Our Communities Adapting to a Changing Climate and Coastline

Sea Grant

S.C. Sea Grant Consortium

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cisa
carolinas integrated sciences & assessments

"Climate" and "Weather"

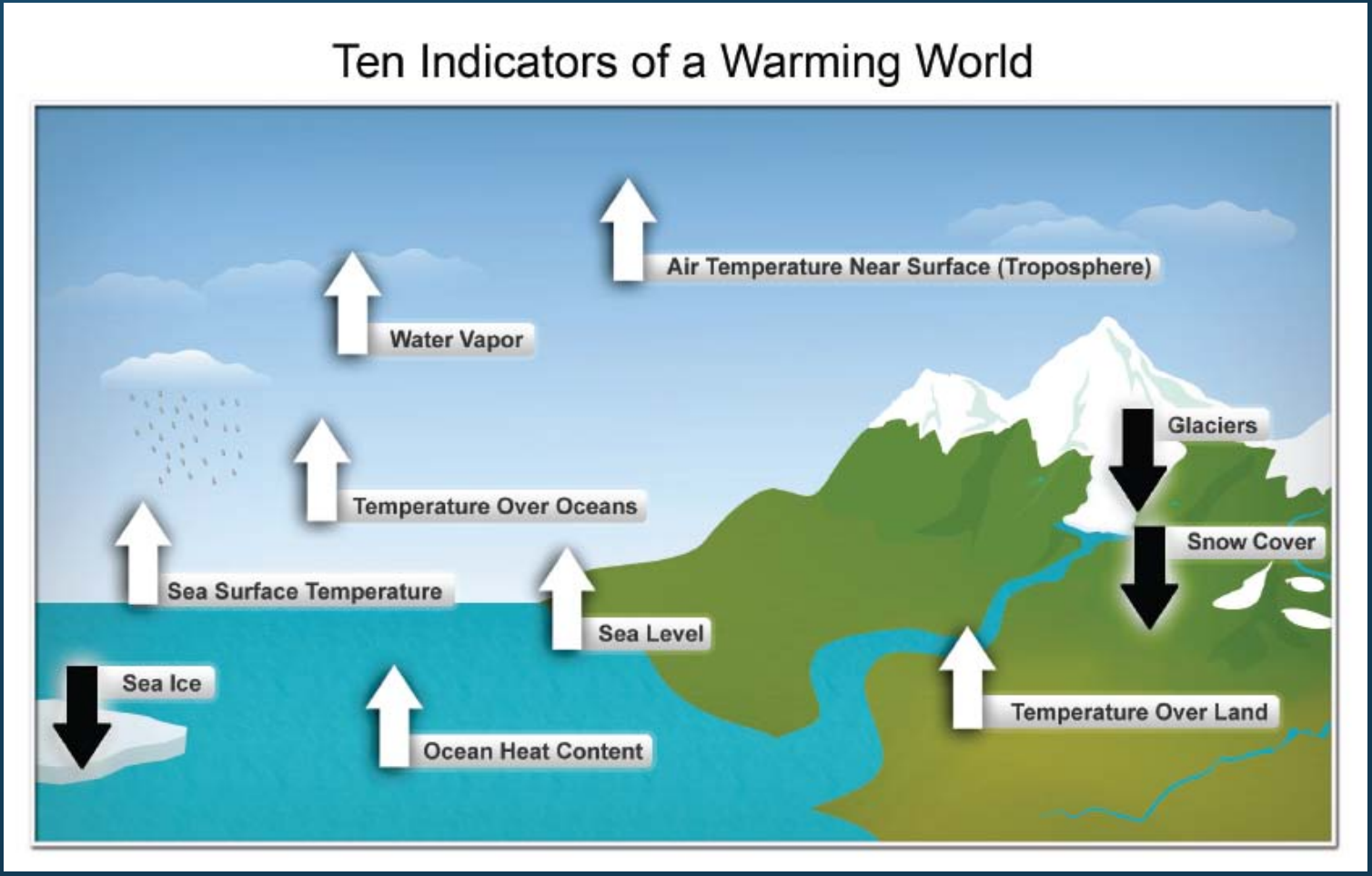
- Weather: current state of the atmosphere (days-to-weeks)
  - Hurricane Hugo
  - Today's high temperature in downtown Charleston
- Climate: average state of the atmosphere (months-to-years)
  - Category 1 hurricanes within 86 mi of Charleston County: average 1 in 11 years
  - Increased global average temperature in 2100

NY Daily News

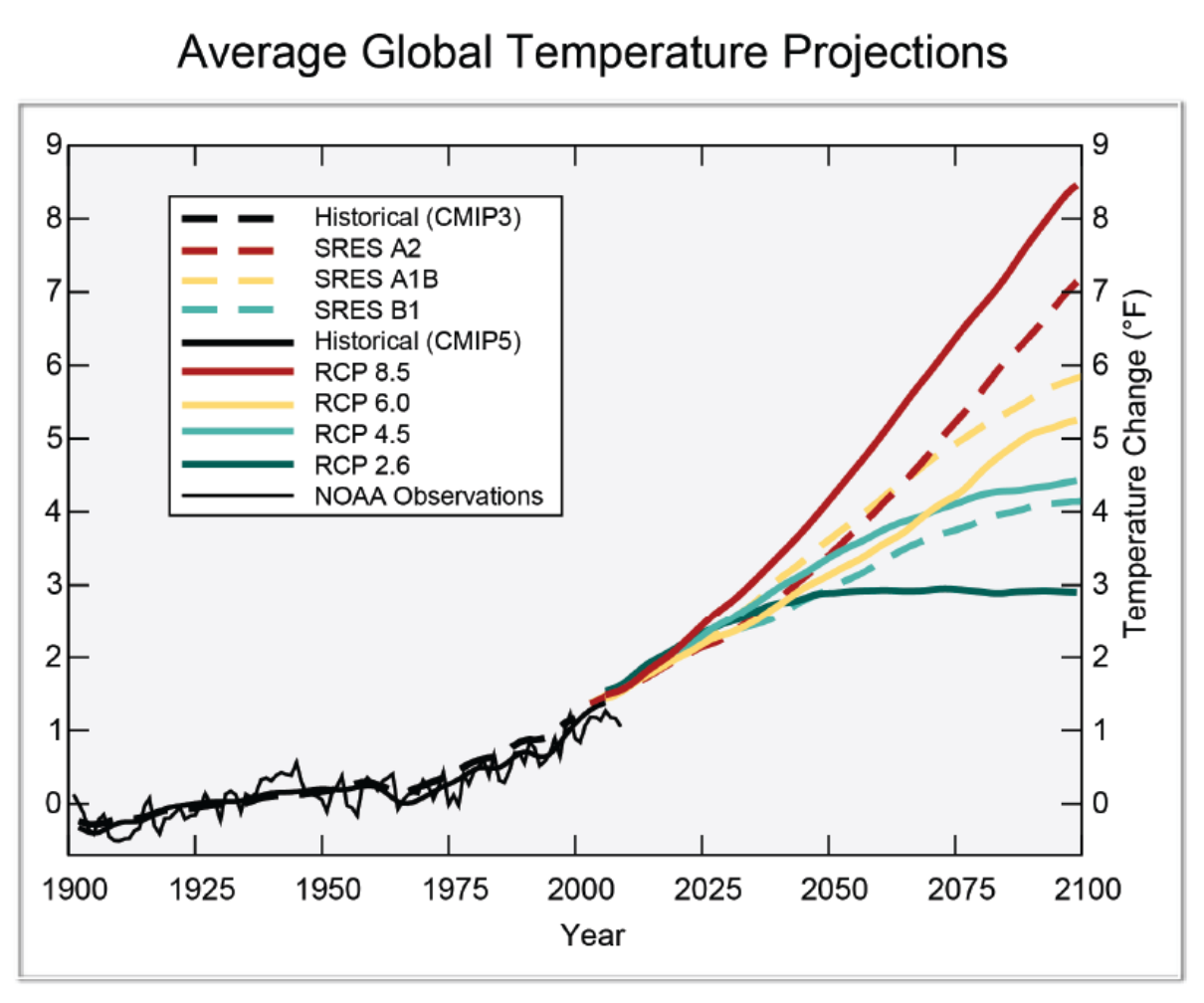
The State

ABC News 4

Jim Cantore


Ten Indicators of a Warming World
Air Temperature Near Surface (Troposphere)
Water Vapor
Glaciers
Temperature Over Oceans
Snow Cover
Sea Surface Temperature
Sea Level
Sea Ice
Temperature Over Land
Ocean Heat Content

NOAA, NCDC



National Climate Assessment 2013 public draft

"S

news.nationalgeographic.com

gototeam.com

beaufort.locale.com

What coastal hazards does SC experience? How might they change?

