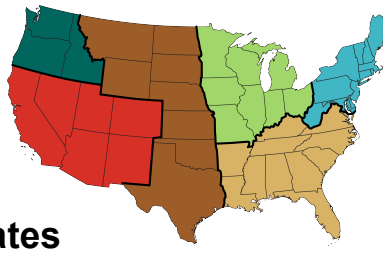
United States Global Change Research Program



Regional Climate Trends and Scenarios: Contiguous United States

This document provides a brief overview of the observed changes in the climate of the contiguous 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/national, and should be cited as:

Kunkel, K.E, L.E. Stevens, S.E. Stevens, L. Sun, E. Janssen, D. Wuebbles, and J.G. Dobson, 2013: Regional Climate Trends and Scenarios for the U.S. National Climate Assessment. Part 9. Climate of the Contiguous United States, NOAA Technical Report NESDIS 142-9, 77 pp.

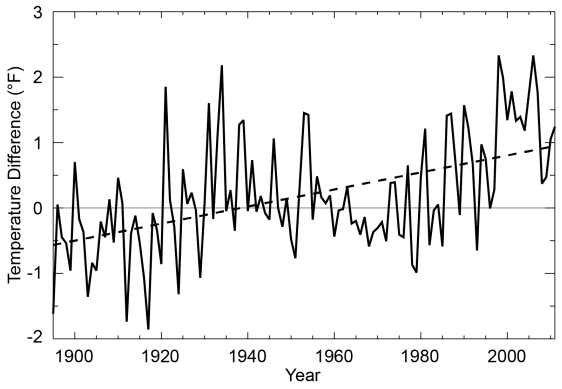
Observed Regional Climate Trends

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

Temperature

- Annual temperatures for the contiguous U.S. increased rapidly in the early part of the 20th century, then decreased slightly during the middle of the century. Since about 1980, temperatures have been increasing (see figure). Since 1895, the observed warming trend is statistically significant (at the 95% confidence level) for all seasons.
- Warming has been greatest in the west and north, although the southeast has not experienced any overall warming (one of the few regions globally not to exhibit a 20th century warming trend).
- The length of the freeze-freeze season has increased by about two weeks since 1900. The increase has been greater in the western U.S. than in the eastern U.S.

Difference in Mean Annual Temperature for the Contiguous U.S.
(Deviations from the 1901-1960 Average)



Precipitation

- For the contiguous U.S. as a whole there have been statistically significant upward trends in annual and fall precipitation. Trends in the other seasons are not statistically significant.
- Trends for individual regions are not statistically significant for most seasons, with the exceptions of upward trends for fall and annual precipitation in the Northeast, fall in the Southeast, summer and annual in the Midwest, and annual in the Great Plains, and a downward trend for summer in the Southeast.

Extremes

- The number of heat waves has tended to increase since a minimum in the 1960s, with the 2001-2011 decade having the second highest number of extreme hot spells, behind the 1930s. The number of cold waves has decreased in recent years, with the 2000s having the smallest number of any decade since 1895.
- A national upward trend in the number of extreme precipitation events is highly statistically significant. The 2000s experienced the greatest number of such extremes. Regionally, this upward trend is prominent in the eastern regions, while far western regions have not experienced an overall trend.

Additional Climate Features

- Lakes with long-term ice cover records show sizeable decreases in ice cover area and duration.

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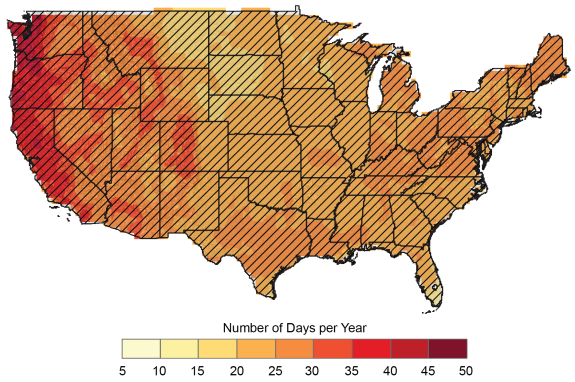
Future Regional Climate Scenarios

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

- CMIP3 models simulate statistically significant increases in annual mean temperature across the contiguous U.S. for all future time periods and both emissions scenarios. Both the CMIP3 and NARCCAP simulations indicate relatively small spatial variations.
- 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.
- NARCCAP models simulate increases throughout the contiguous U.S. in the number of hot days (maximum temperature of more than 95°F). The number of consecutive 95°F days is simulated to increase the most in south-central and southwest areas.
- The length of the freeze-free season is simulated to increase by 20 to 30 days across most of the U.S., and up to 50 days in portions of the far west (see figure).

Simulated Change in Annual Mean Freeze-Free Season Length
(A2 Scenario, 2041-2070 minus 1980-2000)

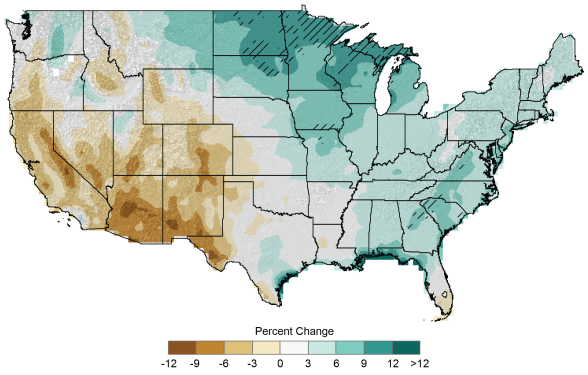


- Cooling degree days are simulated to increase throughout the country, with the greatest increases in the Southeast and Southwest U.S. Heating degree days are simulated to decrease everywhere, with the largest decreases in high elevation areas.

Precipitation

- Annual mean precipitation is simulated by both the CMIP3 and NARCCAP models to generally increase in the north and decrease in the Southwest U.S. (see figure). Under the A2 scenario, changes are statistically significant in far northern and southwestern areas by the end of the 21st century. Changes in the central part of the country are either not statistically significant or the models do not agree 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.

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



- NARCCAP simulations for changes in the number of wet days (precipitation exceeding 1 inch) are not statistically significant over most of the country. Simulations for the number of consecutive dry days (precipitation less than 0.1 inches) show statistically significant increases for the Southwest U.S. In most other areas, the changes are not statistically significant.