

The Relationship of Climate Change to Coastal Hazard Risk



Dr. Jess Whitehead
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Dr. Jessica Whitehead is the Chief Resilience Officer with the North Carolina Office of Recovery and Resiliency. She leads an innovative team to build the state's initiative to help storm-impacted communities rebuild smarter and stronger in the face of future natural disasters and long-term climate change. This team will improve collaboration between governments, non-profits, the private sector and academia, with a goal of developing solutions that enhance the resilience of communities and the natural environment while creating safe and affordable housing solutions.

Prior to NCORR, Dr. Whitehead was the coastal communities hazards adaptation specialist for North Carolina Sea Grant, where she assisted coastal users with integrating information about resilience to coastal weather and climate hazards into their decision-making processes. She earned a PhD in geography and Master of Science degree in meteorology from The Pennsylvania State University. She also earned a Bachelor of Science degree in physics with a concentration in meteorology from the College of Charleston.



NCORR

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A RESILIENT NORTH CAROLINA IN THE FACE OF CLIMATE CHANGE



Leading the state's efforts to rebuild smarter and stronger.

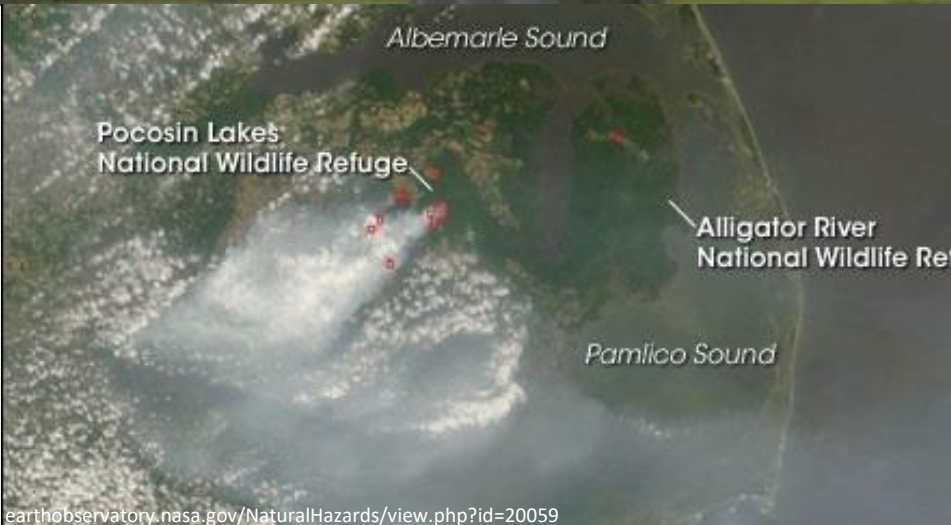
11 JUNE 2019

TAKE AWAY #1: CLIMATE IS CHANGING AS WE INCREASE GREENHOUSE GASES.

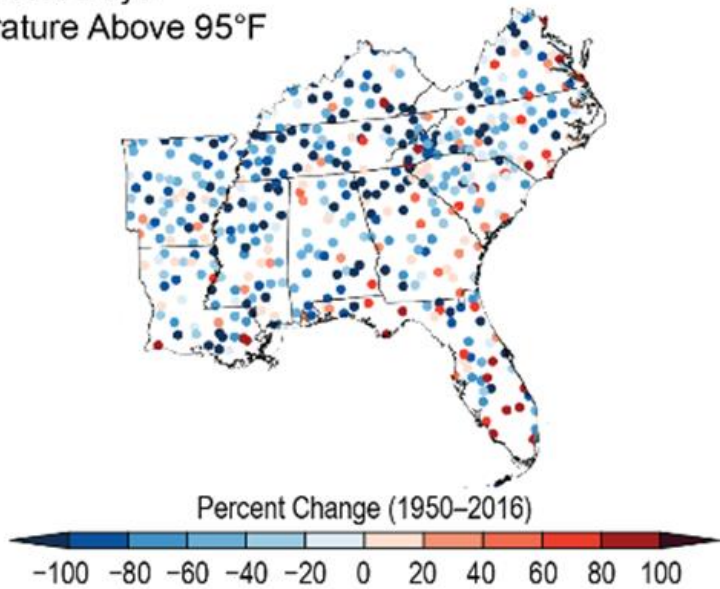
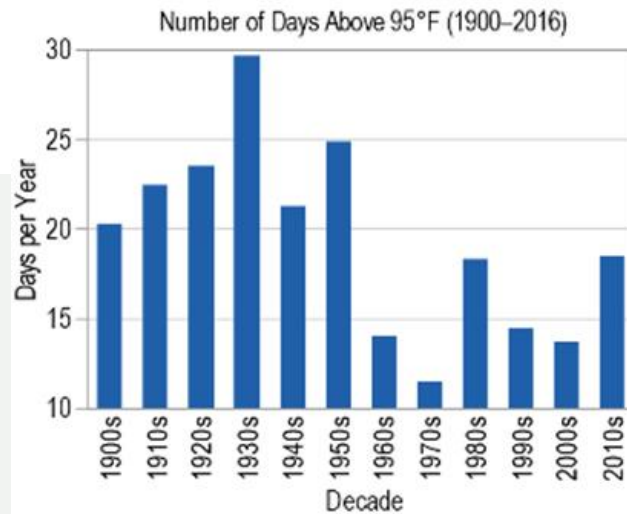


Scientific studies depict a future with more extreme weather events that increases the risk of flooding, drought, and extreme heat events.

