The Fourth National Climate Assessment:

Process, Findings, and Implications for the Southeast

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SECOORA mtg. June 19, 2019

U.S. Global Change Research Program

Outline

1. Scene-Setting
2. Developing the Fourth National Climate Assessment (NCA4)
3. NCA4 Overview of Findings
4. What does it mean for the Southeast?

Legislative Origins for the NCA

Global Change Research Act of 1990, Section 106:

Not less frequently than every 4 years [USGCRP] shall prepare and submit to the President and Congress an assessment which:

- Integrates, evaluates, and interprets the findings of [USGCRP] and discusses the scientific uncertainties associated with such findings
- Analyzes the effects of global change on the natural environment, agriculture, energy production and use, land and water resources, transportation, human health and welfare, human social systems, and biological diversity
- Analyzes current trends in global change, both human- induced and natural, and projects major trends for the subsequent 25 to 100 years.

NEW EFFORT – to develop a Sustained Assessment – build assessment capacity, new scientific insights on-going basis, build networks to promote interactions, timely indicator measurements, special and foundational reports

2. Developing the Fourth National Climate Assessment (NCA4)

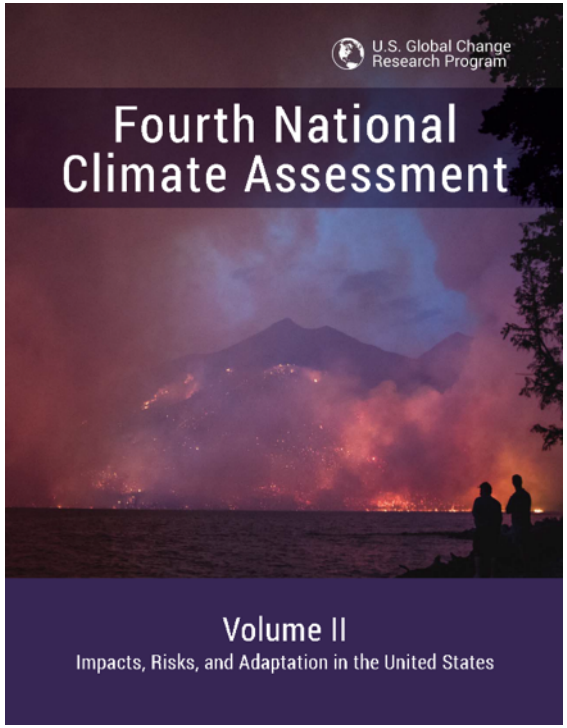
NCA4 Vol I:
Climate Science Special Report

- Released Nov 3, 2017
- Key advances:
  - Detection and attribution
  - Extreme events (tropical cyclones, tornadoes, atmospheric rivers)
  - Downscaled information (including sea level rise)
  - Potential surprises
  - Climate model weighting
- Summarized in Ch. 2 (Our Changing Climate) of NCA4 Vol II (Impacts, risks, adaptation)

Read and download the report at
science2017.globalchange.gov

NCA4 Vol II:
Impacts, Risks, & Adaptation in the U.S.

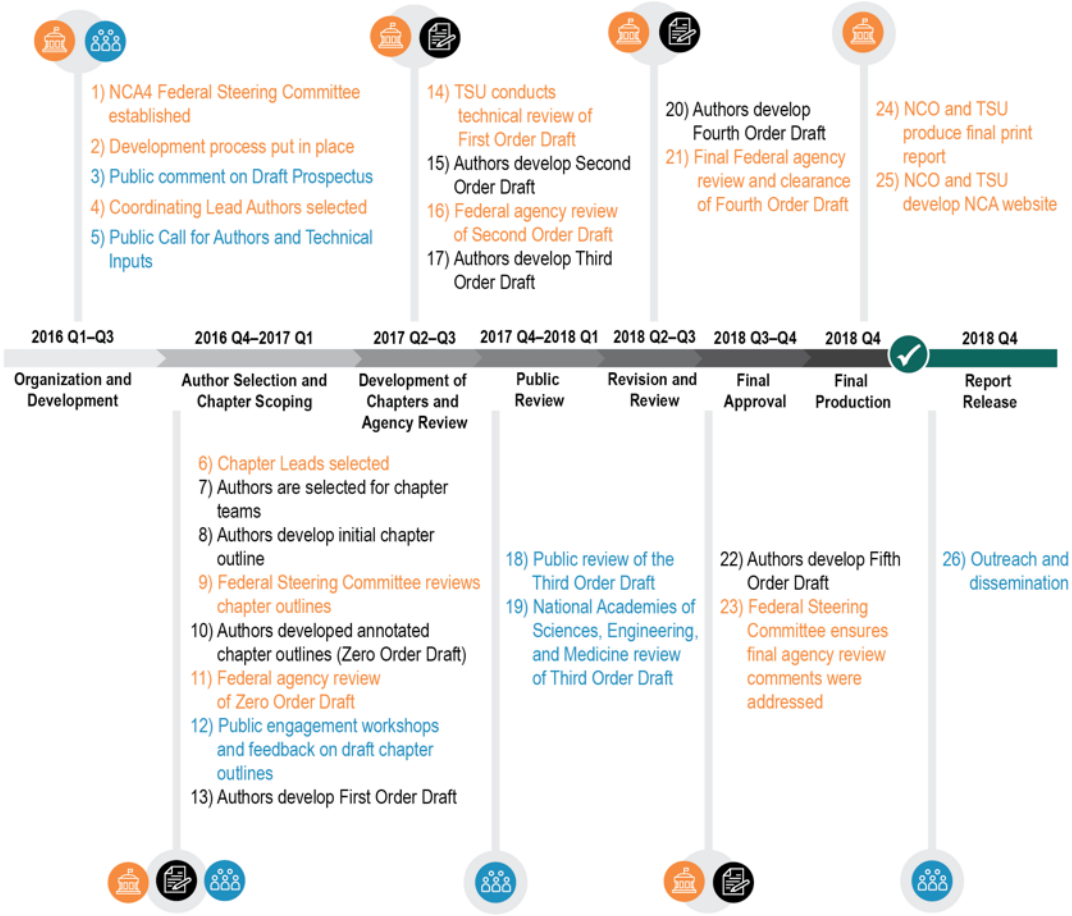
- Released Nov 23, 2018
- **Policy relevant**, but not policy prescriptive
- Places a strong emphasis on **regional information**
- Quantifies **impacts in economic** terms
- Integrates **international** considerations
- Assesses a **range of potential impacts**, helping decision makers better identify risks that could be avoided or reduced
- Uses **case studies** to provide additional context and to showcase community success stories