- Hurricanes
- Heat
- Precipitation changes
- Sea level rise/Flooding

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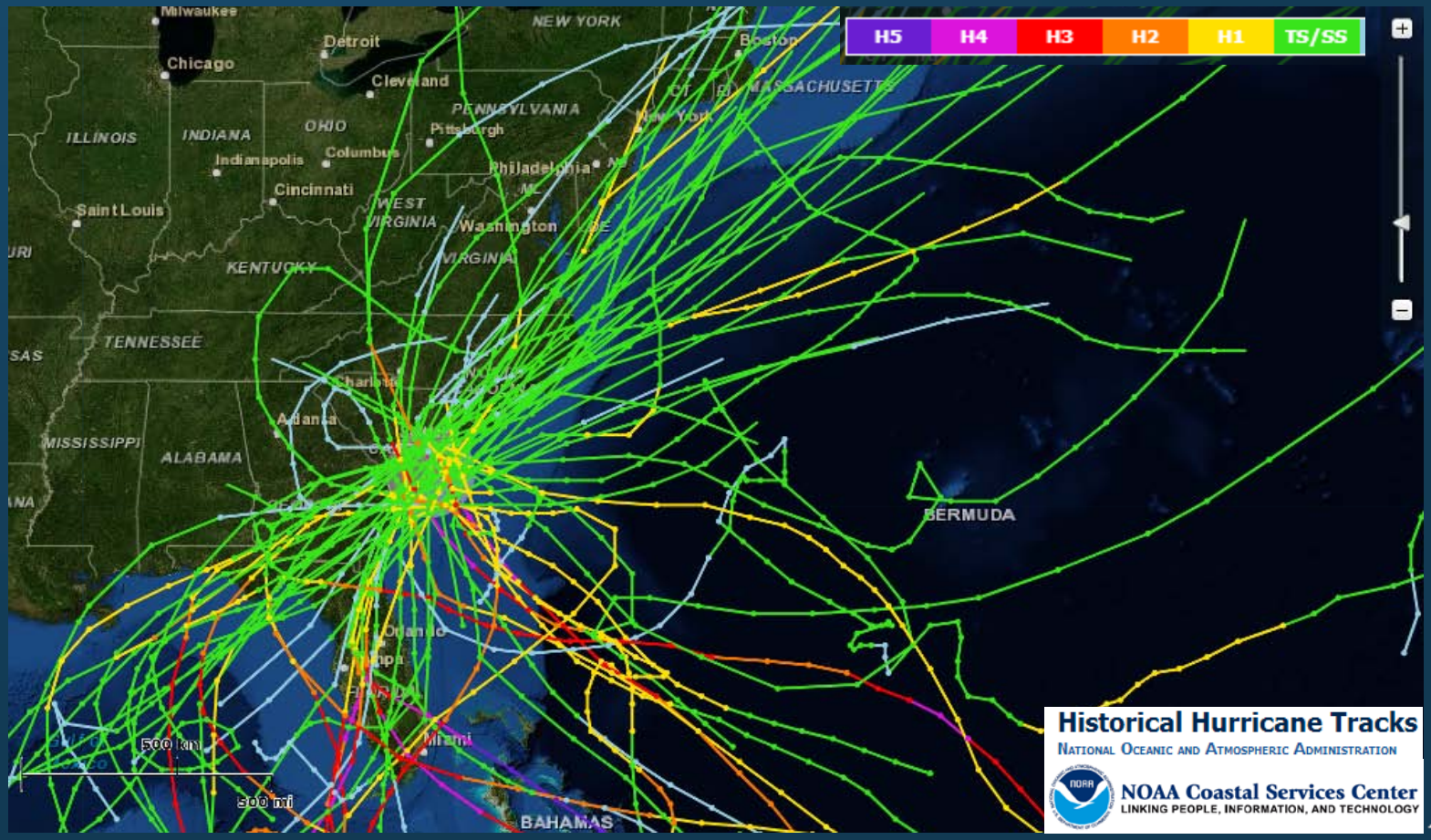
Hurricanes/Tropical Storms 1900-2012



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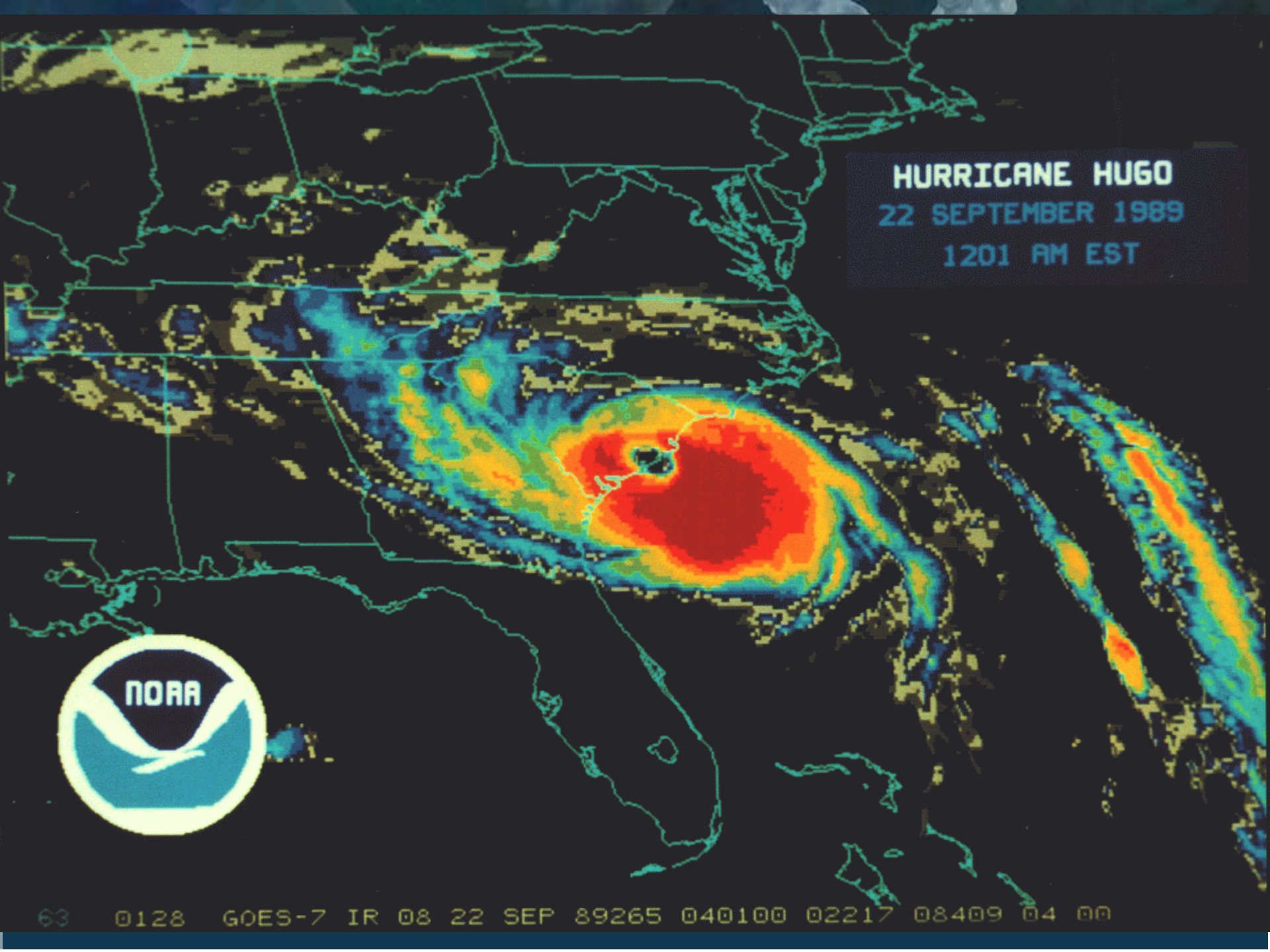
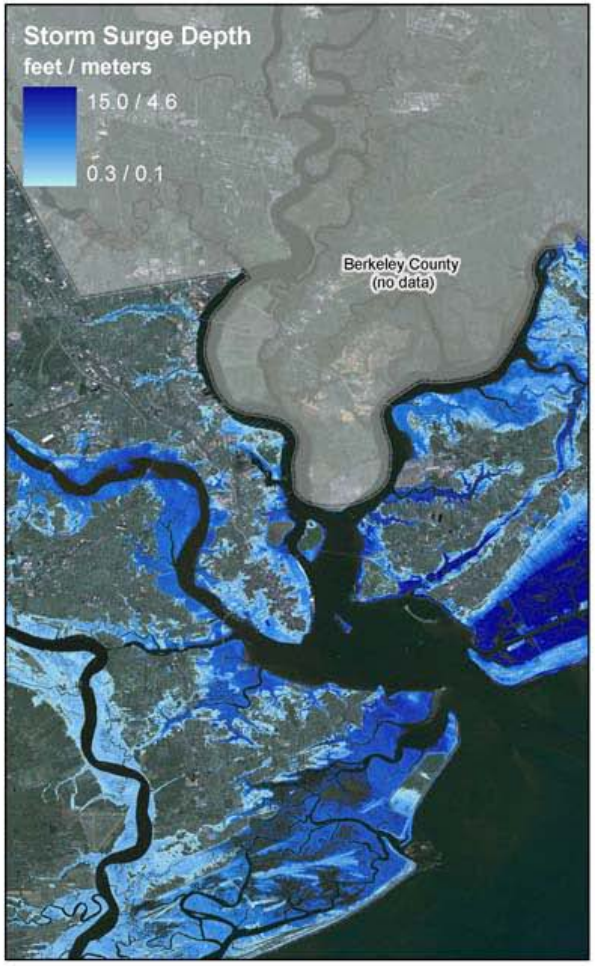

HURRICANE HUGO
22 SEPTEMBER 1989
1201 AM EST
NOAA
63 0128 GOES-7 IR 08 22 SEP 89265 040100 02217 08409 04 00

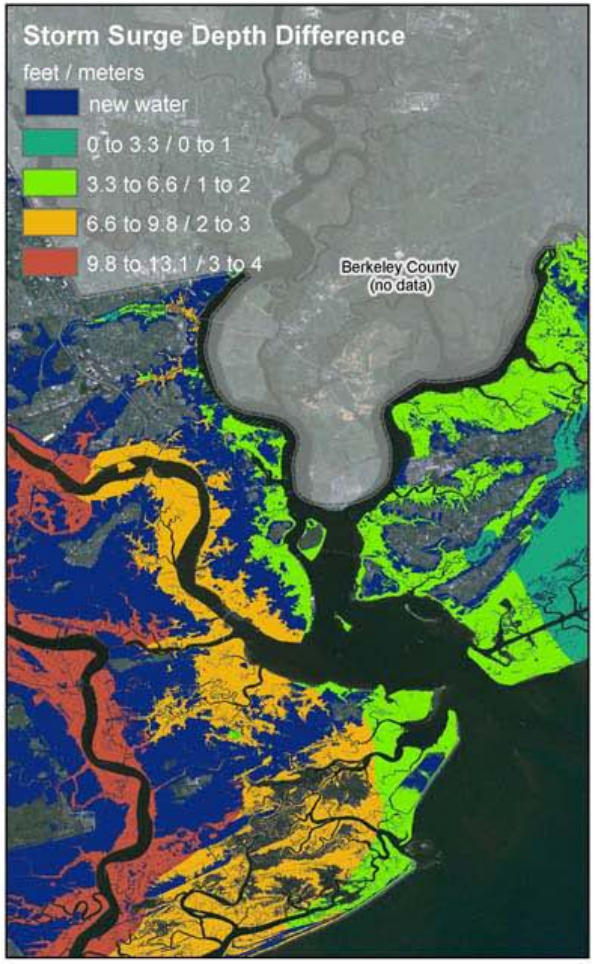
It Could've Been Worse!:
A Visualization of Storm Surge if Hurricane Hugo Had Made Landfall Just 20 Miles to the South