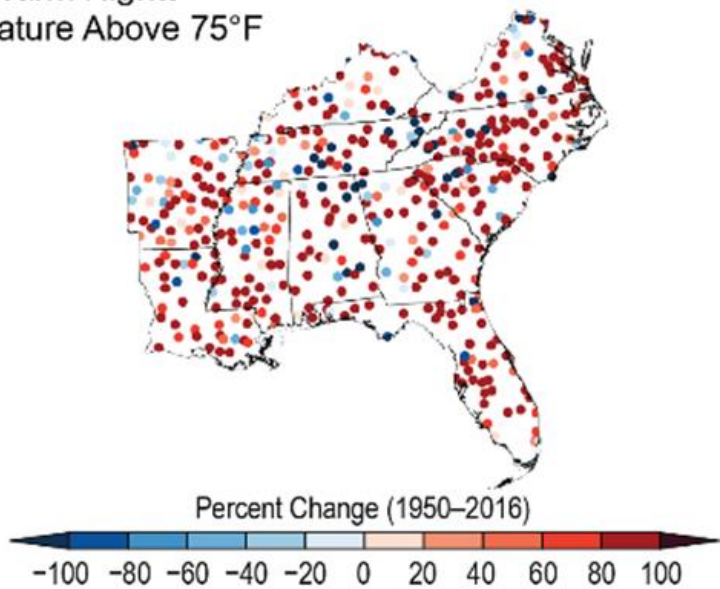
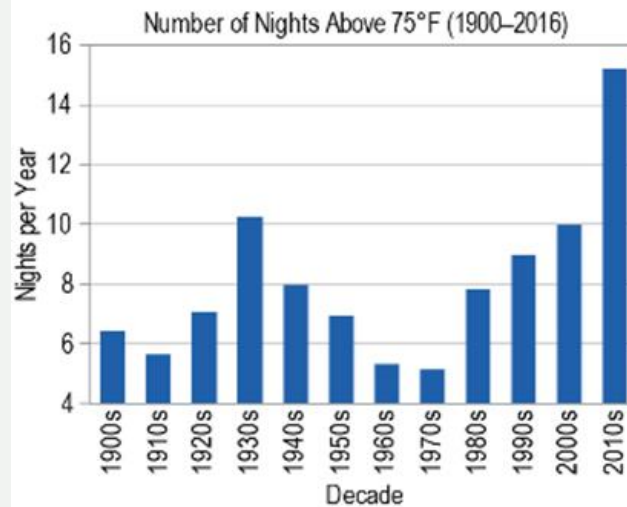
TAKE AWAY #2: CLIMATE CHANGE EXACERBATES WHAT WE ALREADY MANAGE



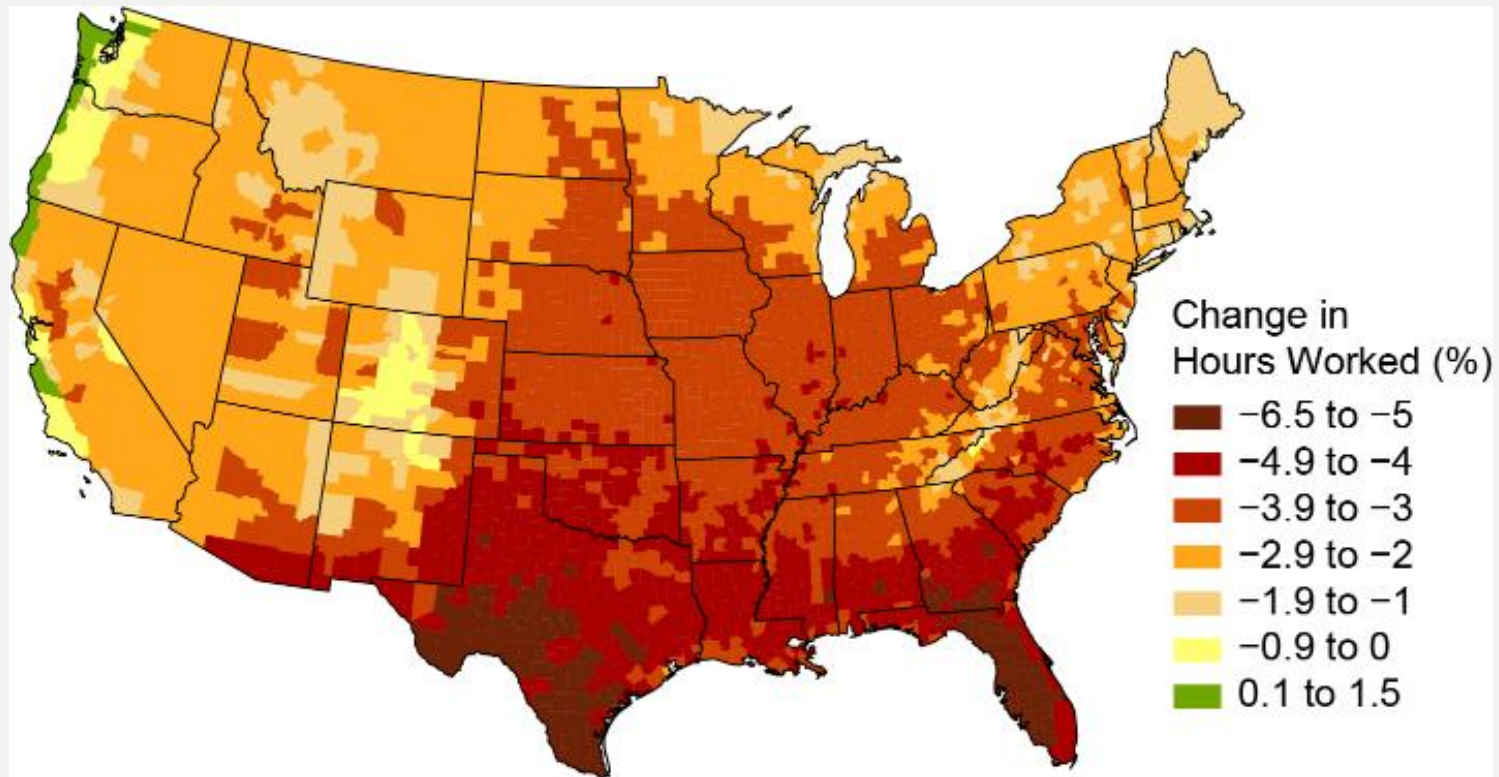
Number of Hot Days Maximum Temperature Above 95°F