Read and download the report at
nca2018.globalchange.gov

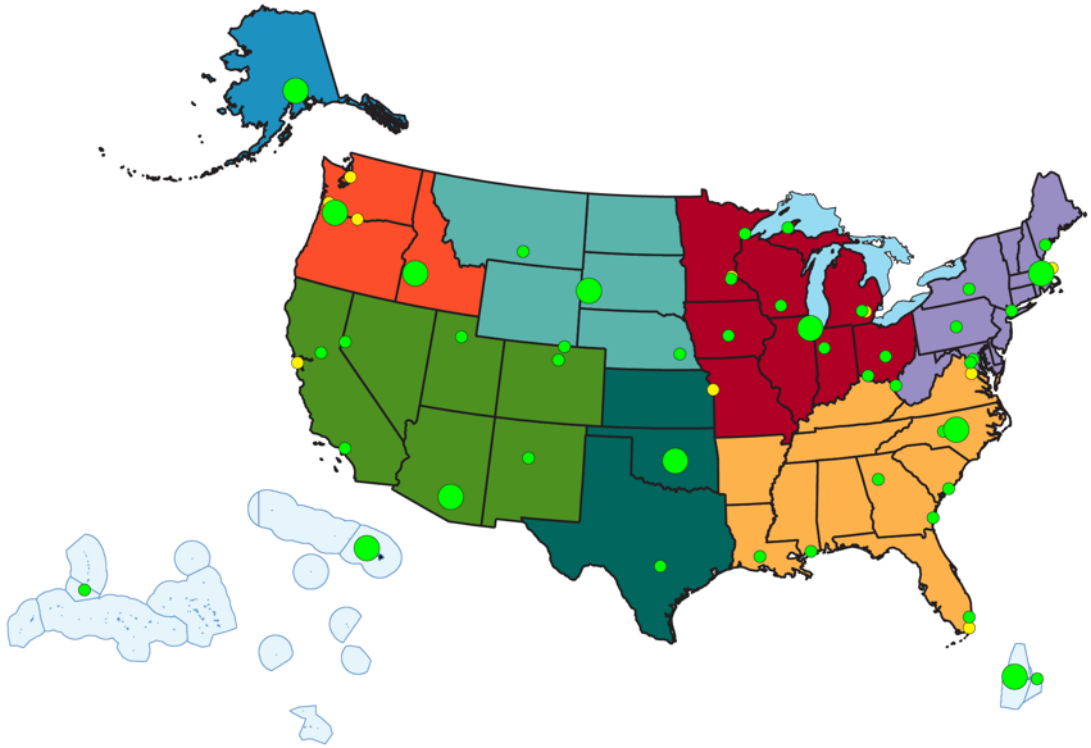
Report Development Process

- Multiple points of **federal review and decision** *(orange icons)* were present throughout the process.
- In addition, **public engagement** *(blue icons)* was a cornerstone of the NCA4 development process.
- Authors used these feedback mechanisms to inform/revise **chapter development** *(black icons)*.



Public Engagement

- Public feedback on the draft prospectus
- Public call for author nominations
- Public call for technical inputs (good place for SECOORA work input)
- A series of Regional Engagement Workshops (REWs) and sector-specific webinars (SECOORA input)
- Public call for Review Editors
- A 90-day public review & comment period

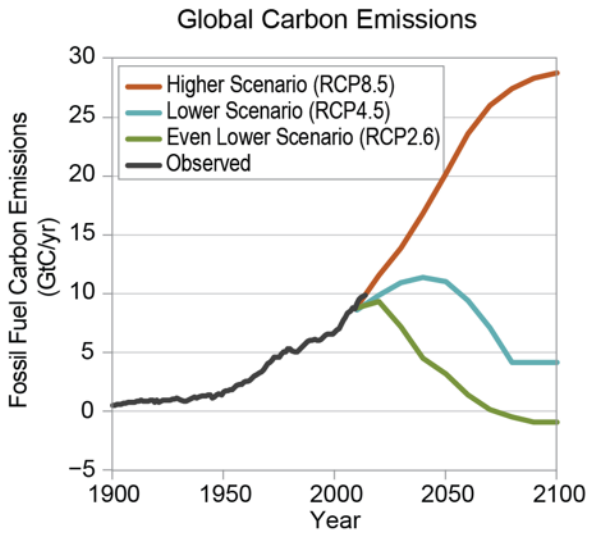


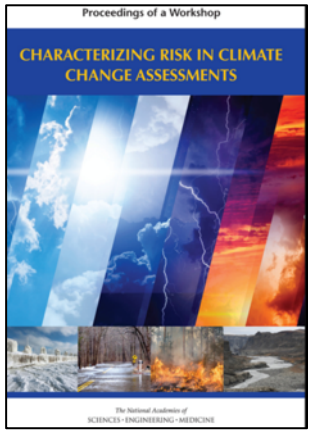
Large green dots illustrate the hub locations for the 11 REWs in early 2017. Small green dots indicate satellite locations for those workshops. Small yellow dots show locations of some additional engagement activities, such as presentations or listening sessions at professional society meetings.

Table of Contents

Risk Framing in Key Messages

- A **"risk-based framing"** is used to ensure NCA4 focuses on issues of high importance to decision-making and to help with communicating assessment outcomes
- In response to user needs and with guidance from a workshop of the National Academies, NCA4 Key Messages addressed:
  - ✓ What do stakeholders value/what is at risk in a given sector or region?
  - ✓ What outcomes do we wish to avoid with respect to these valued things?
  - ✓ What do we expect to happen in the absence of adaptive action and/or mitigation?
  - ✓ How bad could things plausibly get/are there important thresholds or tipping points in the unique context of a given region, sector, etc.?