Hurricane Hugo Characteristics at Landfall: Category 4; Winds=120 knots (138 mph); Pressure=935 MB; Northwest Movement=23 knots (26 mph); Tide=0.6 m (2.1 ft)

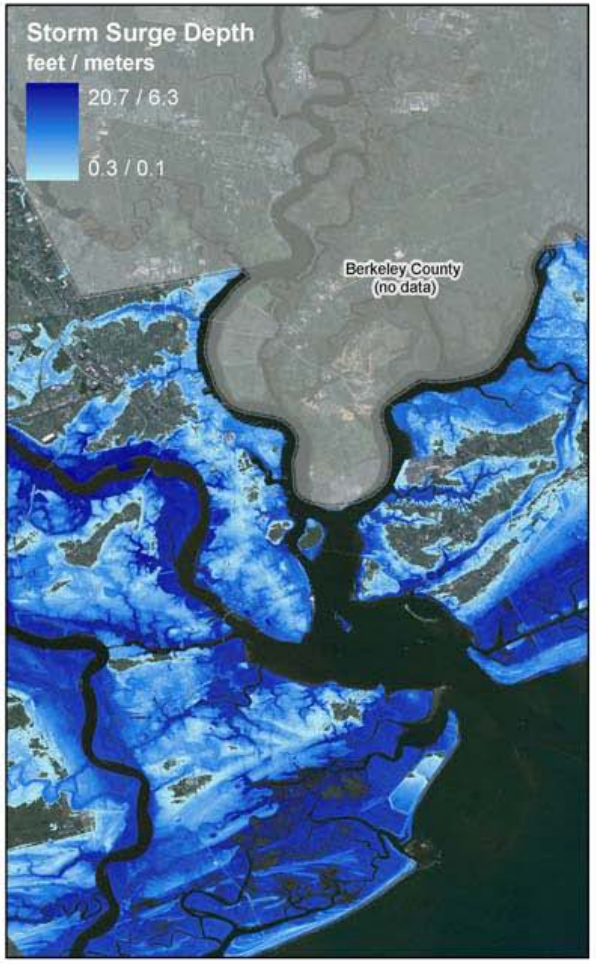
ACTUAL — Modeled Surge for Hugo with Landfall at Sullivan's Island



HYPOTHETICAL VS. ACTUAL — Increase in Storm Surge Extent and Depth



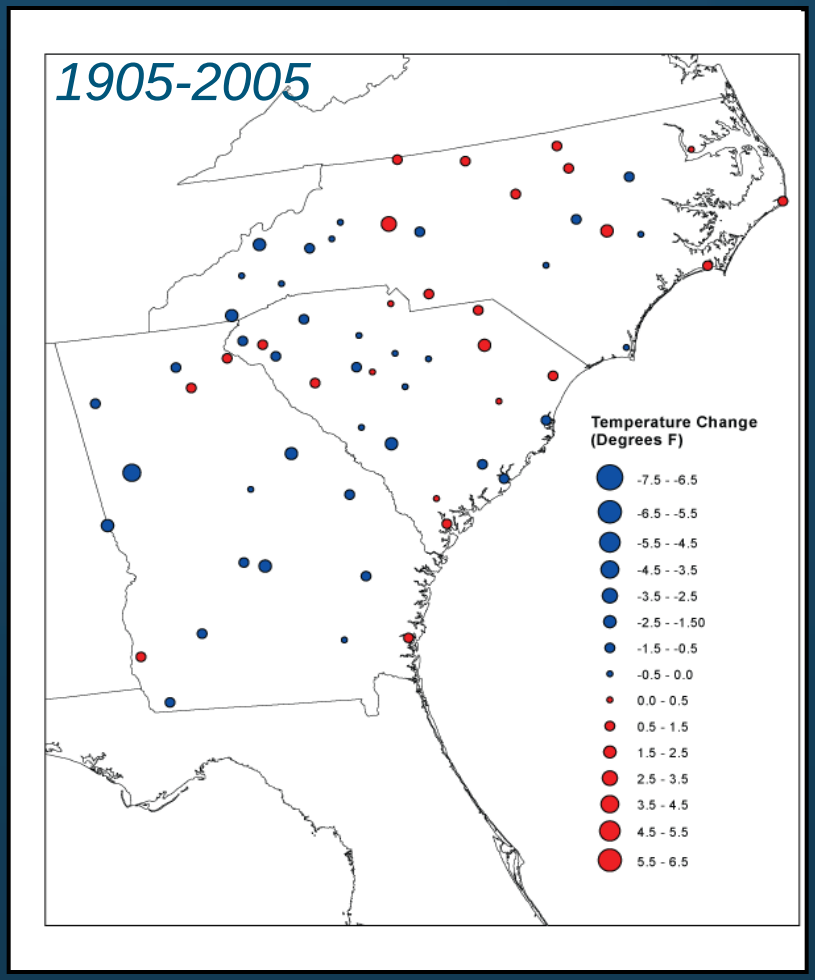
HYPOTHETICAL — Modeled Surge for Hugo with Landfall at Kiawah Island

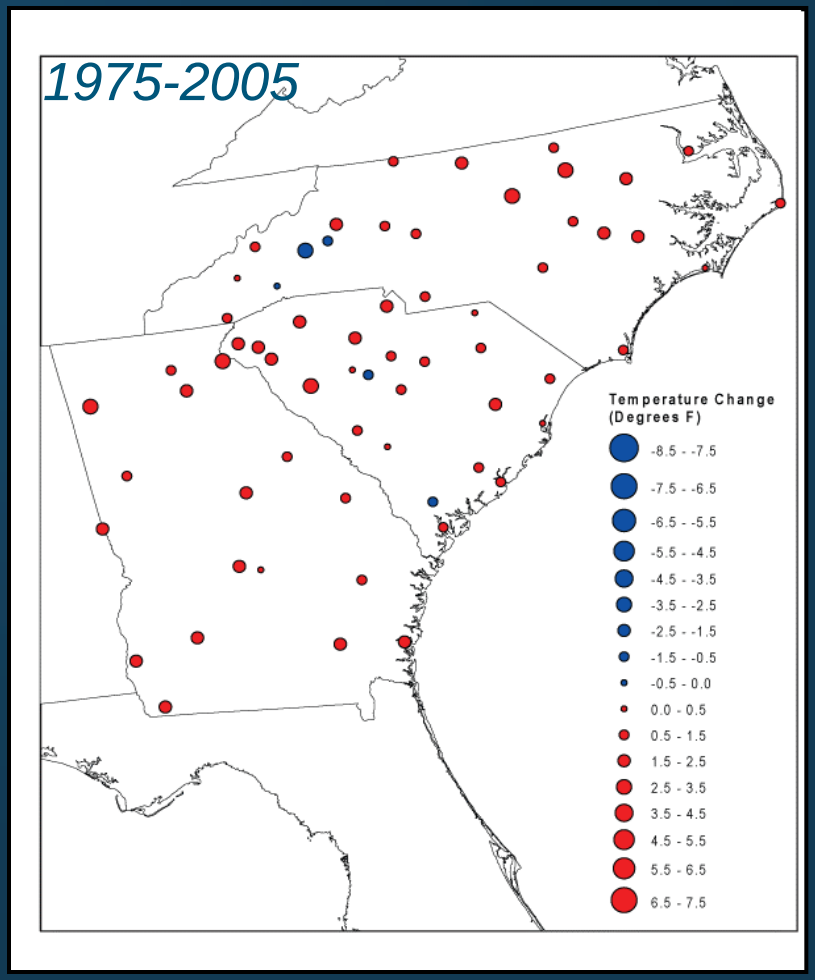


Hurricanes in the future

- More intense, but not more frequent (and maybe less frequent – Knutson et al. 2010)
- Competing influences
  - Sea surface temperatures
  - Wind shear
- Model difficulties
  - Coarse resolution
  - Feedback problems: moisture, clouds

