



Key Message 1

Red mangrove in Titusville, Florida

Urban Infrastructure and Health Risks

Many southeastern cities are particularly vulnerable to climate change compared to cities in other regions, with expected impacts to infrastructure and human health. The vibrancy and viability of these metropolitan areas, including the people and critical regional resources located in them, are increasingly at risk due to heat, flooding, and vector-borne disease brought about by a changing climate. Many of these urban areas are rapidly growing and offer opportunities to adopt effective adaptation efforts to prevent future negative impacts of climate change.

Key Message 2

Increasing Flood Risks in Coastal and Low-Lying Regions

The Southeast's coastal plain and inland low-lying regions support a rapidly growing population, a tourism economy, critical industries, and important cultural resources that are highly vulnerable to climate change impacts. The combined effects of changing extreme rainfall events and sea level rise are already increasing flood frequencies, which impacts property values and infrastructure viability, particularly in coastal cities. Without significant adaptation measures, these regions are projected to experience daily high tide flooding by the end of the century.

Key Message 3

Natural Ecosystems Will Be Transformed

The Southeast's diverse natural systems, which provide many benefits to society, will be transformed by climate change. Changing winter temperature extremes, wildfire patterns, sea levels, hurricanes, floods, droughts, and warming ocean temperatures are expected to redistribute species and greatly modify ecosystems. As a result, the ecological resources that people depend on for livelihood, protection, and well-being are increasingly at risk, and future generations can expect to experience and interact with natural systems that are much different than those that we see today.

Key Message 4

Economic and Health Risks for Rural Communities

Rural communities are integral to the Southeast's cultural heritage and to the strong agricultural and forest products industries across the region. More frequent extreme heat episodes and changing seasonal climates are projected to increase exposure-linked health impacts and economic vulnerabilities in the agricultural, timber, and manufacturing sectors. By the end of the century, over one-half billion labor hours could be lost from extreme heat-related impacts. Such changes would negatively impact the region's labor-intensive agricultural industry and compound existing social stresses in rural areas related to limited local community capabilities and associated with rural demography, occupations, earnings, literacy, and poverty incidence. Reduction of existing stresses can increase resilience.

Executive Summary



The Southeast includes vast expanses of coastal and inland low-lying areas, the southern portion of the Appalachian Mountains, numerous high-growth metropolitan areas, and large rural expanses. These

beaches and bayous, fields and forests, and cities and small towns are all at risk from a changing climate. While some climate change impacts, such as sea level rise and extreme downpours, are being acutely felt now, others, like increasing exposure to dangerous high

temperatures, humidity, and new local diseases, are expected to become more significant in the coming decades. While all regional residents and communities are potentially at risk for some impacts, some communities or populations are at greater risk due to their locations, services available to them, and economic situations.

Observed warming since the mid-20th century has been uneven in the Southeast region, with average daily minimum temperatures increasing three times faster than average daily maximum temperatures. The number of extreme rainfall events is increasing. Climate model simulations of future conditions project increases in both temperature and extreme precipitation.