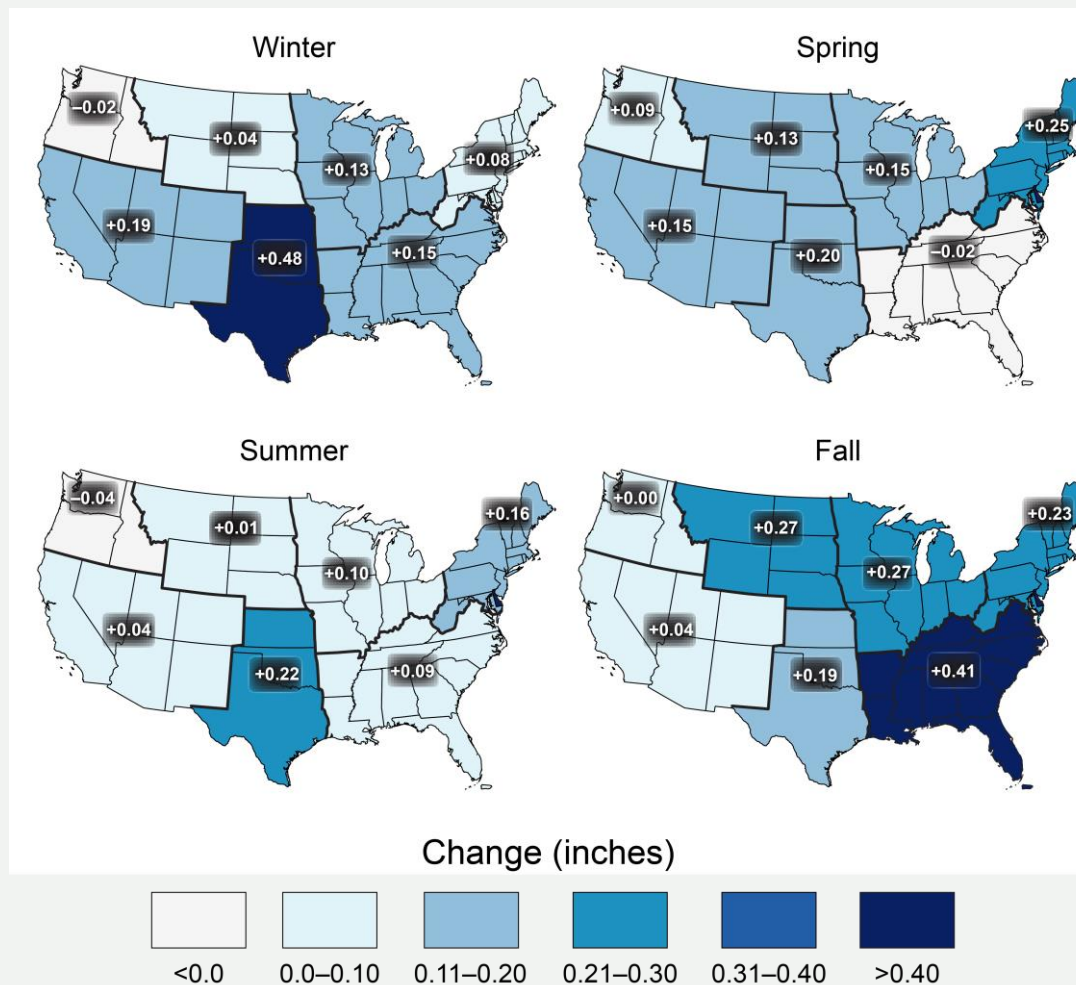
Number of Warm Nights Minimum Temperature Above 75°F



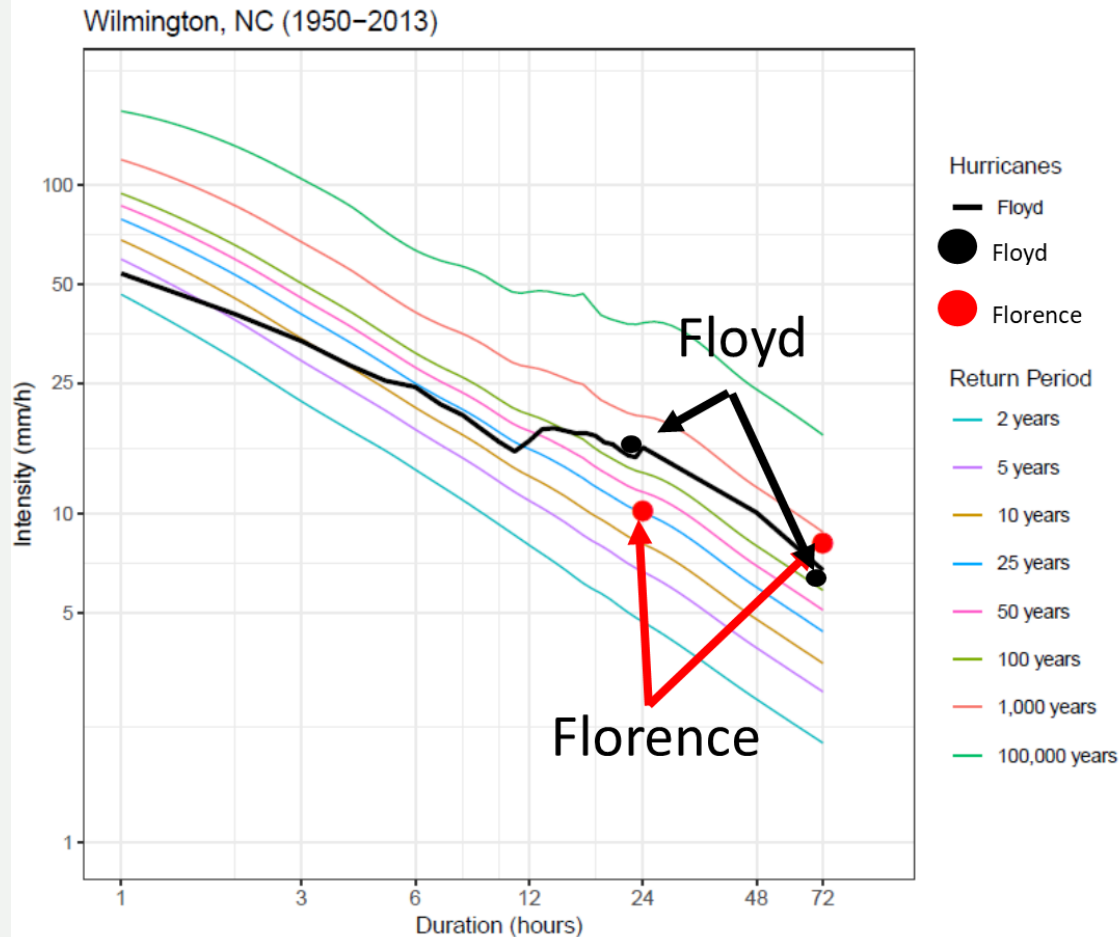
NCA4 FIG. 19.21: PROJECTED CHANGES IN HOURS WORKED