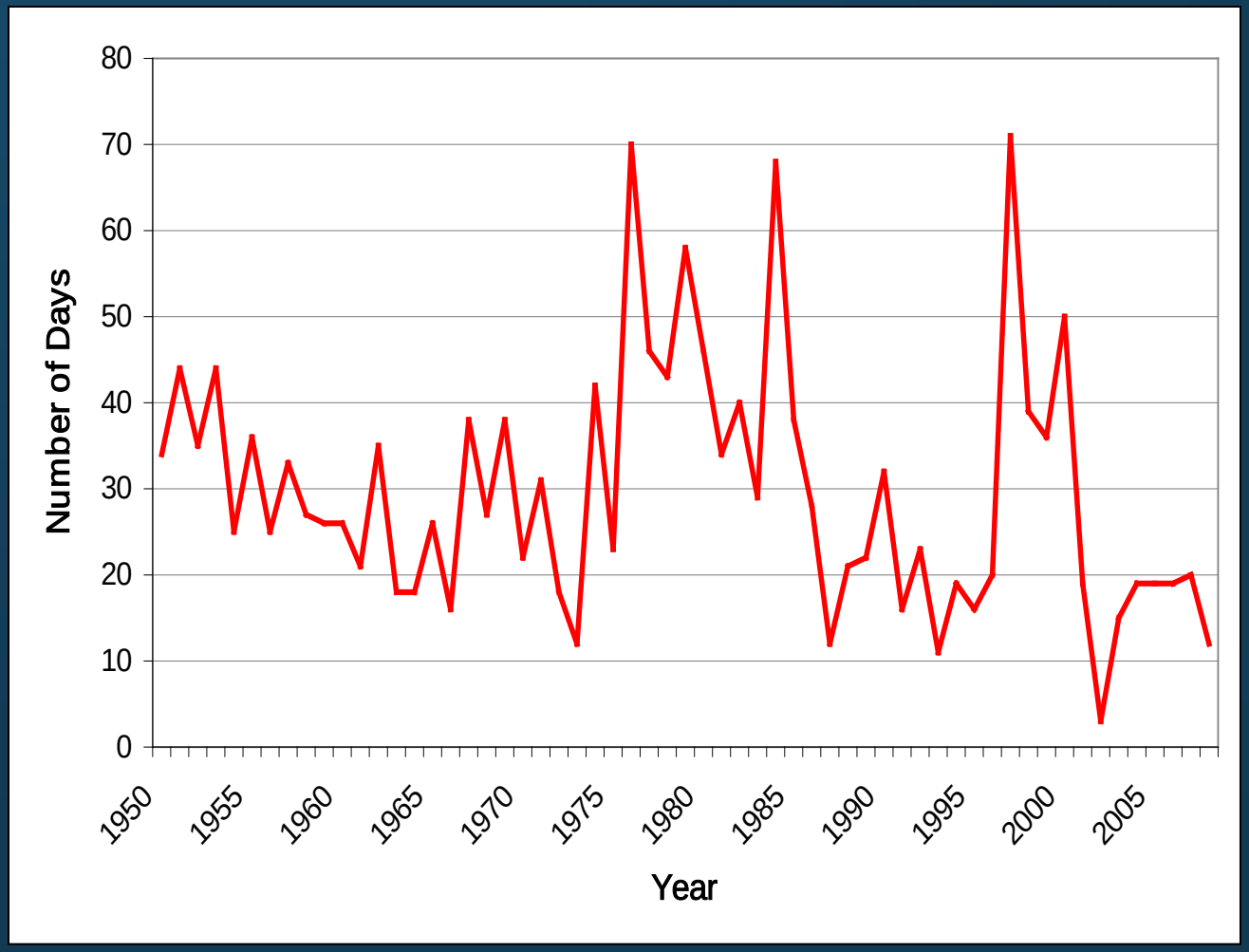
Temperature changes





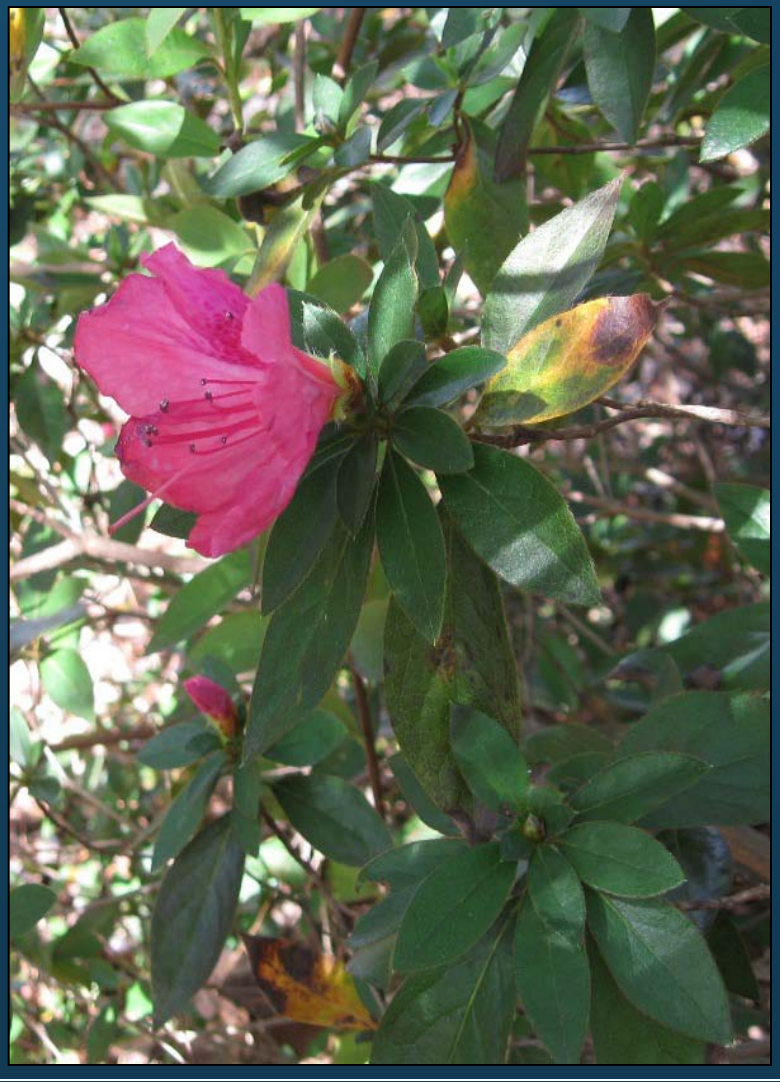
(Mizzell 2009)

Charleston: Days above 90 °F (1951-2009)



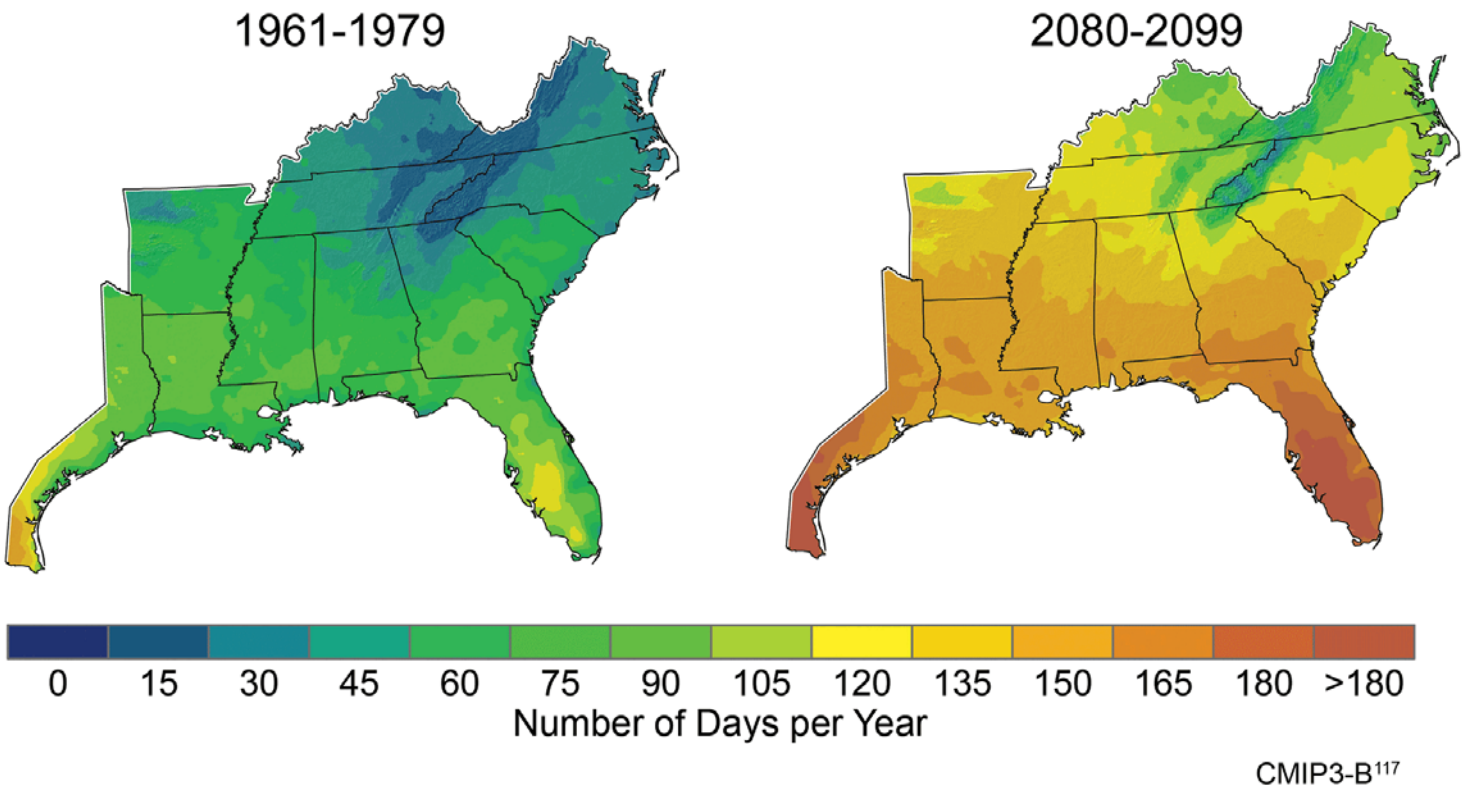
- Average 30 days per year
- Trend not statistically significant

Future Temperature Scenarios



- Southeast: greatest increases in summer
- Increasing *minimum* temperatures
- Warmer nights, warmer winters
- More frequent heat waves

Increasing Temperatures



The number of days per year with peak temperature over 90ºF is expected to rise significantly, especially under a higher emissions scenario[91] as shown in the map above. By the end of the century, projections indicate that North Florida will have more than 165 days (nearly six months) per year over 90ºF, up from roughly 60 days in the 1960s and 1970s. The increase in very hot days will have consequences for human health, drought, and wildfires.