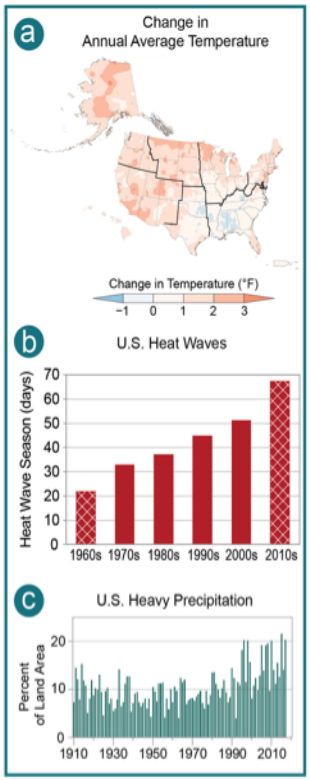


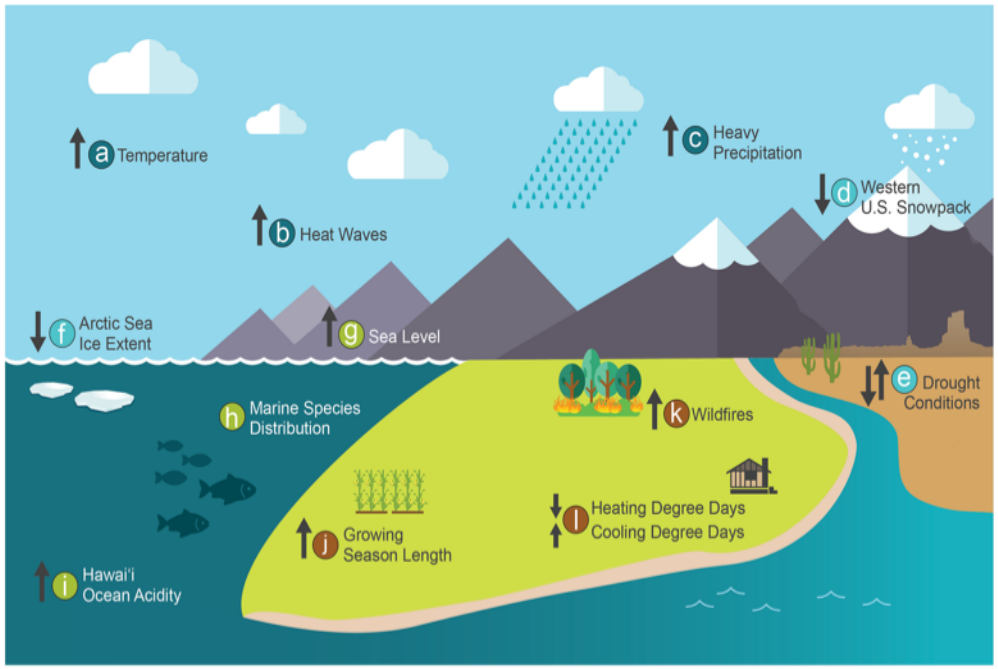
3. NCA4 Overview of Findings

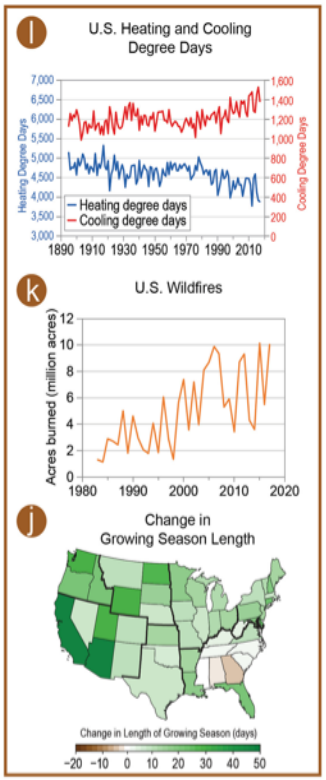
NCA4 Volume II in 5 Bullets

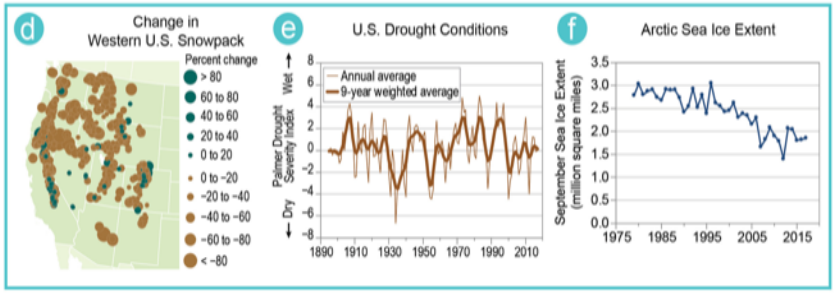
- Earth's climate is now changing faster than at any point in modern civilization.
- These changes are primarily the result of human activities, the evidence of which is overwhelming and continues to strengthen
- The impacts of climate change are already being felt across the country, and climate-related threats to Americans' physical, social, and economic well-being are rising
- Americans are responding in ways that can bolster resilience and improve livelihoods
- However, neither global efforts to mitigate the causes of climate change nor regional efforts to adapt to the impacts currently approach the scales needed to avoid substantial damages to the U.S. economy, environment, and human health and well-being over the coming decades