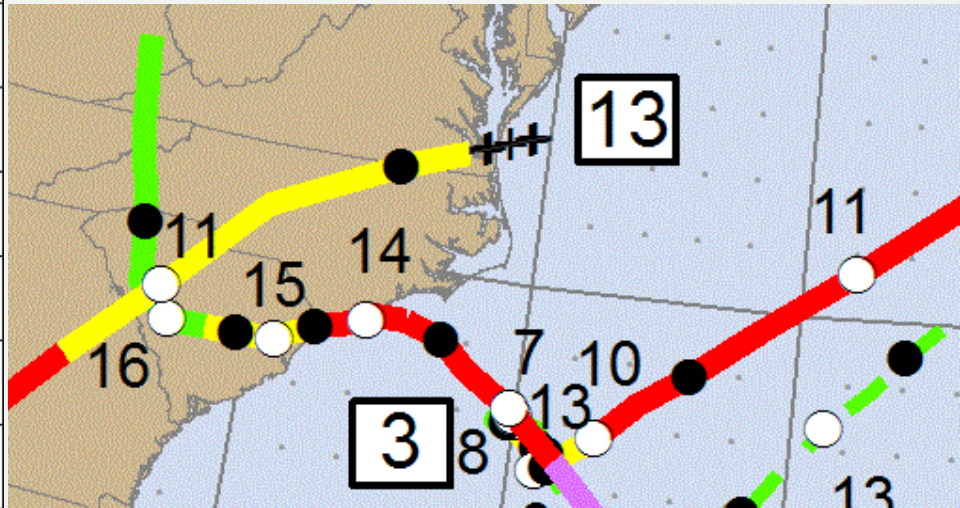
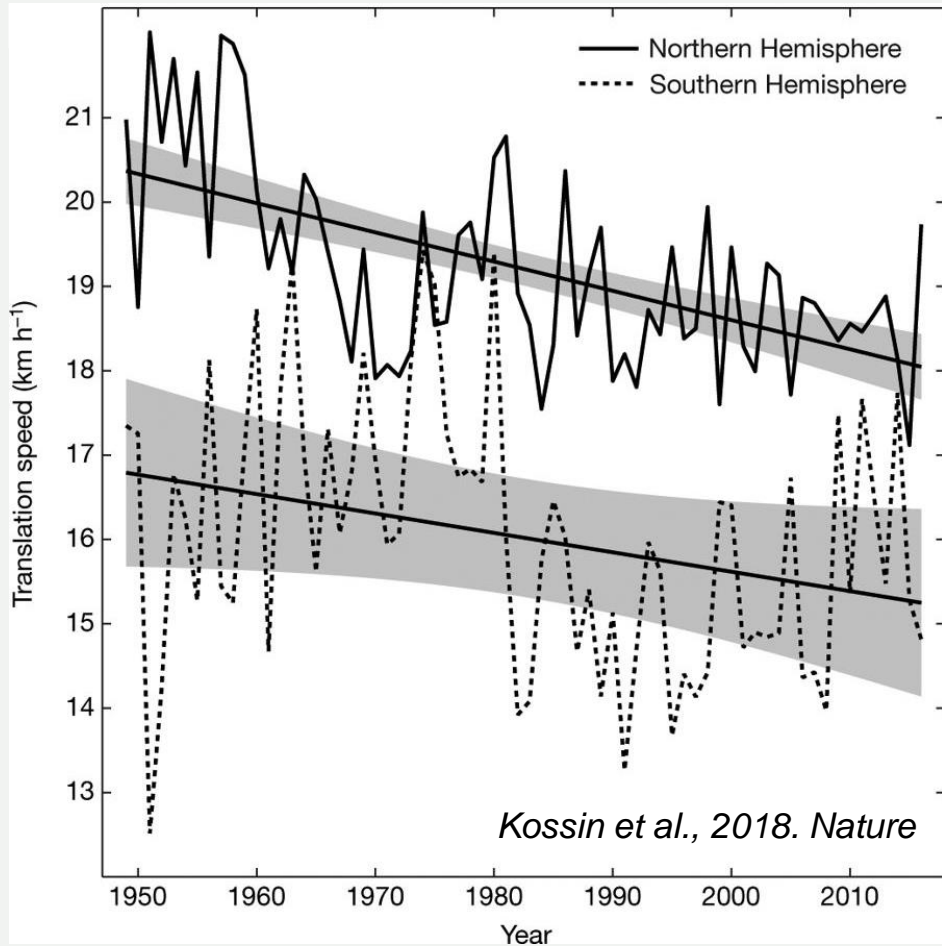
OBSERVED CHANGE IN DAILY 20-YEAR RETURN LEVEL PRECIPITATION



