United States Global Change Research Program

Regional Climate Trends and Scenarios: The Southeast U.S.

This document provides a brief overview of the observed changes in the climate of the Southeast[1] United States as well as possible future climate conditions as simulated by climate models, based on two scenarios of future greenhouse gas emissions. It summarizes the detailed findings presented in one of nine regional and national climate descriptions created by the National Oceanic and Atmospheric Administration (NOAA) in support of the National Climate Assessment (NCA). It is also hoped that these findings are of direct benefit to decision makers and communities seeking to develop adaptation plans. The full Regional Climate Trends and Scenarios report is available at http://scenarios.globalchange.gov/regions/southeast-and-caribbean, and should be cited as:

Kunkel, K.E, L.E. Stevens, S.E. Stevens, L. Sun, E. Janssen, D. Wuebbles, C.E. Konrad II, C.M. Fuhrman, B.D. Keim, M.C. Kruk, A. Billet, H. Needham, M. Schafer, and J.G. Dobson, 2013: Regional Climate Trends and Scenarios for the U.S. National Climate Assessment. Part 2. Climate of the Southeast U.S., NOAA Technical Report NESDIS 142-2, 94 pp.

Observed Regional Climate Trends

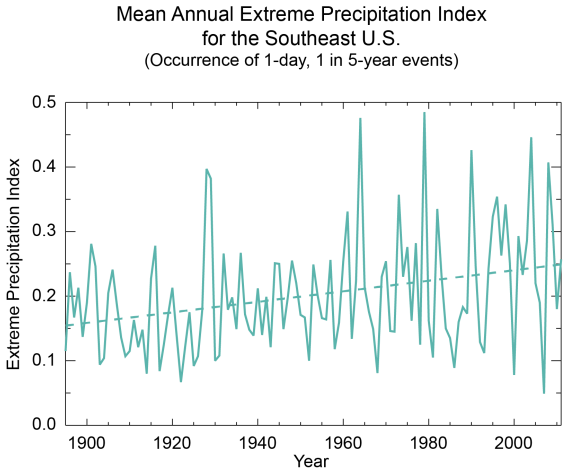
This section summarizes the observed climate trends of the Southeast U.S., focusing mainly on temperature and precipitation, as well as other climate features, including heat waves, extreme precipitation, and tropical cyclones. These historical data are primarily from the National Weather Service's Cooperative Observer Network (COOP), which has been in operation since 1895.

Temperature

- The Southeast is one of the few regions globally not to exhibit an overall warming trend in surface temperature over the 20th century. This "warming hole" also includes parts of the Great Plains and Midwest regions in the summer.
- In recent years (since the 1970s), however, temperatures have steadily increased across the region, with the most recent decade (2001-2010) being the warmest on record.

Precipitation

- Along the northern Gulf Coast, precipitation has increased annually and in summer. For the Southeast region as a whole, long-term trends in precipitation are statistically significant (at the 95% confidence level) for fall, which shows an upward trend, and summer, which shows a slight downward trend.



Extremes

- The number of extreme hot days in the Southeast has tended to decrease or remain the same, while the number of warm summer nights has increased. The number of extreme cold days has decreased across the region.
- Year-to-year variability in precipitation has increased over the last several decades across much of the region, with more exceptionally wet and dry summers. The frequency of extreme precipitation events has been increasing across the Southeast region, particularly over the past two decades (see figure).

Additional Climate Features

- The decadal frequencies of both hurricane and major hurricane (category 3 and greater) landfalls have declined slightly over the last 100 years; however, there is large decade-to-decade variability.
- Sea levels across the extensive coastline of the Southeast have slowly risen over the 20th century.

[1] Kentucky, Virginia, Tennessee, North Carolina, South Carolina, Arkansas, Louisiana, Mississippi, Alabama, Georgia, and Florida.

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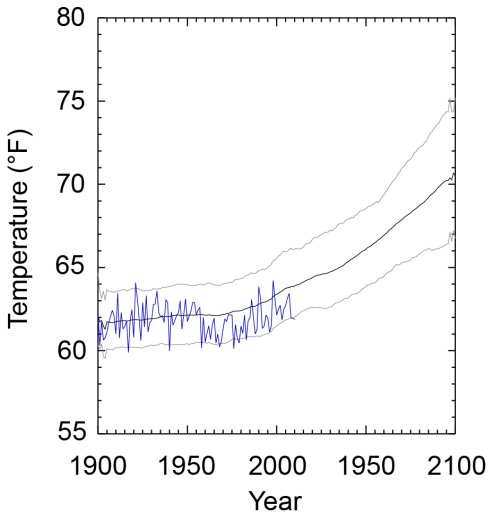
Future Regional Climate Scenarios

This section describes simulated future climate conditions based on climate models using two emissions scenarios generated by the Intergovernmental Panel on Climate Change: the high (A2) scenario, in which emissions of heat-trapping gases continue to rise, and the low (B1) scenario, where emissions peak in the mid-21st century and decline substantially thereafter. These scenarios were chosen because they incorporate much of the range of potential future human impacts on the climate system, and are used in a large body of literature. These simulations use data from the WCRP's Coupled Model Intercomparison Project 3 (CMIP3), as well as from statistically- and dynamically-downscaled data sets, including North American Regional Climate Change Assessment Program (NARCCAP) data (for A2, mid-century only).

Temperature

- The CMIP3 models indicate statistically significant annual mean temperature increases across the Southeast (for all future time periods and both emissions scenarios). Spatial variations are relatively small, with the greatest warming simulated to occur in the northwest part of the region.
- There is uncertainty within the range of model-simulated temperature changes, but for each model simulation, the warming is unequivocal and large compared to historical temperature variations.
- The lack of mid-20th century warming in the Southeast is not simulated by the models. However, 21st century simulations of temperature indicate that future warming will be much larger than the observed values for the 20th century (see figure).
- NARCCAP model simulations indicate increases throughout the Southeast in the number of hot days (maximum temperature of more than 95°F). Increases in the length of the freeze-free season are in the range of 20 to 30 days by mid-century across most of the region.
- The number of days with minimum temperatures below 10°F (varying from zero in Florida to about 10 in the far north in the present-day climate) are simulated by the NARCCAP models to become near zero everywhere by mid-century.

Mean Annual Temperature from Observations and CMIP3 Model Smulations (A2 Scenario) for the Southeast U.S.



Precipitation

- Annual mean precipitation in the Southeast is simulated by both the CMIP3 and NARCCAP models to generally increase, with the greatest increases indicated for winter. Decreases are also simulated for some areas and seasons, and are greatest in summer (see figure). For the most part, any simulated changes in precipitation are either not statistically significant or the models are not in agreement on the sign of the changes.
- The range of model-simulated precipitation changes is considerably larger than the multi-model mean change for both the high and low emissions scenarios, meaning that there is great uncertainty associated with precipitation changes in these scenarios.
- The NARCCAP models simulate increases in the number of wet days (precipitation exceeding 1 inch) throughout the Southeast, with the greatest increases simulated across the Appalachian Mountains.

Simulated Change in Seasonal Mean Precipitation
(A2 Scenario, 2041-2070 minus 1980-2000)