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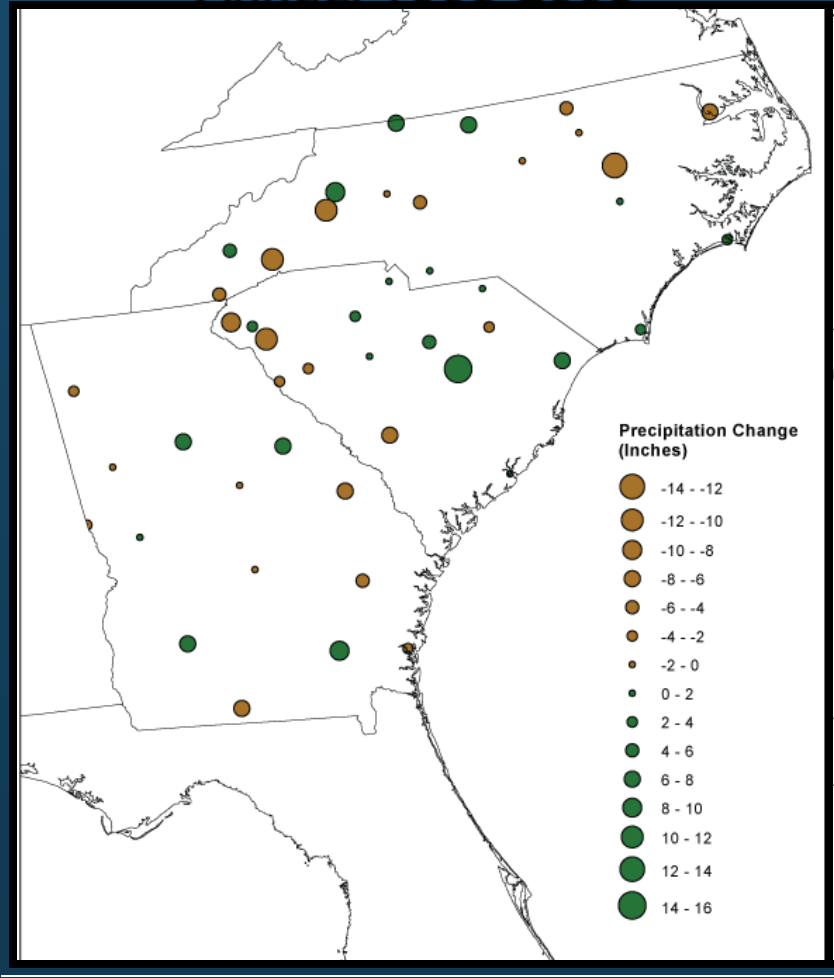
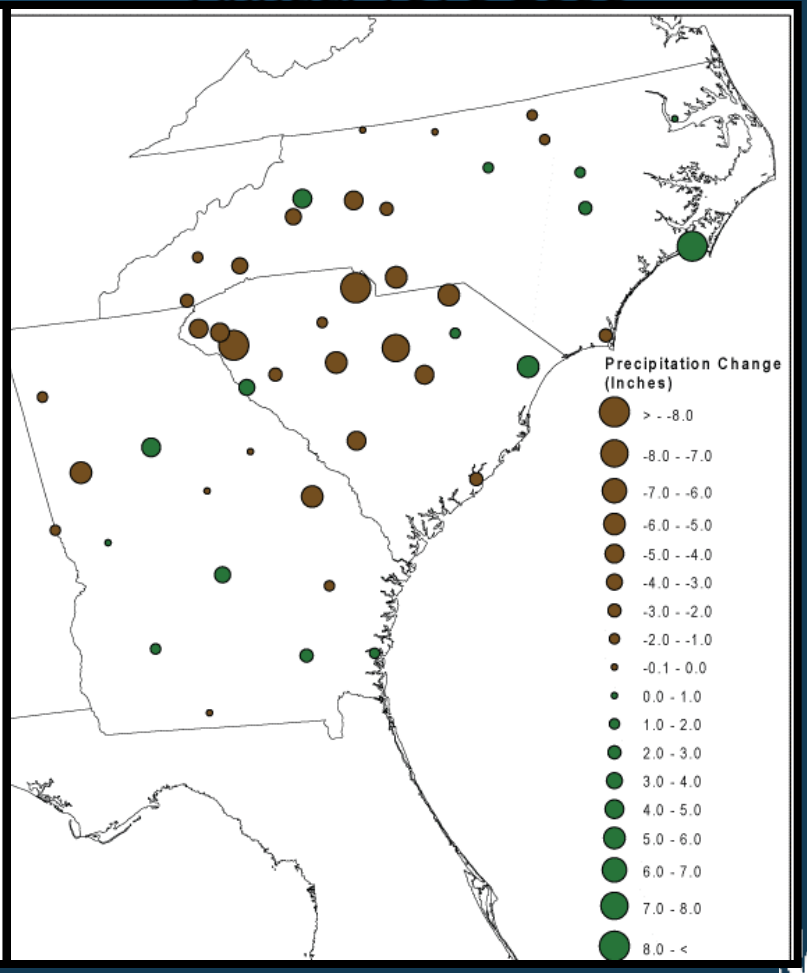
Observed Precipitation Trends

Annual 1905-2005



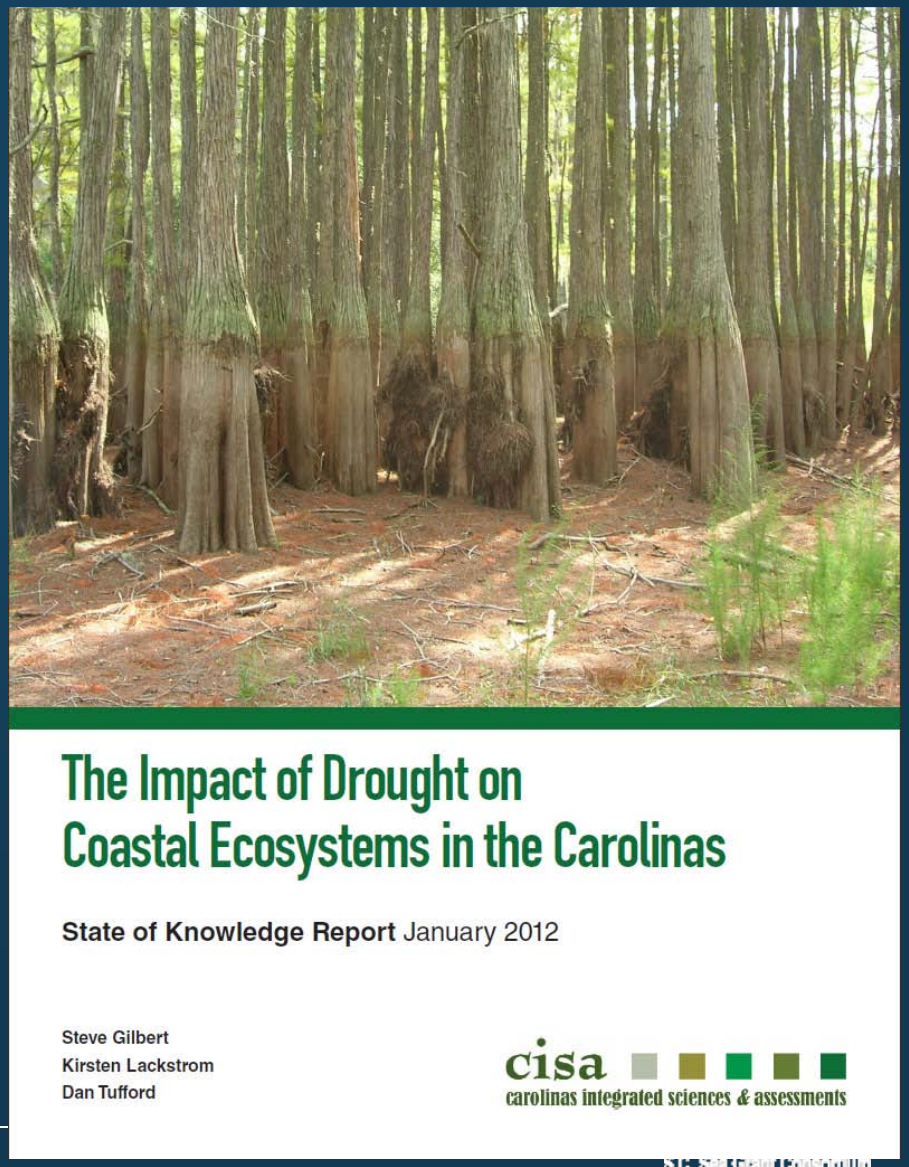
Annual 1975-2005



(Mizzell 2009)

Drought impacts

- Repeated drought affects freshwater pond species
- Salinity intrusion from reduced flow
  - Tidal freshwater marsh habitat conversion
- Circulation changes lead to hypoxia events
- One of multiple stressors for marsh dieback
- Drainage, fire impacts on Carolina bays



Future Precipitation Scenarios

- Rainfall continues to be more variable
  - More frequent floods
  - More frequent droughts

Human Health Consequences of Greater Precipitation Variability

- More Concentrated Runoff
  - Nutrient flushing in stormwater: algal blooms
  - Contaminated shellfish beds
  - Drinking water treatment
- Drought
  - Water shortages
  - Air quality and respiratory illness
  - Recreational risks to swimmers, boaters