100- YEAR STORMS ARE BECOMING MORE FREQUENT



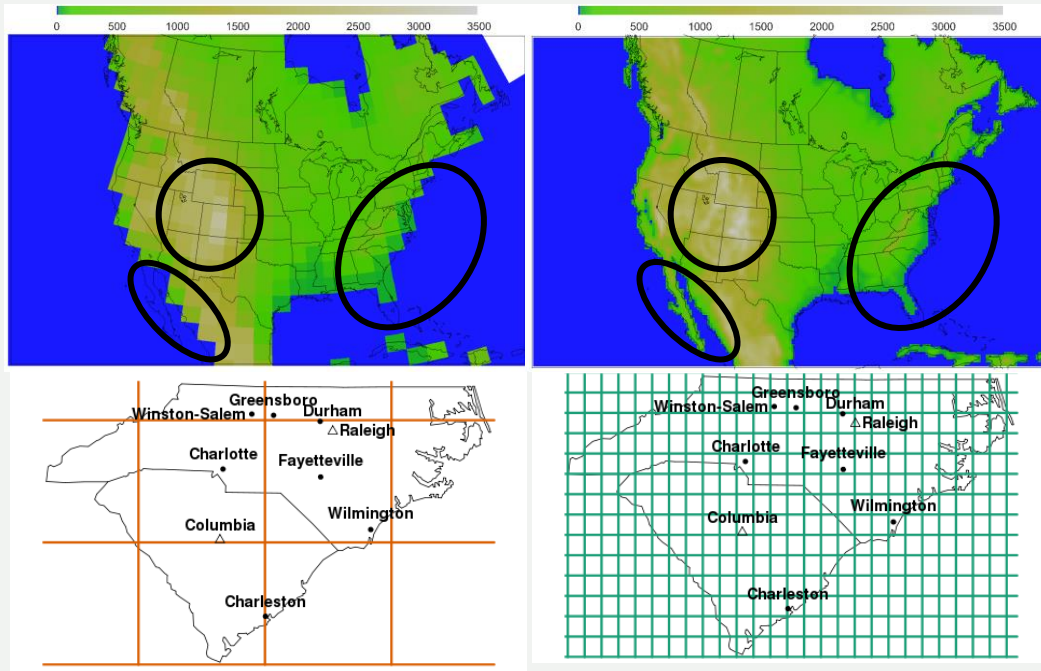
TROPICAL SYSTEMS ARE MOVING SLOWER



www.nhc.noaa.gov

ENGINEERING IMPLICATIONS: ONGOING RESEARCH

IDF curves for **Wilmington, NC**



	Value for 24h 25 year rain (in)
NOAA	
Atlas 2008	9.45
Our Study	
1952-2013	9.49
1994-2013	13.6

Value for 25 year rain (in)	CESM RCP4.5 (in)	CESM RCP8.5 (in)
2025-2099	16.1	15.4



COASTAL RESILIENCE

Bouncing back & *building beyond.*

PLAN & BUILD RESILIENCE

Develop and implement plan to become more resilient.



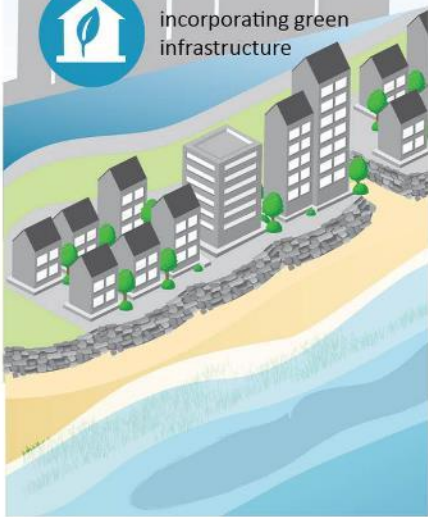
improving forecasts, observation models, computer systems



getting information to decision makers faster



incorporating green infrastructure



DISASTER STRIKES

Disasters can be imminent or strike unexpectedly.



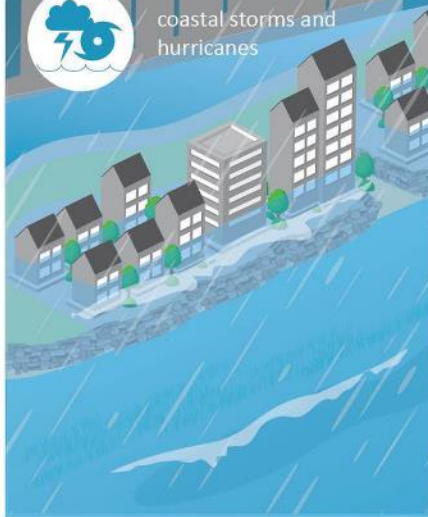
sea level rise



tsunamis



coastal storms and hurricanes



RESPOND

Immediately take action following a disaster.



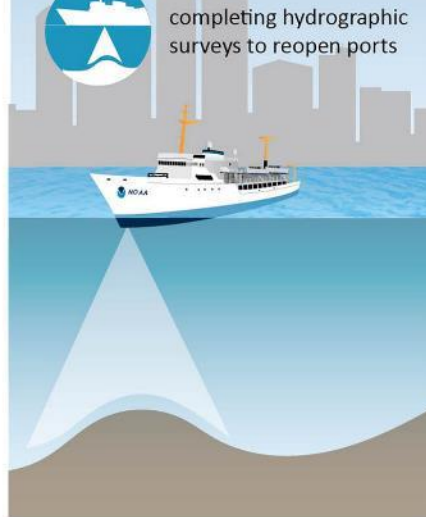
pollution response



damage assessment imagery



completing hydrographic surveys to reopen ports



RECOVER

Assess resilience and manage adaptively.



assessing damage to communities, economy, and environment



issuing grants to rebuild and restore habitat



providing data and tools for analysis



Assess resilience and begin planning for the next disaster.

Building resilience is an iterative process.

Planning for resilience?

It's a bit like planning a dinner party.