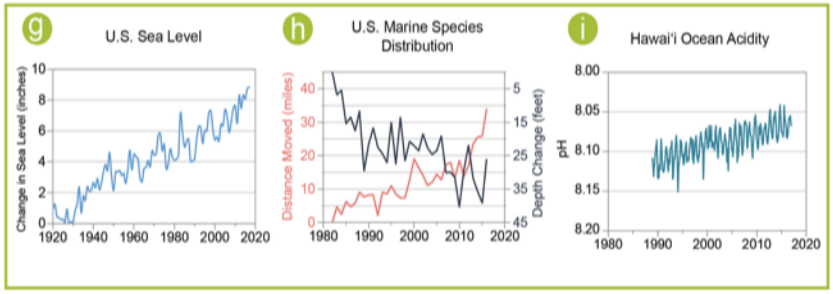
Observed Change



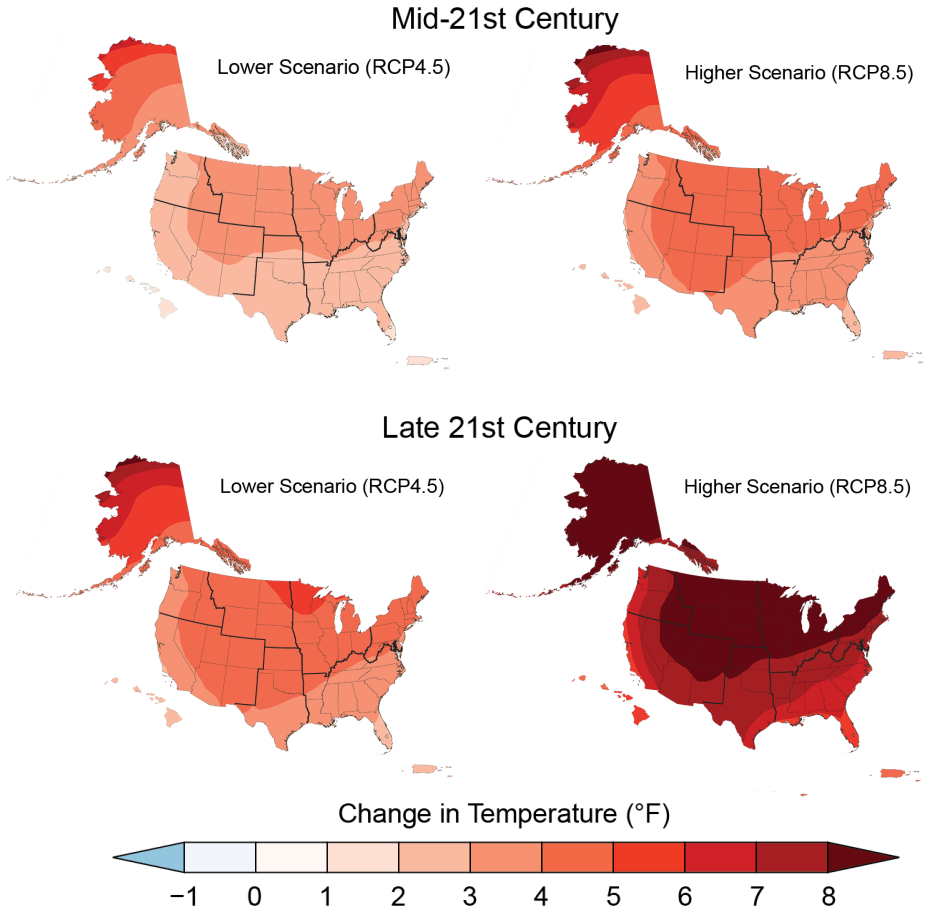


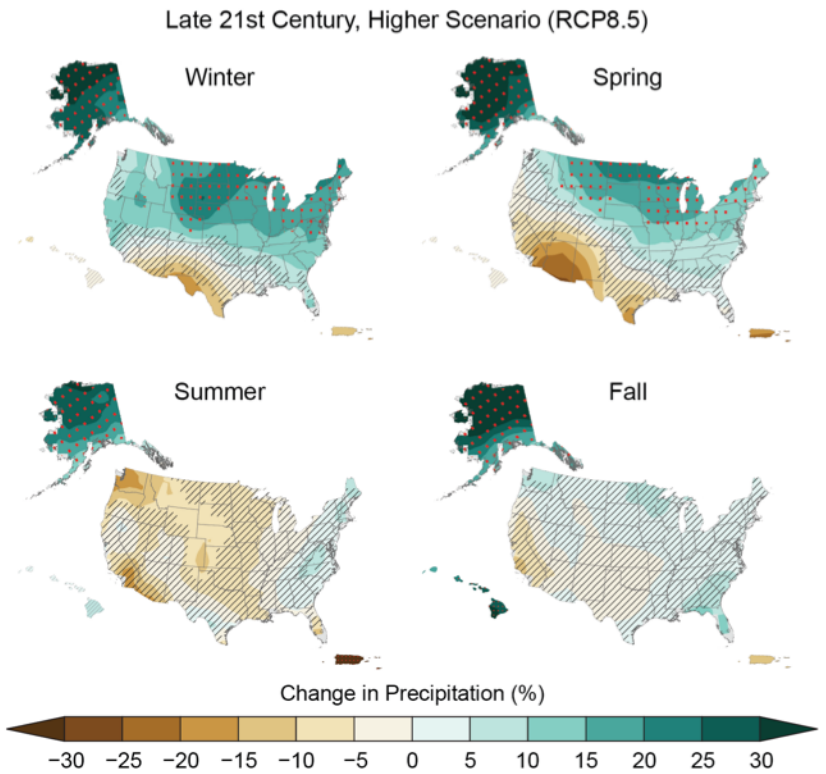






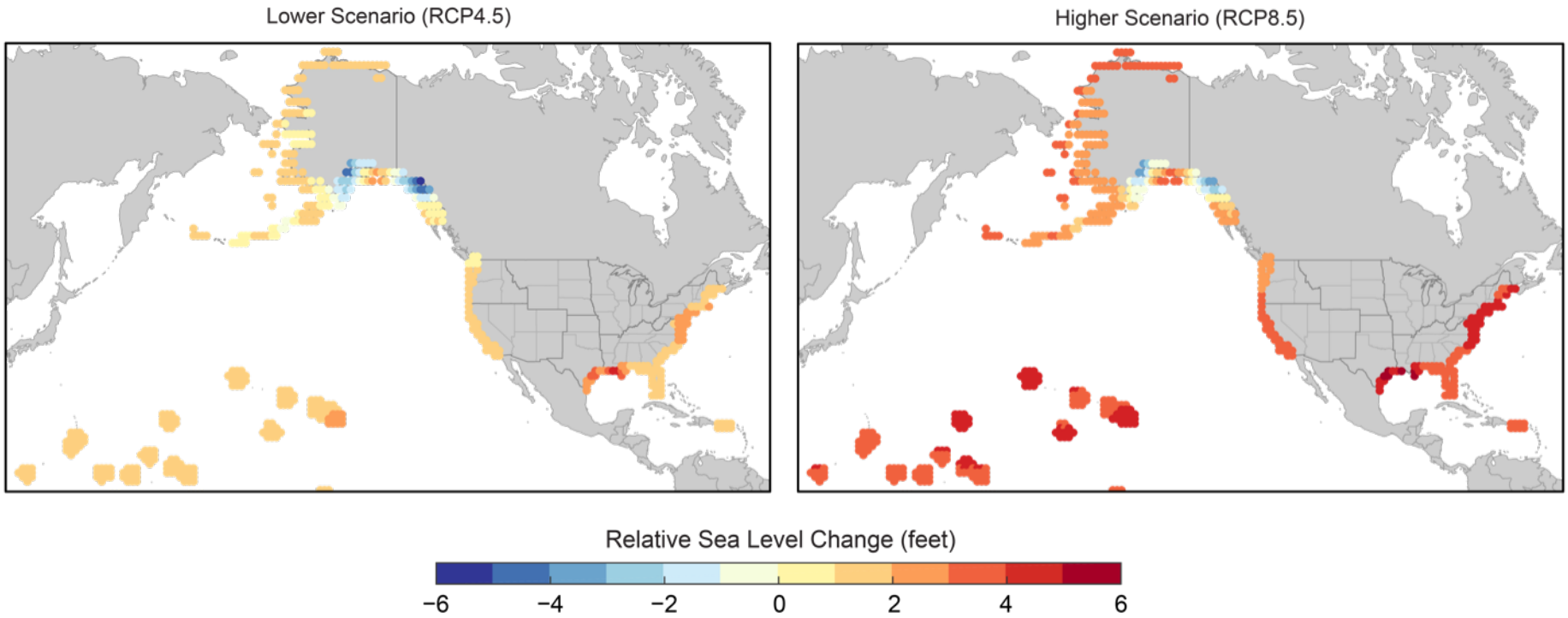
Projected Change:
Temperature & Precipitation





Areas with red dots show where projected changes are large compared to natural variations; areas that are hatched show where changes are small and relatively insignificant.