Sea level rise

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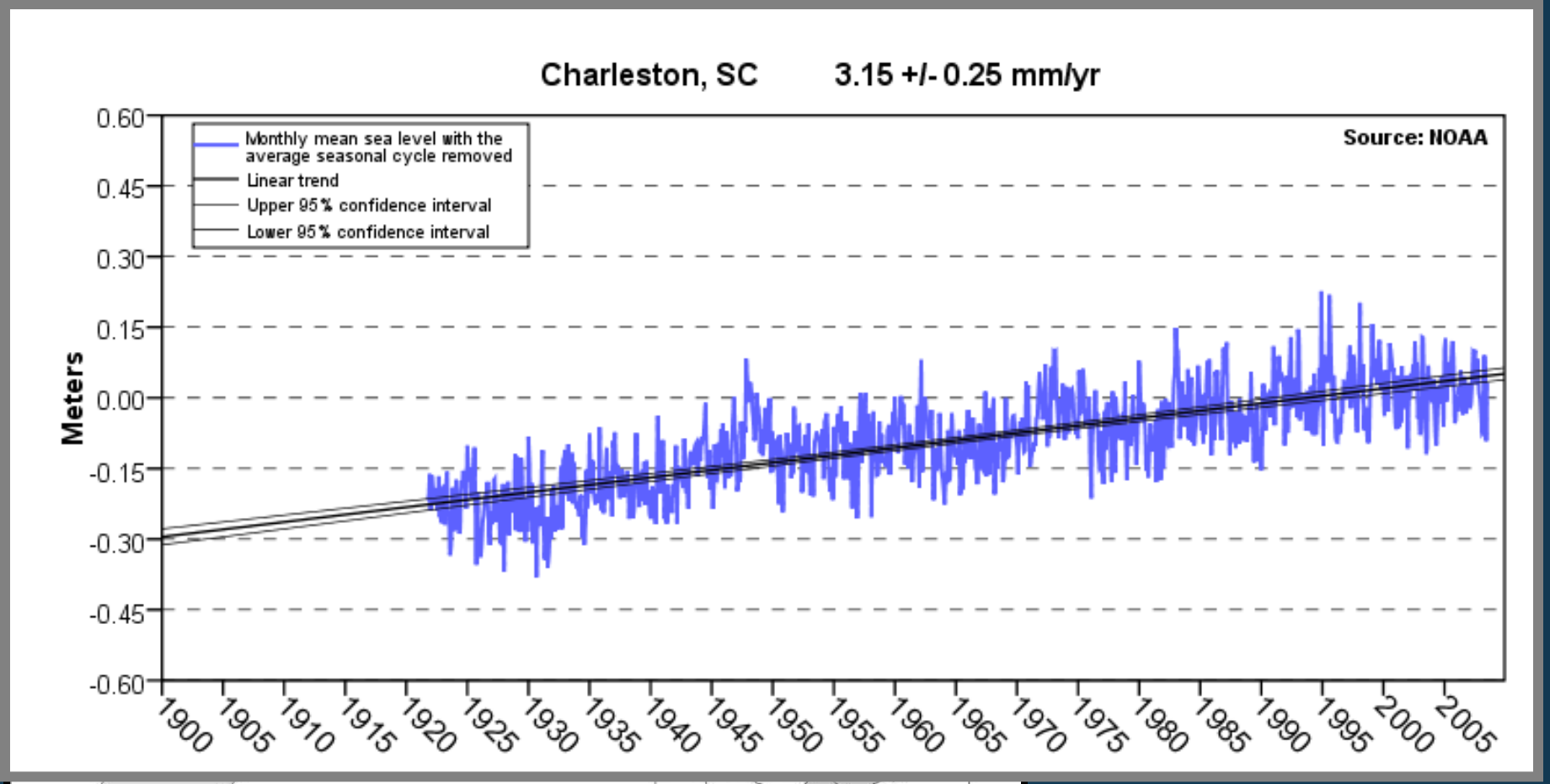

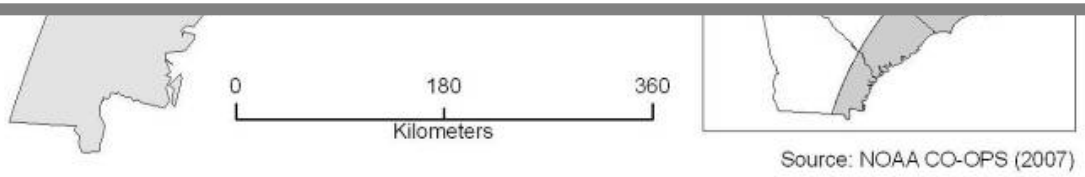

http://tidesandcurrents.noaa.gov/sltrends/sltrends_station.shtml?stnid=8665530

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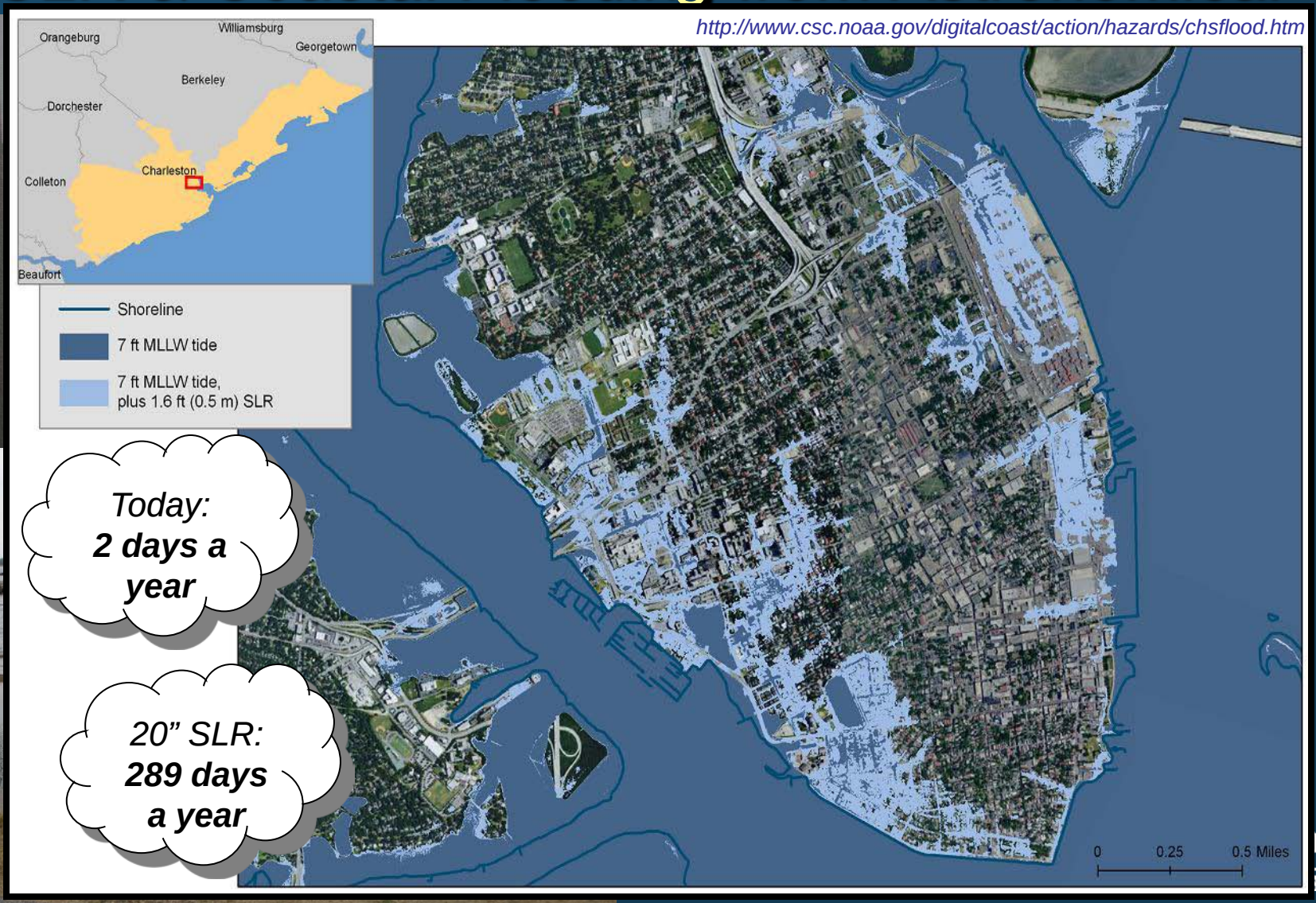
SLR & Coastal Flooding from Astronomical Tides