Mariner's Menu

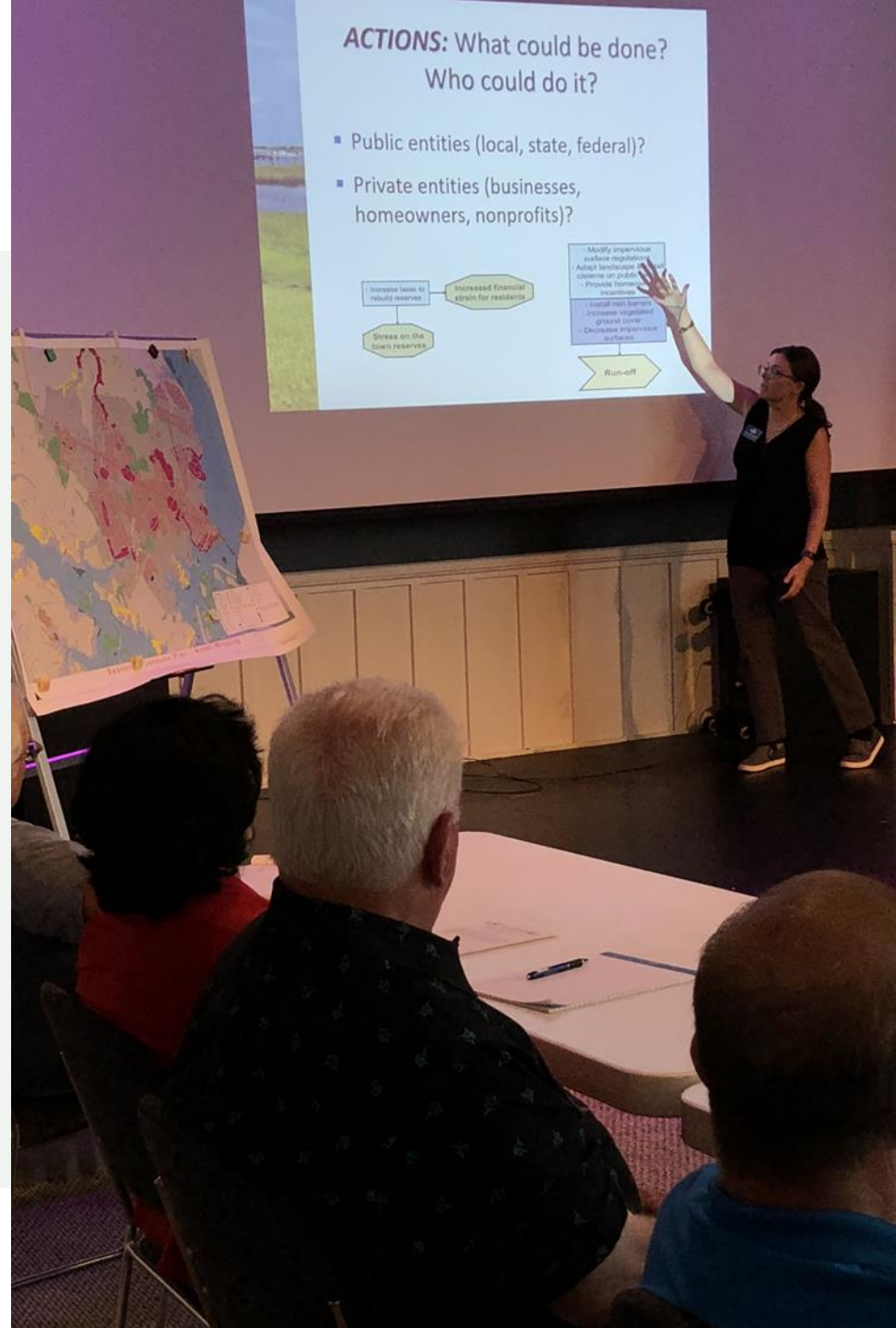
30 YEARS OF FRESH SEAFOOD IDEAS

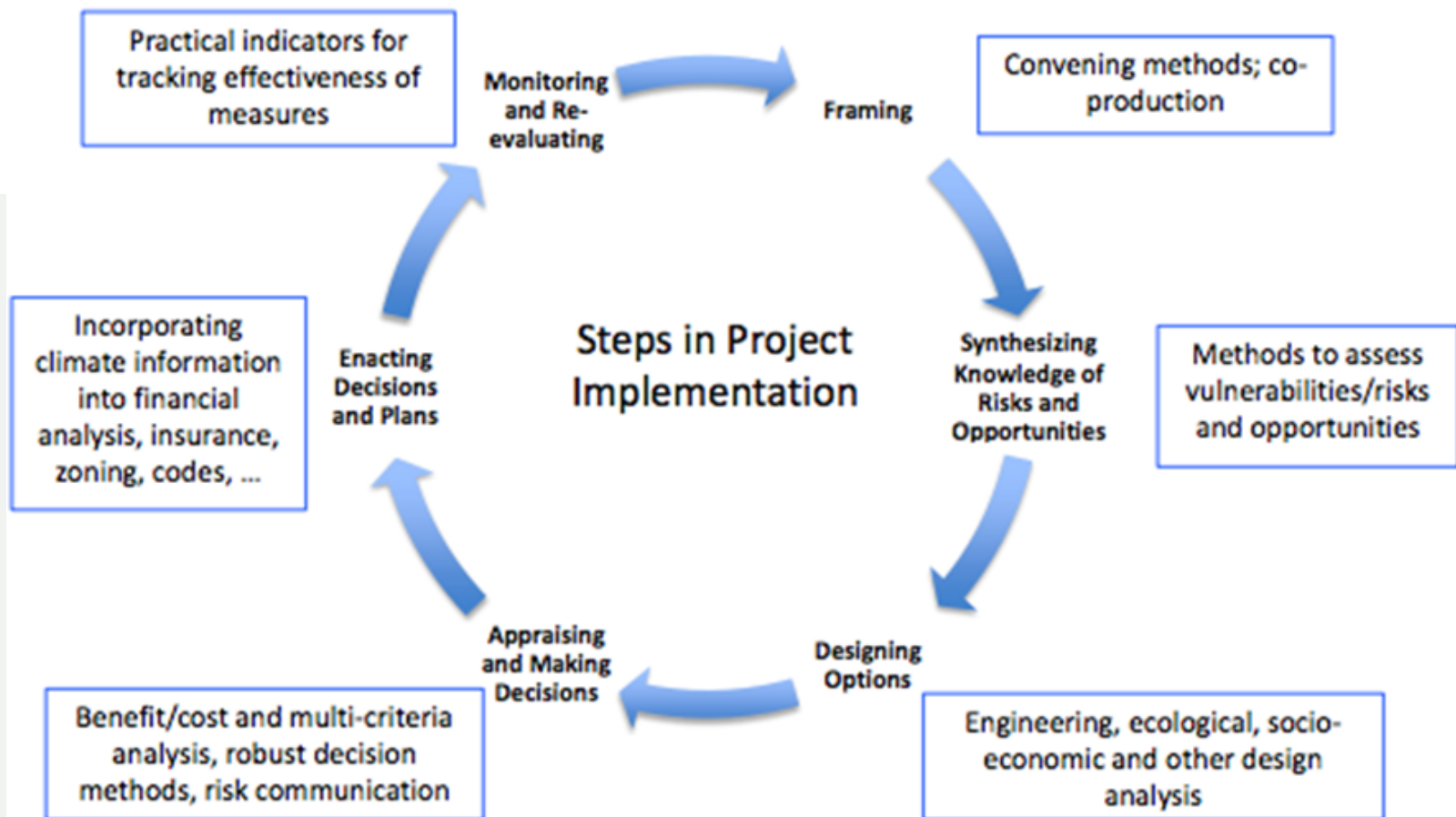
BY JOYCE TAYLOR

EDITED BY SARAH FRIDAY PETERS • PUBLISHED BY NORTH CAROLINA SEA GRANT
PHOTOGRAPHS BY SCOTT D. TAYLOR • ILLUSTRATIONS BY CONNIE MASON


RESILIENCE PLANNING:

- Set goals
- Invite the right participants
- Choose your menu
 - Partner and ask for help
 - Add resilience lens to existing grants
 - Prioritize assets available/at risk
 - Consider what your community will accept
- Task who will monitor, implement, and adjust





Moss et al. 2019: Evaluating Knowledge to Support Climate Action: A Framework for Sustained Assessment; Report of an Independent Advisory Committee on Applied Climate Assessment
(<https://journals.ametsoc.org/doi/pdf/10.1175/WCAS-D-18-0134.1>)

An aerial photograph showing a two-lane asphalt road with a yellow dashed center line. To the left of the road is a grassy shoulder and a utility pole. To the right is a narrow waterway or ditch, followed by a larger body of water and a marshy area. A yellow diamond-shaped road sign is visible on the right side of the road. A semi-transparent white rectangular box is overlaid on the right side of the image, containing the text.

How can you
transform what
you are
already doing
for resilience?

Photo: Baxter Miller/RISING

Local and Regional Plans

Resiliency Tools

Comprehensive/CAMA Land Use

Description: 20- to 30-year planning horizon addressing all tackling broad scope of community goals by guiding future growth, development, and land use; includes significant public engagement

Requirement: Yes, for Coastal Area Management Act (CAMA) communities per 15A NCAC 07B

Resilience Connection: Can provide fact-base, public engagement/education and policy guidance linking hazard mitigation, floodplain management, sea level rise projections, and long-term recovery to support development of regulations/higher standards and incentive programs



Hazard Mitigation Plan

Description: Includes detailed hazard identification and risk assessment (HIRA) for residential and commercial builds, critical infrastructure/assets

Requirement: Yes, for FEMA funding eligibility (PDM, FMA, HMGP, etc.)

Resilience Connection: Provides analysis to justify investment in pre-and post-disaster mitigation or adaptation actions to risk posed by natural hazards, including those exacerbated by climate change (coastal flooding and sea level rise)



Open Space and Recreation Plan

Description: developed to protect and enhance community open space resources

Requirement: No, but can receive FEMA Community Rating System points

Resilience Connection: Can absorb and store water with natural feature, and coastal open spaces (such as wetlands) can act as erosion and wave buffers. Equitable access to open spaces/recreation can lead to better public health outcomes thereby reducing vulnerability. May tie into flood buyout or future transfer of development rights program.

Beach/Shore Protection Management Plan

