m) and this was not even the worst case scenario (it was 20 ft. (6 m) at nearby Bull's Bay). The height of storm surge is highly dependent on the hurricane's angle relative to land and rivers as it approaches. Therefore, very few upland areas in Charleston are completely safe and flood insurance is valuable, even for those spared by this event. This is why flood insurance is so important. While strong hurricane landfalls can seem rare, their destruction is catastrophic.

Events this fall were a lesson in flood vulnerability as well as the many types of flooding we are exposed to on the coast. A variety of extreme events have the potential to flood Charleston's streets. However, the damage can be minimized. Last October, the City of Charleston opened parking garages to the public to shelter vehicles away from flooded streets. Municipal officials will continue their efforts to educate and warn citizens while preparing drainage systems for the next big storm. For their part, citizens should heed warnings, stay insured, and be ready to evacuate when advised. Learn more about Charleston's response and some of the lessons learned from this event on page 2, "***Webinar Recap - Facing the Flood: A case study of Charleston's response to and path forward following the SC Flood of October 2015***."

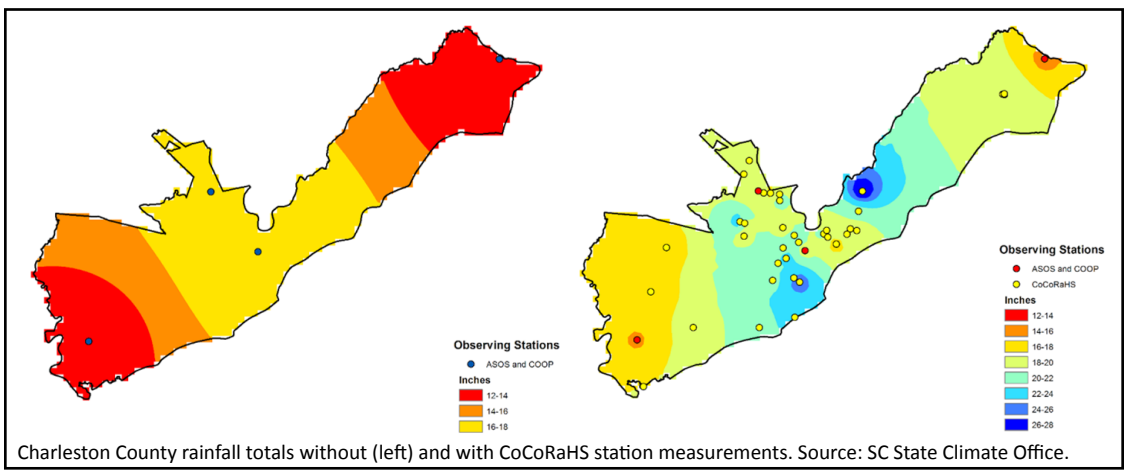
Increasing Rainfall Data Resolution through Citizen Science

By: Sumi Selvaraj

The Community Collaborative Rain, Hail, and Snow (CoCoRaHS) network consists of thousands of volunteers. This network produces the largest volume of daily precipitation data in the US. It is used regularly by a wide variety of agencies and organizations, such as the National Weather Service (NWS) and state climate offices, use regularly. The CoCoRaHS data supplement data collected by other surface weather monitoring stations, such as the Automated Surface Observing System (ASOS) and NWS Cooperative Observer Program (COOP), and helps emergency managers and others better understand highly localized precipitation variability. The SC State Climate Office created maps of Charleston County, SC, showing rainfall totals during the October flood event. The map on the left shows only rainfall totals from ASOS and COOP stations, interpolated over space. Including the CoCoRaHS observers' rainfall data creates a much higher resolution map (right) that better displays the local variability of this heavy rainfall event.

ASOS and COOP weather stations provide valuable weather information. However, because they are sometimes few and far between, local variations in precipitation would be missed without CoCoRaHS observations. And, the more measurement points there are, the higher resolution the data. So, there is always a need for more CoCoRaHS observers!

If you or someone else you know might be interested in citizen science or contributing to weather observations, consider joining the CoCoRaHS network. For more information, check out the CoCoRaHS's website and CISA's CoCoRaHS project page about the citizen science condition monitoring network in the Carolinas.



Charleston County rainfall totals without (left) and with CoCoRaHS station measurements. Source: SC State Climate Office.

The Paris Climate Agreement: How Might it Impact the Carolinas?

By: Sean Bath

On December 12, 2015, representatives from more than 190 countries agreed to reduce greenhouse gas emissions in an attempt to limit the impacts of global climate change. The Paris agreement differs from its predecessor, the Kyoto Protocol. The new agreement does not create legally binding emissions reductions targets, nor does it separate countries by developed and developing categories. Rather, the Paris agreement relies on independent national pledges and a 5-year review and update cycle of those pledges. The system essentially relies on peer pressure to encourage countries to willingly reduce emissions. Ultimately, work at the local and regional level will help with successful implementation of the Agreement.

U.S. National Action and the Clean Power Plan

Federal action to reduce emissions is already underway in the form of the Clean Power Plan (CPP). The CPP mandates reductions targets to states and requires states to propose and implement a plan to reach that goal. How each state decides to reach the target is entirely optional. This structure may encourage the Carolinas to modify their energy portfolios and enhance the efficiency of existing power plants. However, the future of the CPP is uncertain as both the Carolinas have joined a 24-state lawsuit challenging the CPP's legality. Regardless, the Paris Agreement sends a clear signal that national-level initiatives will continue to be a global priority.

Support for Action - To Mitigate and to Adapt

The Paris Agreement concerns reach beyond national regulations. It is a significant goal of the international community to provide support for mitigation and adaptation. First, the recurrent 5-year review cycle established by the Agreement is intended to provide reassurance to investors that clean energy is the long-term future of global energy markets. Second, the deal reinforces the international commitment to financial pledges to developing countries. The goal is to mobilize $100 billion from public and private sources by 2020.

Third, world leaders launched "Mission Innovation," which seeks to develop clean energy technology research by doubling R&D investments over 5 years. Twenty countries representing 80% of clean energy research are joining 28 international investors led by Bill Gates to support promising technologies. Fourth, the U.S. has pledged to double its grant-based financial support for climate adaptation by 2020 (see other funding announcements). The U.S. currently spends about $400 million on adaptation projects in developing countries.

Local and Regional Action

Keeping global temperatures below 2°C, recognizing the importance of pursuing 1.5°C, and adapting to climate and weather impacts will require a monumental effort. National governments may be reluctant to commit to actions that could reduce economic growth. Under these circumstances, local and regional actors play a key role in emissions reduction and adaptation. The Paris Agreement recognizes the importance of these players, such as the Compact of Mayors, the Under-2 MOU, and the American Businesses Act on Climate Pledge.

In the Carolinas, a loose network of governments, universities, businesses, and citizen organizations work together to support local initiatives that reduce emissions and bolster resilience. CISA fits into this network by providing verified scientific information to decision makers throughout the Carolinas. The CISA team builds interpersonal relationships and do hands-on research focused on informing climate-sensitive decisions. For CISA and others in this network, these activities are made possible by federal support in the form of grant funding, data collection, and communication efforts. The Paris Agreement has the potential to strengthen these connections which will ultimately support a climate-ready region.