http://www.csc.noaa.gov/digitalcoast/action/hazards/chsflood.htm



Today: ***2 days a year***

20" SLR: ***289 days a year***

NOAA Coastal Services Center

Sea Grant Consortium

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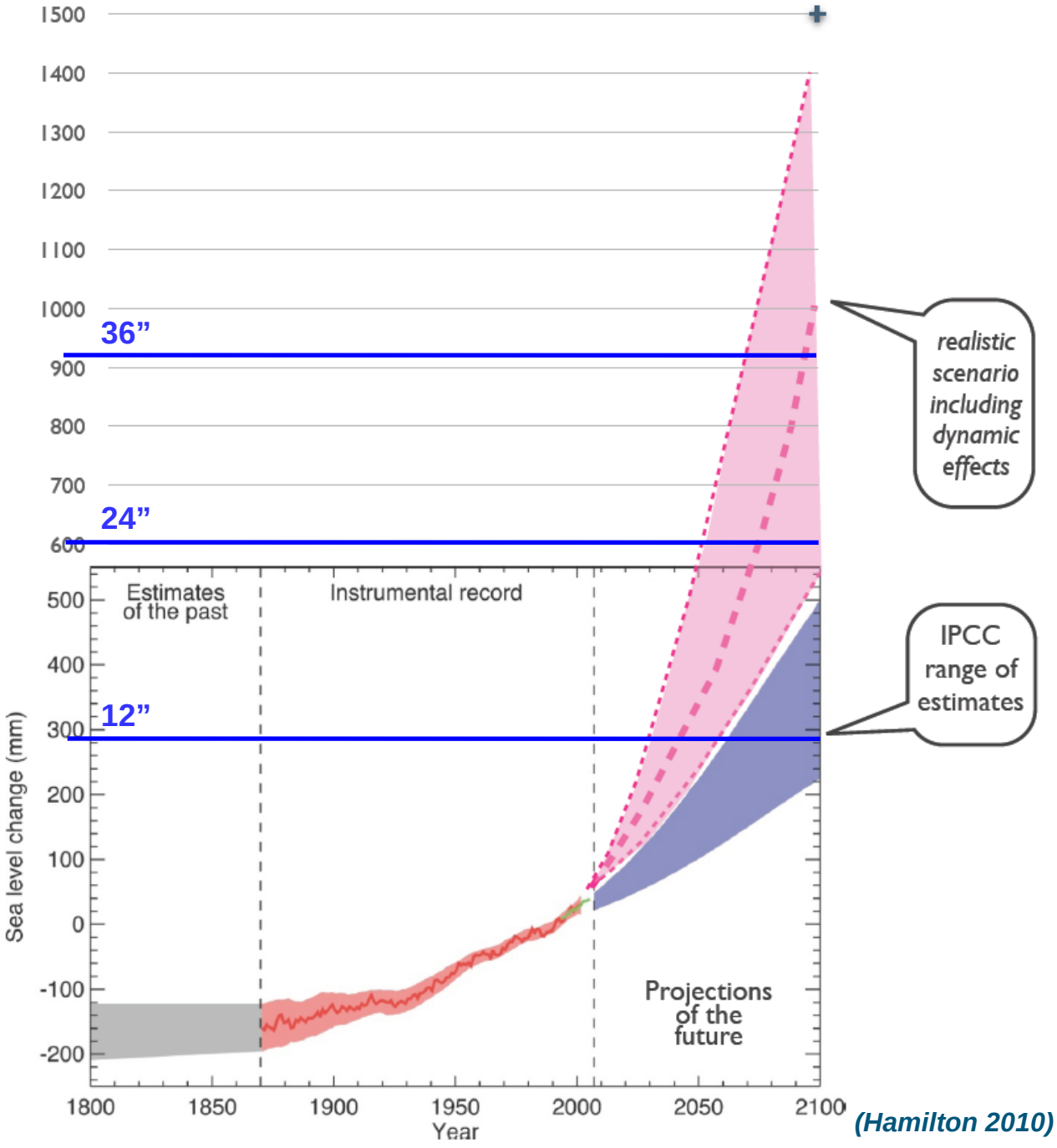
SLR Impacts BEFORE Loss of Land Area

- Altered flooding patterns
  - Changing floodplains
  - Shallow coastal flooding at high tides
  - Higher storm surge
- Changing erosion patterns
- Marshes moving inland
- More frequent salt water intrusion events

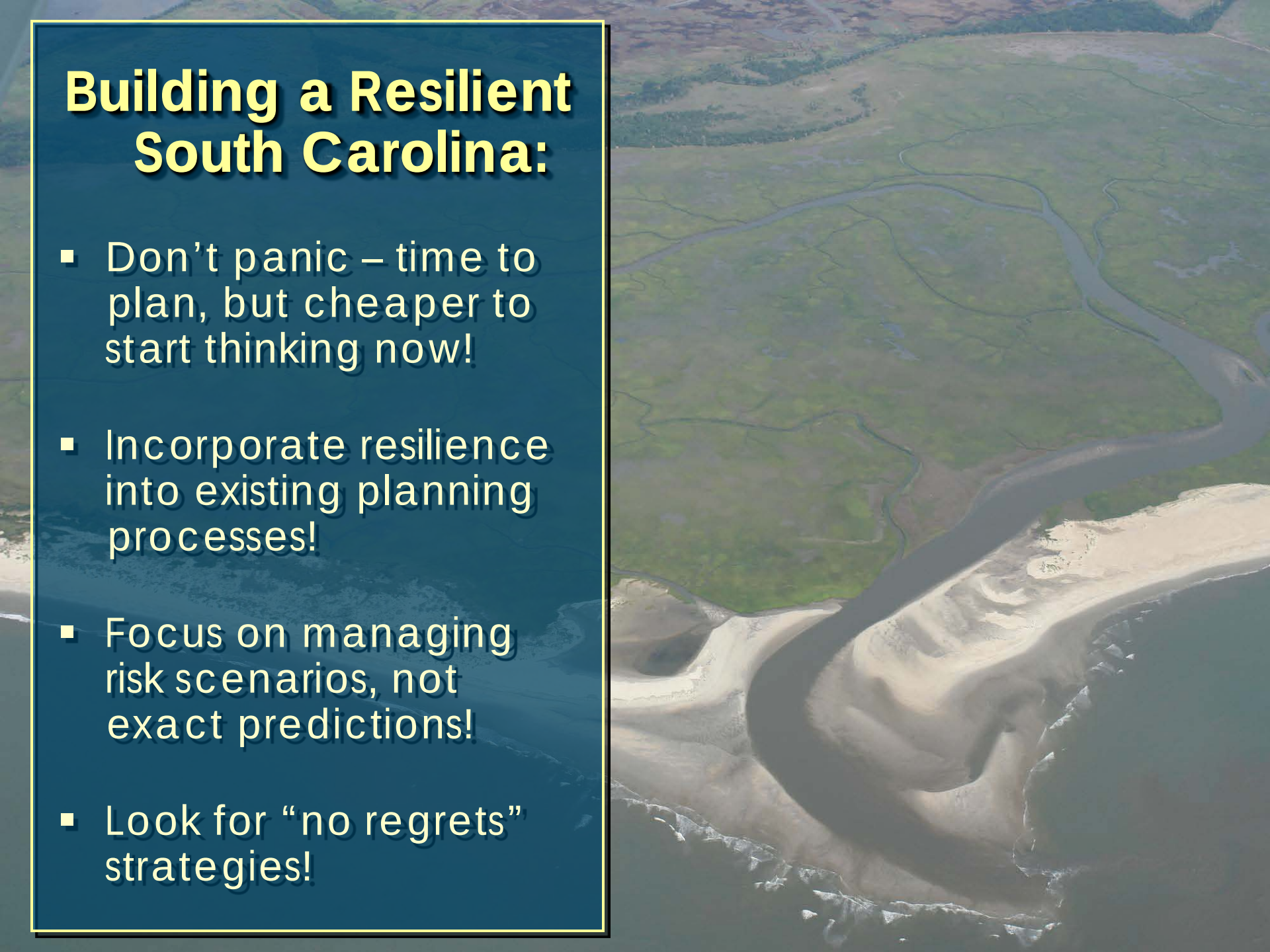
Adapted and modified from Figure 5.1 (IPCC, 2007)



(Hamilton 2010)

Building a Resilient South Carolina:

- Don’t panic – time to plan, but cheaper to start thinking now!
- Incorporate resilience into existing planning processes!
- Focus on managing risk scenarios, not exact predictions!
- Look for “no regrets” strategies!

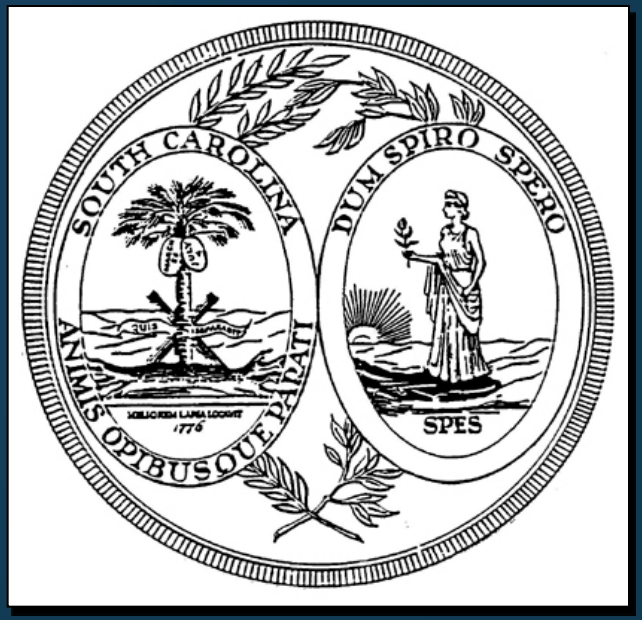


Cost-efficient resilience: Look for "no regrets" strategies

- Elevate above current floodplain requirements
  - Cheaper flood insurance?
  - Easier access during floods!
- Replace critical infrastructure on higher ground
  - Services restored faster after hurricanes!
  - Better evacuation and response!
- Use more pervious surfaces, rain gardens, etc.
  - Less pollutants in runoff that close shellfish beds, harm fisheries!
  - Reduced erosion!
- Prevent development where sea level *will be*
  - Less vulnerable to storm surge!

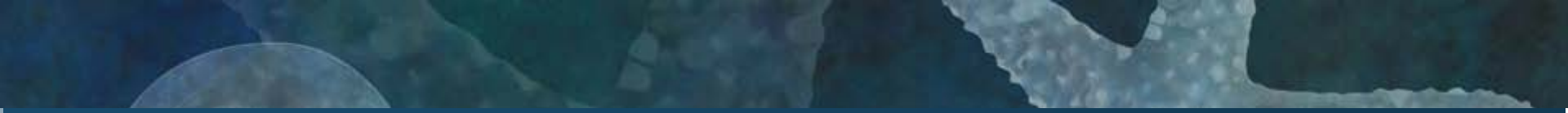
S.C. Sea Grant Consortium

- Free-standing State Agency
  - Created 1978, Act No. 643
  - Began operation 1980
  - Certified by U.S. DOC
- Functions
  - Scientific research
  - Extension and Outreach
  - Education
  - Communications
  - "Facilitation"



Consortium Mission

Generate and provide science-based information to enhance the practical use and conservation of coastal and marine resources that fosters a sustainable economy and environment.