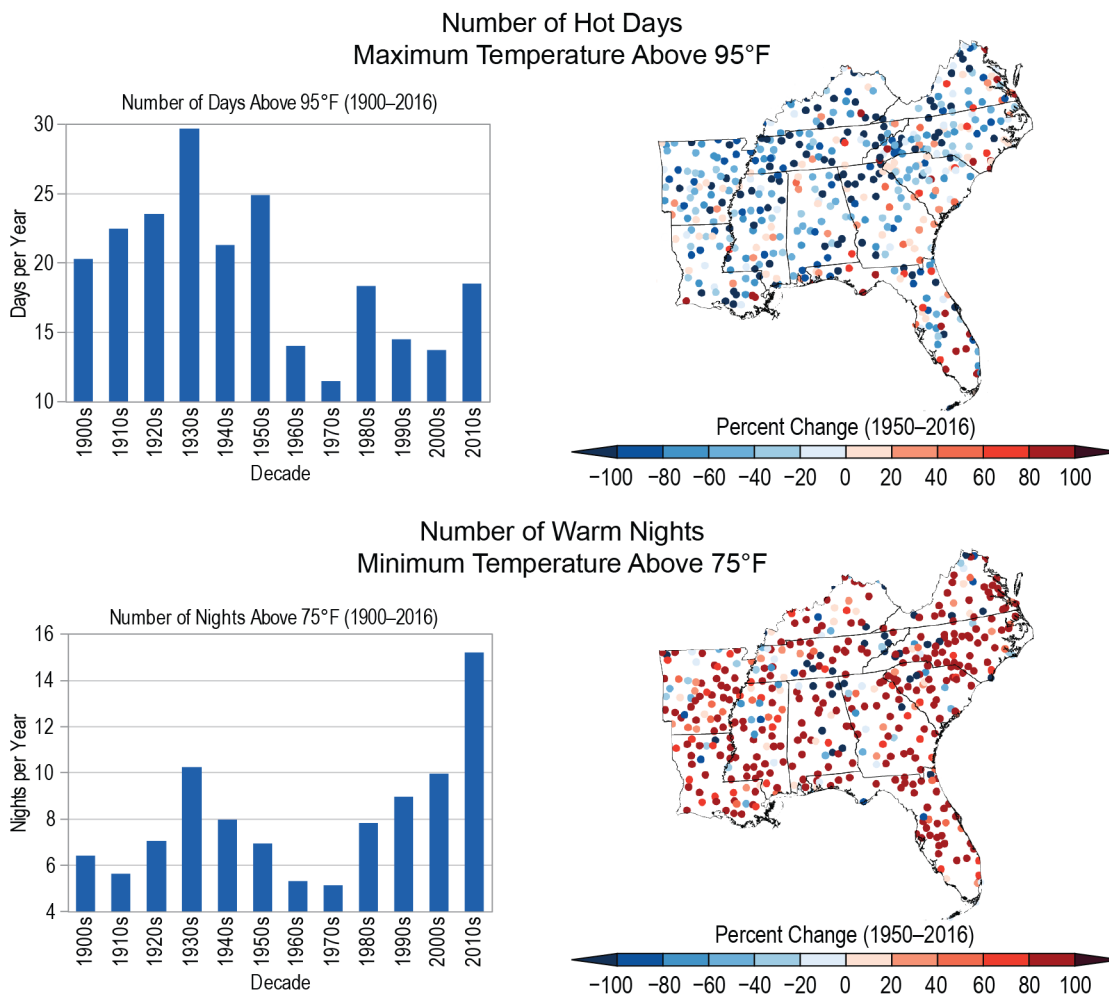
Trends towards a more urbanized and denser Southeast are expected to continue, creating new climate vulnerabilities. Cities across the Southeast are experiencing more and longer summer heat waves. Vector-borne diseases pose a greater risk in cities than in rural areas because of higher population densities and other human factors, and the major urban centers in the Southeast are already impacted by poor air quality during warmer months. Increasing precipitation and extreme weather events will likely impact roads, freight rail, and passenger rail, which will likely have cascading effects across the region. Infrastructure related to drinking water and wastewater treatment also has the potential to be compromised by climate-related events. Increases in extreme rainfall events and high tide coastal floods due to future climate change will impact the quality of life of permanent residents as well as tourists visiting the low-lying and coastal regions of the Southeast. Sea level rise is contributing to increased coastal flooding in the Southeast, and high tide flooding already poses daily risks to businesses, neighborhoods, infrastructure, transportation, and ecosystems in the region.^{1,2} There have been numerous instances of intense rainfall events that have had devastating impacts on inland communities in recent years.

The ecological resources that people depend on for livelihoods, protection, and well-being are increasingly at risk from the impacts of climate change. Sea level rise will result in the rapid conversion of coastal, terrestrial, and freshwater ecosystems to tidal saline habitats. Reductions in the frequency and intensity of cold winter temperature extremes are already allowing tropical and subtropical species to

move northward and replace more temperate species. Warmer winter temperatures are also expected to facilitate the northward movement of problematic invasive species, which could transform natural systems north of their current distribution. In the future, rising temperatures and increases in the duration and intensity of drought are expected to increase wildfire occurrence and also reduce the effectiveness of prescribed fire practices.^{3,4,5,6}