Projected Change:
Sea Level Rise (in 2100 vs. 2000)



Thermal Expansion + Land-Based Ice Melt + Vertical Land Movement + Ocean Circulation…

USGCRP Scenario Products: scenarios.globalchange.gov/sea-level-rise

NCA4 Vol. I (CSSR), Ch. 12: science2017.globalchange.gov/chapter/12/

Current & Future Risks: *Economy and Infrastructure*

- **Regional natural resource-based economies**
  - *Crops, Tourism, Fisheries, Timber*
- **Labor productivity in outdoor sectors**
  - *Agriculture, Construction*
- **Energy supply disruptions**
  - *Heat waves, Drought, Extreme events*
- **International considerations**
  - *Supply chains, Commodity prices*
- **Risks to airports, roads, ports, homes**
  - *(High-tide) Flooding, Heat-induced buckling, Wildfires*

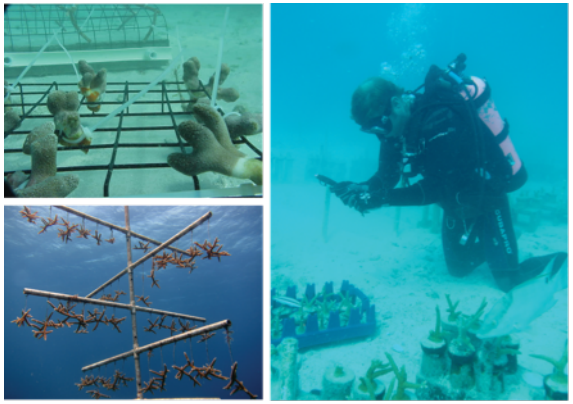
Increasing heavy rains are leading to more soil erosion and nutrient loss on midwestern cropland. Integrating strips of native prairie vegetation into row crops has been shown to reduce soil and nutrient loss while improving biodiversity.

Floodwaters from the Missouri River surround the Omaha Public Power District's Fort Calhoun Station, a nuclear power plant just north of Omaha, on June 20, 2011.

Current & Future Risks: *Natural Environment and Ecosystem Services*

- **Safe and reliable water supplies**
  - *Harmful algal blooms, Drought, Saltwater intrusion, Heavier downpours, Mountain snowpack*
- **Protection from flooding and erosion**
  - *Reef death, mangrove shifts*
- **Changes in recreation and subsistence activities**
  - *Species shifts, Wildfires, Pest & disease outbreaks, Ocean warming & acidification, Arctic sea ice declines*

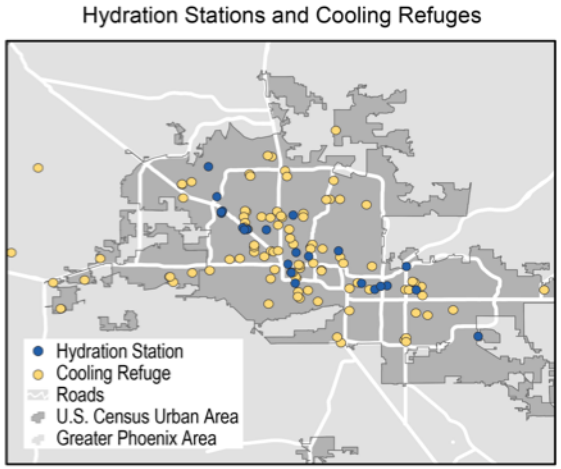
Razor clamming draws crowds on the coast of Washington State. This popular recreation activity is expected to decline due to ocean acidification, harmful algal blooms, warmer temperatures, and habitat degradation.



Examples of coral farming in the U.S. Caribbean and Florida demonstrate different types of structures used for growing fragments from branching corals. Coral farming is a strategy meant to improve the reef community and ecosystem function.

Current & Future Risks: *Human Health and Well-Being*

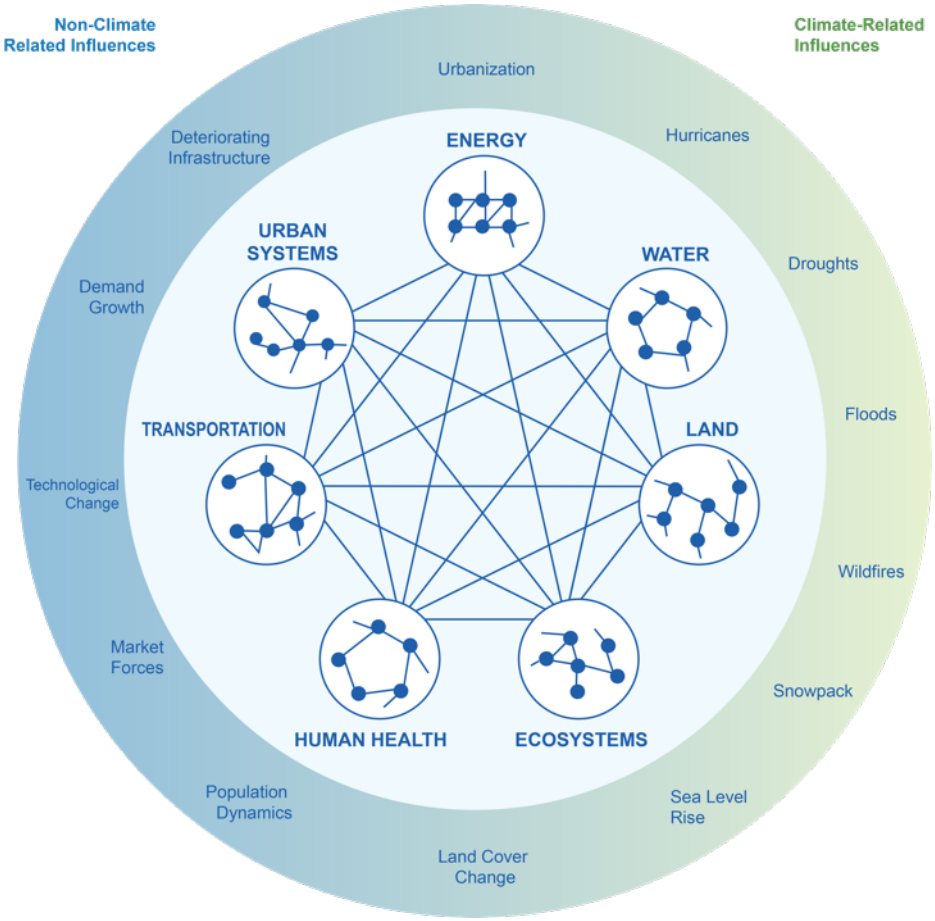
- **Higher temperatures**
  - *Heat exposure*
- **Changes in air quality**
  - *Asthma, Cardiovascular incidences*
- **Changes in extreme events**
  - *Exposures to waterborne, vectorborne, and foodborne diseases*
- **Food quality and availability**
  - *Micronutrient levels, drought / flood-induced supply disruptions*
- **Mental health**
  - *Forced dislocation or relocation, Loss of traditional practices*



Response measures for high heat events, such as hydration stations and cooling refuges in Phoenix, are expected to be needed at greater scales in the coming years if the adverse health effects of more frequent and severe heat waves are to be minimized.

State, local, and tribal leaders discuss the relocation of the tribal community of Isle de Jean Charles, LA, in response to severe land loss, sea level rise, and coastal flooding.