Description: up to 50-yr planning horizon to provide long-term shoreline stabilization and protection to tourism industry, infrastructure, and built environment with minimal environmental harm; ideally regional & self-sustaining

Requirement: Yes, to be eligible for FEMA Public Assistance per 44 CFR 206.225(j)(2)

Resilience Connection: often the primary strategy for reducing risks to beach communities associated with ocean-front erosion caused by storms; projected elevation profile should account for sea level rise scenarios; an important example of pre-disaster recovery planning



Capital Improvements Plan (CIP)

Description: 4- to 6-year plan identifying capital projects (stormwater, transportation, water supply, and other infrastructure) and forecasting funding

Requirement:

Resilience Connection: can leverage funding to implement hazard mitigation measures and provides opportunity to review and consider the impact of proposed improvements on hazard vulnerability (e.g. guide new growth to safer areas); legal question of abandoning or not repairing vulnerable infrastructure post-disaster



Pre- or Post-Disaster Recovery Plan

Description: ideally done during 'blue-sky' conditions, this type of plan identifies policies, operational strategies, and roles and responsibilities for implementation that will guide decisions that affect long-term recovery and redevelopment of the community after a disaster

Requirement: No

Resilience Connection: planning for recovery before a disaster can lead to a faster, more efficient and more equitable recovery, allow a community to 'build back better', and provides more local control over the lengthy and complicated recovery process



Emergency Operations Plan

Description:

Floodplain Management Plan

A localized floodplain management plan goes beyond a regional hazard mitigation plan to conduct a risk assessment that identified and profiled flood hazards that pose a risk to the community, assessed the Town's vulnerability to those hazards, and measured the capabilities in place to mitigate those. The flood hazards typically profiled in this type of plan include:

- Climate Change and Sea Level Rise (1-3 ft)
- Dams/Levee Failure
- Flood: 100-/500-year
- Flood: Stormwater/Localized Flooding
- Hurricane and Tropical Storms
- Storm Bank Erosion

Results and recommendations from this type of effort should account for future conditions (more extreme rainfall events, higher sea levels & storm surge, etc.) and inform updates to other plans and ordinances guiding development or investment



Transportation Plan

Description:

Watershed Restoration Plan

Description: aims to identify causes of impairment and pollutant sources, necessary nutrient load reduction levels and management measures and other components to increase favorable water quality and quantity outcomes that support a healthy environment and economy

Requirement: Yes, to be eligible for 319(h) grant funding

Resilience Connection: maintaining and restoring the natural functions of watersheds can reduce flood risks and, enhance natural habitat and protect a variety of economic interests (aquaculture, beaches, etc.)