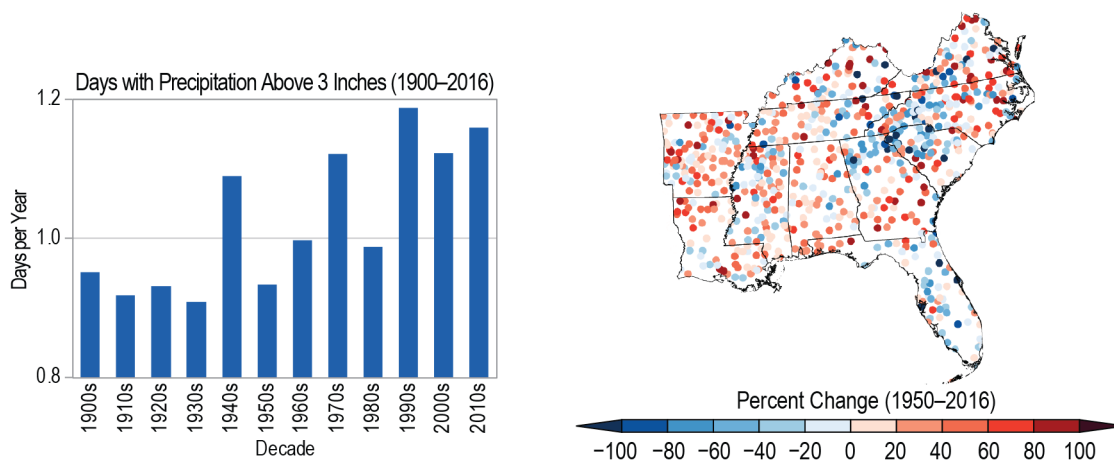
Many in rural communities are maintaining connections to traditional livelihoods and relying on natural resources that are inherently vulnerable to climate changes. Climate trends and possible climate futures show patterns that are already impacting—and are projected to further impact—rural sectors, from agriculture and forestry to human health and labor productivity. Future temperature increases are projected to pose challenges to human health. Increases in temperatures, water stress, freeze-free days, drought, and wildfire risks, together with changing conditions for invasive species and the movement of diseases, create a number of potential risks for existing agricultural systems.⁷ Rural communities tend to be more vulnerable to these changes due to factors such as demography, occupations, earnings, literacy, and poverty incidence.^{8,9,10} In fact, a recent economic study using a higher scenario (RCP8.5)¹¹ suggests that the southern and midwestern populations are likely to suffer the largest losses from future climate changes in the United States. Climate change tends to compound existing vulnerabilities and exacerbate existing inequities. Already poor regions, including those found in the Southeast, are expected to continue incurring greater losses than elsewhere in the United States.

Historical Changes in Hot Days and Warm Nights



Sixty-one percent of major Southeast cities are exhibiting some aspects of worsening heat waves, which is a higher percentage than any other region of the country.¹² Hot days and warm nights together impact human comfort and health and result in the need for increased cooling efforts. Agriculture is also impacted by a lack of nighttime cooling. Variability and change in (top) the annual number of hot days and (bottom) warm nights are shown. The bar charts show averages over the region by decade for 1900–2016, while the maps show the trends for 1950–2016 for individual weather stations. Average summer temperatures during the most recent 10 years have been the warmest on record, with very large increases in nighttime temperatures and more modest increases in daytime temperatures, as indicated by contrasting changes in hot days and warm nights. (top left) The annual number of hot days (maximum temperature above 95°F) has been lower since 1960 than the average during the first half of the 20th century; (top right) trends in hot days since 1950 are generally downward except along the south Atlantic coast and in Florida due to high numbers during the 1950s but have been slightly upward since 1960, following a gradual increase in average daytime maximum temperatures during that time. (bottom left) Conversely, the number of warm nights (minimum temperature above 75°F) has doubled on average compared to the first half of the 20th century and (bottom right) locally has increased at most stations. *From Figure 19.1 (Sources: NOAA NCEI and CICS-NC).*

Historical Change in Heavy Precipitation



The figure shows variability and change in (left) the annual number of days with precipitation greater than 3 inches (1900–2016) averaged over the Southeast by decade and (right) individual station trends (1950–2016). The number of days with heavy precipitation has increased at most stations, particularly since the 1980s. *From Figure 19.3 (Sources: NOAA NCEI and CICS-NC)*