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S.C. Sea Grant Consortium - Functions

- Serve as a Broker and Catalyst
  - Information to inform decision-making
  - Funding to support stakeholder-driven needs
- Work in Partnership with Others
  - Work with stakeholders and constituencies
  - Leverage scarce resources towards common goals
  - Contribute expertise and knowledge
- Support Research, Extension, Education, and Communications
  - Secures funding to support user-driven research at the universities
  - Employs an outreach team to identify info needs and deliver science-based information

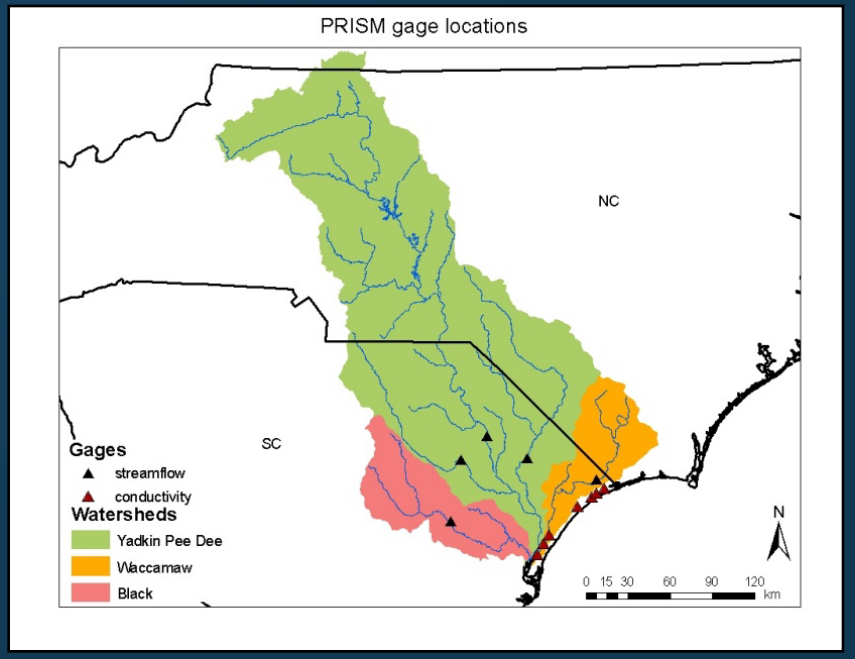
Sea Grant and Climate Extension

- *Carolinas Coastal Climate Outreach Initiative*
  - South Carolina Sea Grant Consortium
  - North Carolina Sea Grant
  - Carolinas Integrated Sciences & Assessment (CISA – Univ. of SC)
- Established Regional Climate Extension Specialist position
- Now: Coastal Climate Extension Specialist (SC)
  Coastal Communities Hazards Adaptation Specialist (NC)
  - Provide tailored, decision relevant climate change information to coastal decision makers

Assessing the Impact of Salt-Water Intrusion in the Carolinas under Future Climatic and Sea-Level Conditions

Goal: Develop decision support tool for industries, resource managers to plan for changes in salt water intrusion events under climate change

Partners: CISA, USGS



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Assessing Flooding Adaptation Needs in the City of Charleston, SC

Goal: Evaluate potential impacts of current and future flooding scenarios on the peninsula

Partners: City of Charleston, NOAA Coastal Services Center, College of Charleston

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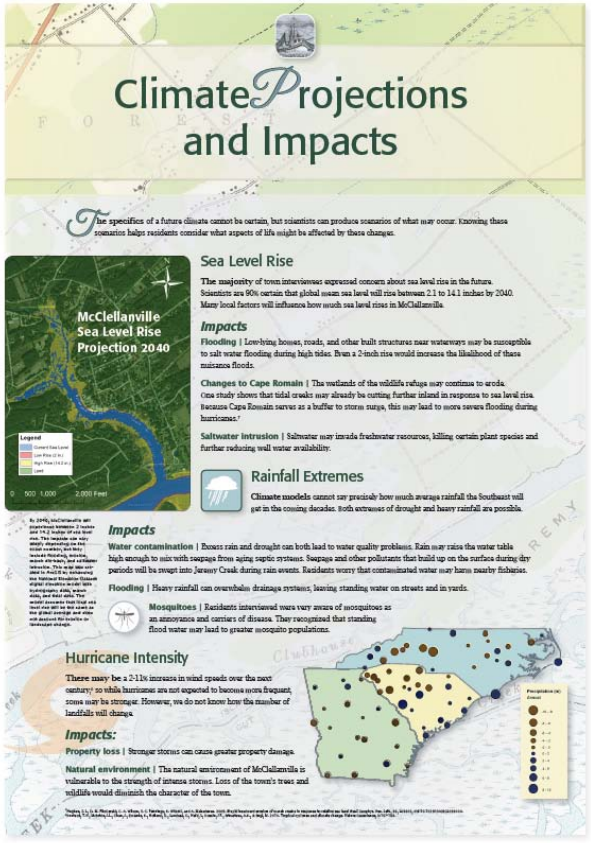
Investigating Climate Change Vulnerability and Resilience in McClellanville, SC



Goal: Develop an adaptation outreach plan for McClellanville, SC

Partners: Kitchen Table Climate Study Group of McClellanville, Oregon Sea Grant

Using participatory scenario building to encourage climate-resilient zoning in the coastal Carolinas

Goal: Write a plan for priority actions to update zoning and form-based codes in the future to encourage climate resilience.

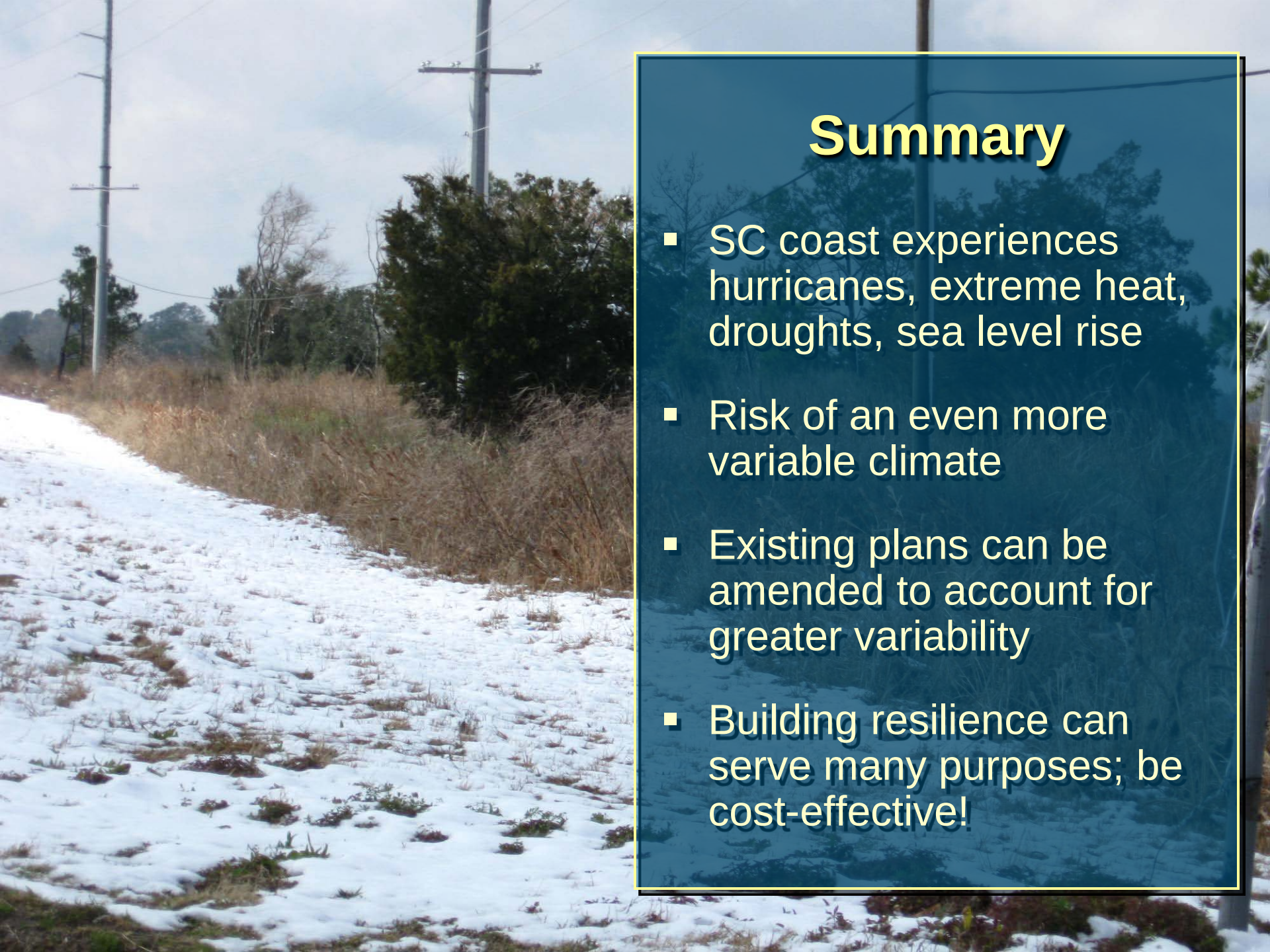
Partners: Beaufort County Government, Social and Environmental Research Institute

(Opticos Design Inc. 2011)

Low Impact Development manual for coastal SC

Goal: Develop a LID manual that includes updated best stormwater management practices to accommodate climate change

Partners: ACE Basin CTP (lead), NIWB NERR CTP, Center for Watershed Protection,



Summary

- SC coast experiences hurricanes, extreme heat, droughts, sea level rise
- Risk of an even more variable climate
- Existing plans can be amended to account for greater variability
- Building resilience can serve many purposes; be cost-effective!