Economic Development Plan

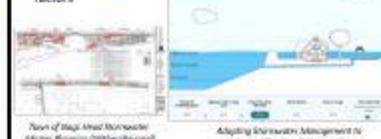
Description:

Stormwater Master Plan

Description: a long-term strategy to reduce flood damages and water quality issues associated with outdated or inadequate stormwater drainage systems

Requirement: No, unless an MSA community

Resilience connection: increasing extreme rainfall events, higher sea levels, and storms put stress on stormwater infrastructure built before there was a clear picture of flood risks. New investments should try to take into account these factors



Building Retrofits & Weatherization

- Retrofitting homes and businesses to have more energy and cost efficient fixtures can help save money to invest in other resilience measures (elevating structure, purchasing a back-up generator, etc.)
- Example: Coastal Community Action - Weatherization Assistance Program

Weatherization Assistance

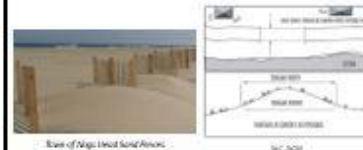


Elevating Water Utility and Transportation Assets

- Description:

Dune Management

- Sand dunes provide a natural buffer against the erosive forces of wind, water, and waves. Sometimes it's necessary to stabilize or strengthen existing sand dunes or build new ones to protect oceanfront buildings and roads.
- Dune establishment and stabilization projects must be thoughtfully planned and carried out to avoid damaging the beach and dune system.



Marsh Sills: A type of 'Living Shoreline'

- Shoreline stabilization technique using natural habitat elements (e.g. tall grasses and wetlands) that increases resilience to coastal erosion and flooding
- Traps sediment reducing wetland or marsh edge loss, dissipates wave energy and storm surge, provides recreation services
- *NEW* Marsh Sill General Permit (15A NCAC 7H .2702)



Elevating Critical Components Above BFE

- Unlike entire buildings or structures, elevating critical components like HVAC, electrical panels, and back-up generators can ensure key assets (e.g. pump station or other) aren't completely compromised during a flood.
- A higher design flood elevation standard may be appropriate for critical facilities than for single-family homes.



Low Impact Development (LID) & Green

- Replacing impervious surface with natural features allows for more effective water quantity and quality management.

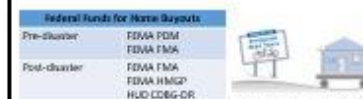
Example measures include:

- Permeable Pavement
- Green Roofs
- Green Walls
- Green Streets
- Green Parking
- Green Yards
- Green Corridors
- Green Canyons
- Green Highways
- Green Bridges
- Green Parks
- Green Plazas
- Green Streets
- Green Yards
- Green Corridors
- Green Canyons
- Green Highways
- Green Bridges
- Green Parks
- Green Plazas



Pre- & Post-disaster Home Buyout Program

- A form of hazard mitigation
- Property owner gets paid fair-market value (pre-storm) to have home demolished and kept as open space in perpetuity falling under the ownership of the municipality or county (unless a third party is arranged such as a community land trust, or the land is leased for \$1 to a neighboring resident).
- Buyout properties have been: restored as wetlands, reforested, turned into parks, pedestrian or biking trails, Frisbee golf courses, community garden space, or left vacant to be used as temporary excess parking space



Habitat Conservation

- Description:

FORTIFIED Roof/Building Construction

- FORTIFIED is a nationally recognized building method and standard (3 levels: Root, Silver & Gold) based on observations by the Insurance Institute for Business and Home Safety (IBHS)
- It is code-plus and exceeds the vast majority of building codes by improving the performance of buildings against natural hazards and reducing the risk of personal property losses.
- A FORTIFIED Evaluator is the only professional who can help you earn a FORTIFIED Designation and take advantage of all the program benefits.
- The program starts by focusing on the roof, which is the most important and vulnerable part of every building.
- The FORTIFIED Commercial Program makes new and existing commercial buildings more resistant to damage from severe weather.



Urban Forest and Tree Management

- Description: See N/A

- Trees offer many advantages to an urban landscape
- Reduce the attractiveness of an urban area
- Form part of the ambience of shopping districts
- Shade a pedestrian walkway or open-air mall
- Draw businesses, such as shops and street vendors
- Revive blighted urban areas
- Keep city streets cooler and reduce indoor air conditioning costs
- Filter pollutants from the air and provide oxygen
- Reduce stress and otherwise improve health
- Offer shade for seating, children's play areas and other recreation sites
- Reduce stormwater runoff
- Provide respite from the heat and opportunities for social gathering in pocket parks and squares
- Provide recreational opportunities and wildlife corridors, such as urban river walks and other tree-lined routes
- Provide habitat for birds and other wildlife

Coastal & Wetland Restoration

- Description: of development rights program.

Beach Nourishment/Maintenance

- Description:

SET THE TABLE FOR RESILIENCE

- Set goals that incorporate local knowledge and values
- Create a climate for conversation
- Use a resilience lens on existing funding proposals
- Partner to tailor data to local needs
- Make implementation feasible through prioritizing steps





NORTH CAROLINA OFFICE OF RECOVERY AND RESILIENCY

THANK YOU

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