Interconnected Systems

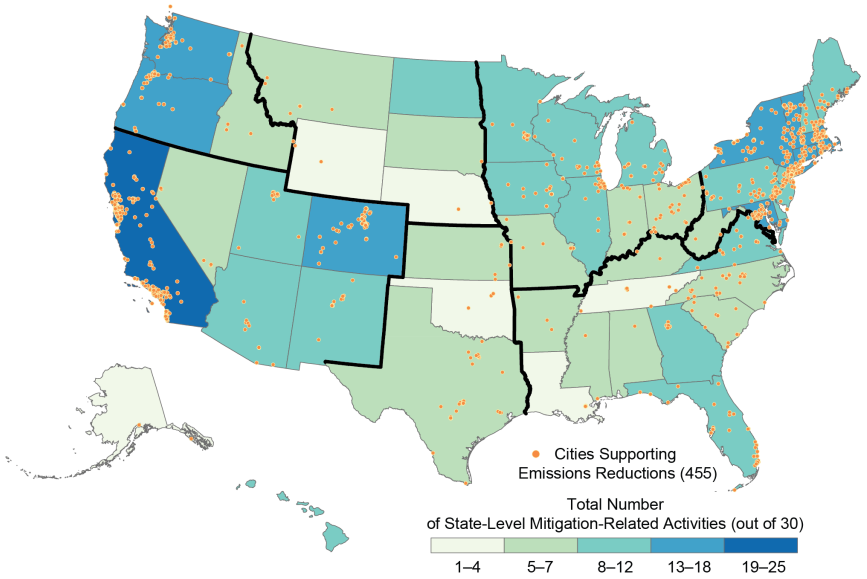


- Sectors are interacting and interdependent through physical, social, institutional, environmental, and economic linkages.
- These sectors and the interactions among them are affected by a range of climate-related and non-climate influences.

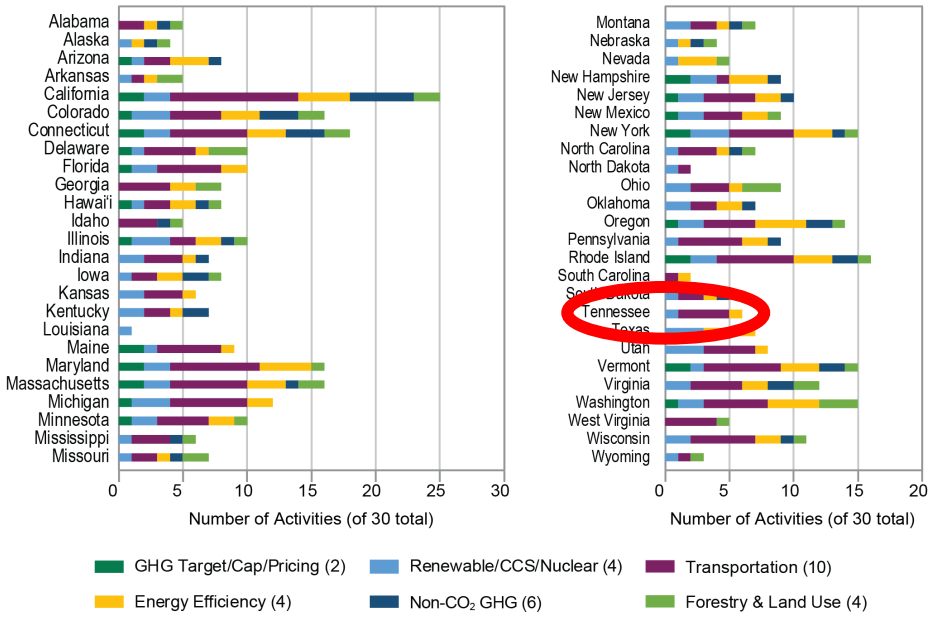
Example

1. Wildfire chars hillside
2. Extreme /heavy rainfall induces a landslide
3. Landslide cuts off roadways
4. Services (healthcare, emergency response, etc.) and economic activity are disrupted

Reducing Risks: Through Emissions Mitigation



Source: EPA



Source: America's Pledge 2017

- Sub-national mitigation-related activities are growing across all sectors of the economy
- The magnitude and rate of these activities (both domestically and abroad) do not yet approach the scale needed to avoid the worst impacts

Reducing Risks: Through Adaptation Action

- Adaptation is an ongoing, iterative process
- Since NCA3, the scale and scope of adaptation implementation has increased, including by federal, state, tribal, and local agencies
- It remains difficult to tally the extent of adaptation implementation since there are no common reporting systems, and many actions that reduce climate risk are not labeled as climate adaptation.
- Enough is known, however, to conclude that adaptation implementation is not uniform nor yet common across the U.S.

4. What does it mean for the Southeast?

What has already occurred?

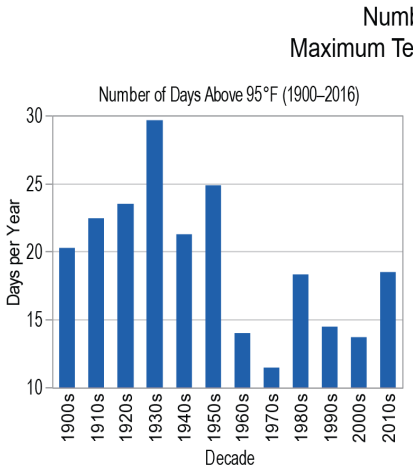
Temperature: SE little overall warming since 1900. High annual average temps in 20s and 30s (drought), cooler temps until 70s.

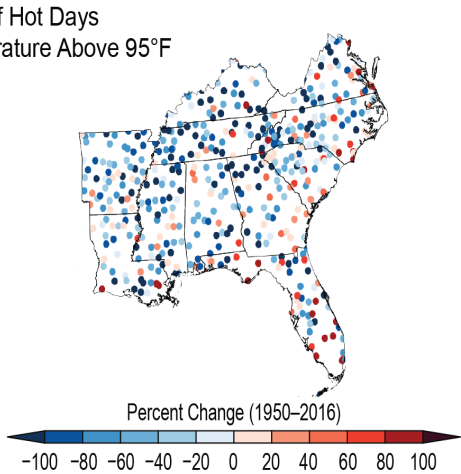
Since the 60s SE warming at a similar rate as the rest of the US

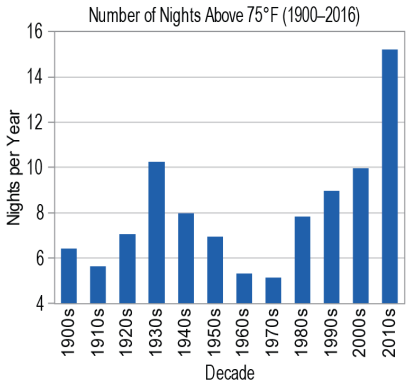
Days above 95°F lower since 1960 compared to pre-1960

