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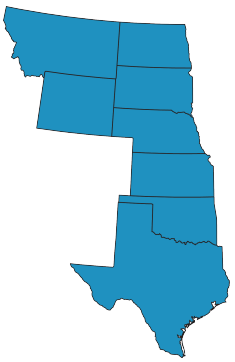


Regional Climate Trends and Scenarios: The U.S. Great Plains

This document provides a brief overview of the observed changes in the climate of the Great Plains region[1] of the 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/great-plains, and should be cited as:

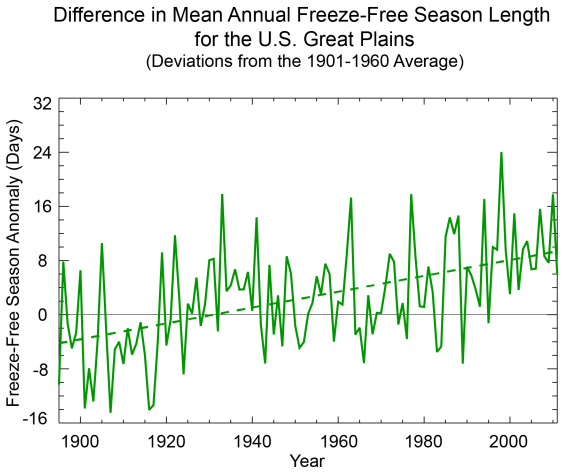
Kunkel, K.E, L.E. Stevens, S.E. Stevens, L. Sun, E. Janssen, D. Wuebbles, M.C. Kruk, D.P. Thomas, M. Shulski, N. Umphlett, K. Hubbard, K. Robbins, L. Romolo, A. Akyuz, T. Pathak, T. Bergantino, and J.G. Dobson, 2013: Regional Climate Trends and Scenarios for the U.S. National Climate Assessment. Part 4. Climate of the U.S. Great Plains, NOAA Technical Report NESDIS 142-4, 82 pp.

Observed Regional Climate Trends

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

Temperature

- Temperatures in the Great Plains have generally been above the 1901-1960 average for the last 20 years, both annually and seasonally. Eight of the ten summers from 2002 through 2011 were above the 1901-1960 average. Northern states in the region have experienced the greatest increases in their long-term average temperatures.
- Freeze-free season length has been generally increasing since the early 20th century (see figure), with the trend over the entire time period (1895-2011) being statistically significant. The last occurrence of 32°F in the spring has been occurring earlier, and the first occurrence of 32°F in the fall has been happening later.



Precipitation

- Annual precipitation for the Great Plains was greater than normal during the last few years, except for 2011. However, 20th century trends in precipitation are not statistically significant (at the 95% confidence level) for any season.

Extremes

- Extreme cold and hot periods exhibit a large amount of year-to-year variability. The recent tendency toward fewer cold waves is more prominent in the northern Great Plains than in the south. Historical occurrences of heat waves are dominated by the severe heat of the 1930s.
- Since 1990, there have been several years with a very high frequency of extreme precipitation events, with the greatest overall value of single-day heavy downpours occurring in 2007.

[1] Montana, North Dakota, South Dakota, Wyoming, Nebraska, Kansas, Oklahoma, and Texas.

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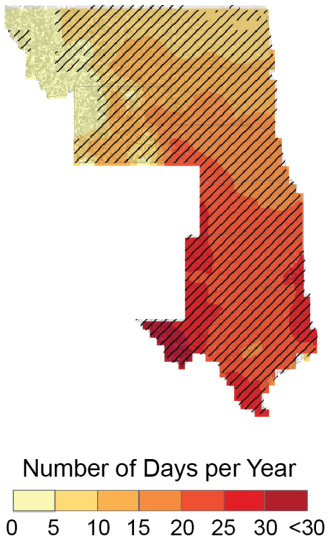
Future Regional Climate Scenarios

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

- Both the CMIP3 and NARCCAP simulations indicate annual mean temperature to increase throughout the Great Plains, with the greatest warming simulated for the northeastern portion of the region under the high emissions scenario. The CMIP3 models indicate that temperature increases across the region are statistically significant (at the 95% confidence level) for all future time periods and both emissions scenarios.
- 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 model simulations indicate increases throughout the region in the number of hot days (maximum temperature of more than 95°F). The largest increases are simulated to occur in southwest Texas (see figure).
- The freeze-free season is simulated by the NARCCAP models to become longer throughout the region, with increases mostly in the 20 to 30 day range.
- NARCCAP models simulate increases in cooling degree days throughout the region, with the greatest increases in the southeastern Great Plains. Heating degree days are simulated to decrease throughout the region, with the largest decreases occurring in high elevation areas of the northwest.

Simulated Change in the Annual Mean Number of Days Above 95°F
(A2 Scenario, 2041-2070 minus 1980-2000)



Precipitation

- CMIP3 models simulate southern parts of the region to have the largest decreases in annual mean precipitation, but northern areas to see increases. NARCCAP simulations indicate future increases in precipitation across most of the region in all seasons except summer (see figure). For the most part, these changes are either not statistically significant or the models do not agree on the sign of the change.
- 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.
- Nearly the entire region is simulated by the NARCCAP models to see increases in the number of wet days (precipitation exceeding 1 inch) and slight decreases for small areas in the far western portions of the Great Plains. However, these simulated changes are mostly not statistically significant.

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