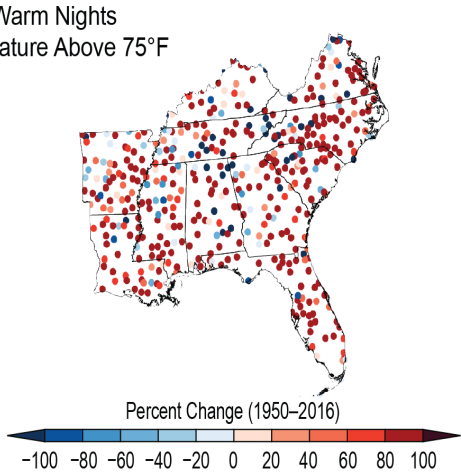
(61% of major SE cities- worsening heat waves – higher % than any other region)

2010s nights with minimum temps greater than 75°F nearly double the long-term average (1901-1960)





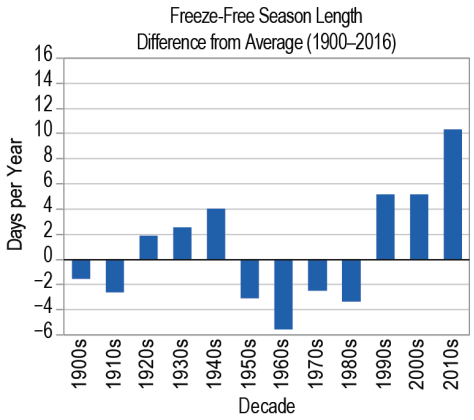


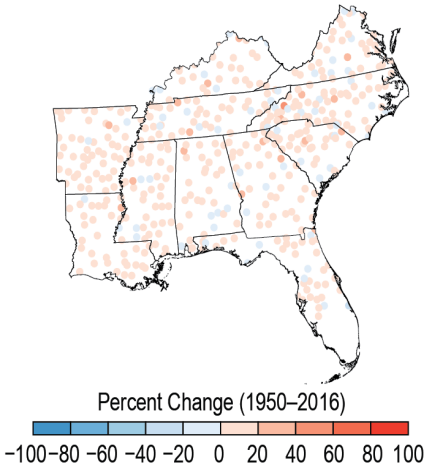


What has already occurred?

Freeze free season longer – most stations since 1980 – nearly 1.5 weeks greater than during any historical period

Historical Change in Freeze-Free Season Length

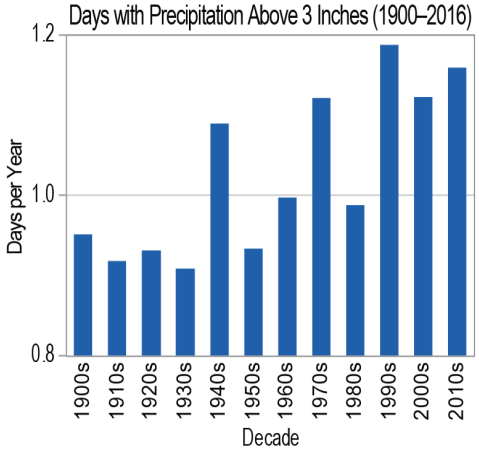


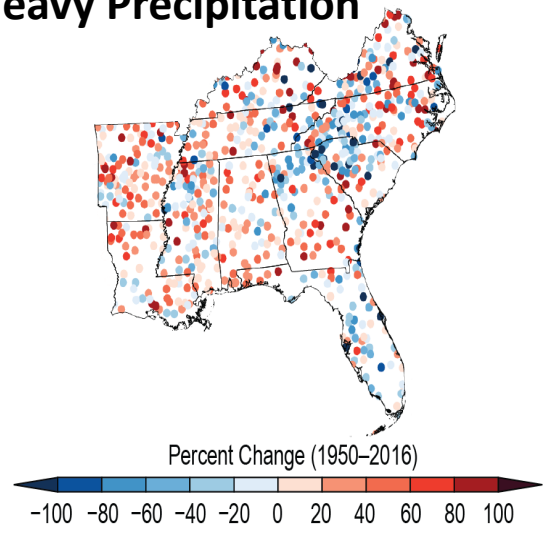


Precipitation: # of extreme rainfall events increasing

70% of precip record show up trends since 1950

Historical Change in Heavy Precipitation



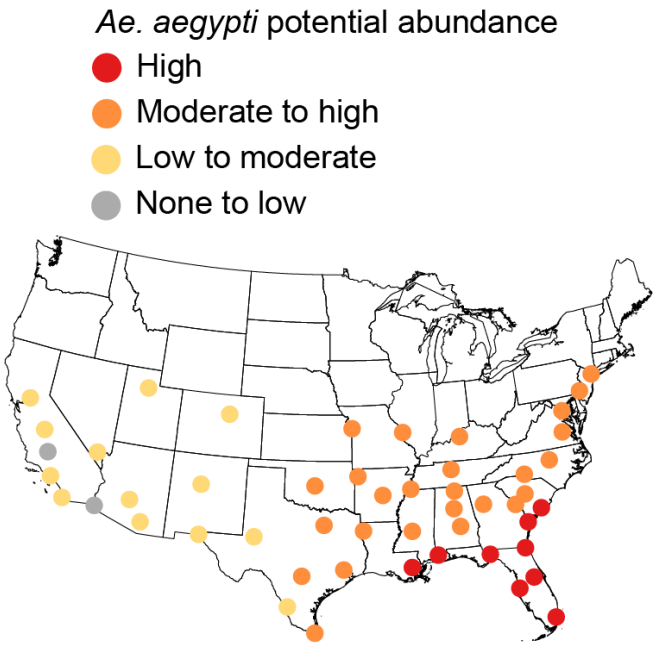


Model Simulations: Future

- **Increases in temperature and extreme precipitation** for both lower and higher scenarios (RCP4.5 and RCP8.5)
- After the middle of the century, projected increases are lower for the lower scenario (RCP4.5). Much larger changes are simulated by the late 21st century under the higher scenario (RCP8.5), which most closely tracks with our current consumption of fossil fuels.
- **Under the higher scenario, nighttime minimum temperatures above 75°F (some 100+ warm nights) and daytime maximum temperatures above 95°F become the summer norm** and nights above 80°F and days above 100°F, now relatively rare occurrences, become commonplace.
- **Cooling degree days** (need for air conditioning) **nearly double**, heating degree days (need for heating) decrease by over a third.
- The **freeze-free season lengthens by more than a month**, and the frequency of freezing temperatures decreases substantially

Key Message #1:
Urban Infrastructure & Health Risks

- **Rapid Population Shifts** – 12 of the 20 fastest growing metro areas in the U.S. are in the Southeast; a more urbanized region creates new vulnerabilities (and opportunities to adapt)
- **Increasing Heat** – Birmingham, New Orleans, and Raleigh are seeing some of the most extreme increases in high heat events in the U.S. – warm nights/urban heat islands – Adaptation action: cool roofs Louisville
- **Infrastructure** – Flooding and SLR affect roads, bridges (most vulnerable bridges by 2050), municipal water supplies, etc. Green structures Atlanta, coping studies SC
- **Vector-Borne Disease** – Changing climate conditions are conducive to expanded spatial extent and annual duration of certain vector-borne diseases
- **Air Quality –** Climate influence remains uncertain (clouds, rain, wind, etc.), already more stagnant air and aeroallergens likely to increase in urban areas

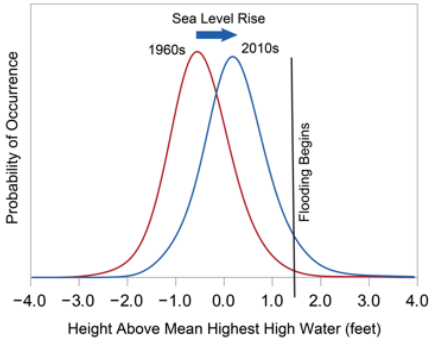


Current suitability for the *Aedes aegypti* mosquito in July. These mosquitoes can spread diseases, including dengue fever, chikungunya, and Zika fever. The Southeast is the region with the greatest potential mosquito activity. Warming temperatures have the potential to expand mosquito habitat and disease risk.

Key Message #2: *Increasing Flood Risks in Coastal & Low-Lying Regions (SLR and heavy rainfall flooding) Impacts to: transportation, housing, historic locations, residents, tourists – Charleston SLR strategy/plan*

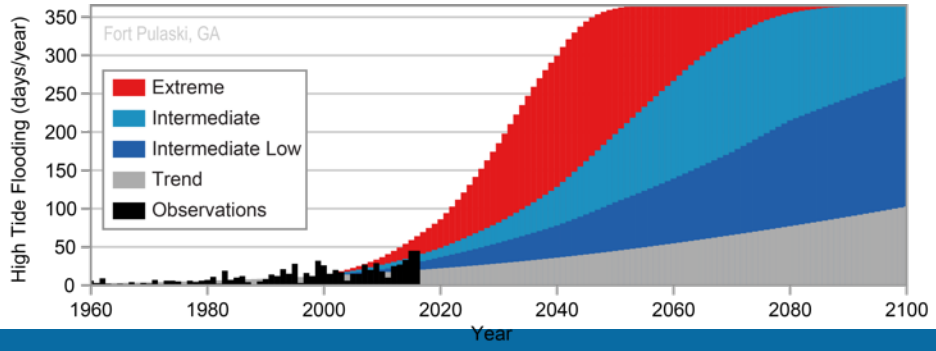
Observed

- NOAA tide gauges show as much as 1 to 3 feet of local relative SLR in the past 100 years (vs 8-9" globally)
- Annual occurrences of high-tide coastal flooding have increased 5- to 10-fold since the 1960s in several low-lying coastal cities in the Southeast
- Numerous 500 yr rainfall flood events since 2014



Projected

- By 2050, many Southeast cities are projected to experience 30+ days of high tide flooding regardless of scenario.
- More extreme coastal flood events are also projected to increase in frequency and duration.
- Increases in heavy rainfall events



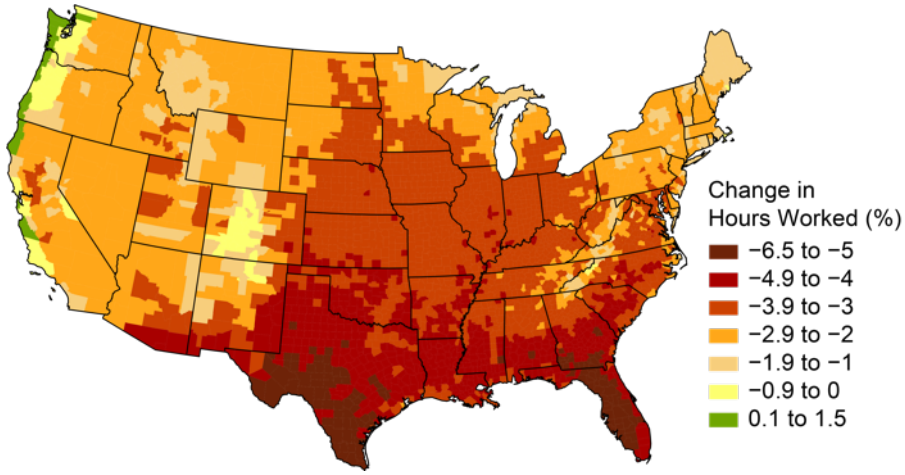
Key Message #3: *Natural Ecosystems Will Be Transformed*

- **Warming Winter Temperature Extremes** – Plant hardiness zones shift; mangrove → salt marsh; (with consequent changes in ecosystems; also agriculture; invasive spp.; increasing pests)
- **Changing Patterns of Fire** – SE region has the most prescribed fire in the U.S., a practice that may become less effective with climate change and urbanization; highest # of wild fires: DoD prescribed
- **Rising Sea Levels and Hurricanes** – Coastal inundation affects marine economies, port/historical infrastructure, and coastal development: LA coastal master plan
- **Drought and Extreme Rainfall** – Tree mortality and impacts on forest ecosystems that drive local economies (family farms)
- **Warming Ocean Temperatures** – shifts in fisheries and coral bleaching; strong hurricanes; SECOORA info

In Louisiana and parts of northern Florida, future coastal wetlands are expected to look and function more like the mangrove-dominated systems currently present in South Florida and the Caribbean.

Key Message #4: *Economic & Health Risks for Rural Communities*

- **Diverse Rural Regions** – Communities centered around energy production, manufacturing, agriculture, forestry, and tourism face unique risks
- **Risks to Agriculture & Forestry** – Freeze-free days, invasive species, drought, wildfire, extreme heat and precipitation Adaptation- change crops and varieties
- **Heat, Health, and Livelihoods** – Outdoor jobs (construction, agriculture) and recreation (hunting, fishing)
- **Compounding Stresses and Constraints to Adaptation** – Poverty, low literacy, and limited capacity to respond can exacerbate impacts and inhibit resilience



Estimated % change in hours worked in 2090 (vs 2003-07) under a higher warming scenario (RCP8.5). Projections indicate **an annual average of 570 million labor hours lost per year in the Southeast by 2090** in high-risk industries (i.e., agriculture, forestry, and fishing; hunting, mining, and construction; manufacturing, transportation, and utilities).

Acknowledgements

- David Reidmiller, USGCRP for the original slide deck
- All authors and contributors to the NCA process

THANK YOU!

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