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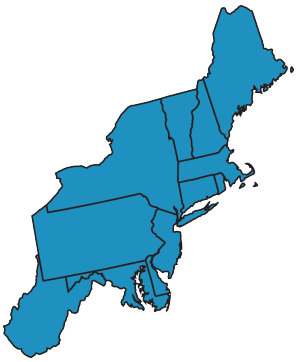


Regional Climate Trends and Scenarios: The Northeast U.S.

This document provides a brief overview of the observed changes in the climate of the Northeast[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 much more 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). The full Regional Climate Trends and Scenarios report is available at http://scenarios.globalchange.gov/regions/northeast, and should be cited as:

Kunkel, K.E, L.E. Stevens, S.E. Stevens, L. Sun, E. Janssen, D. Wuebbles, J. Rennells, A. DeGaetano, and J.G. Dobson, 2013: Regional Climate Trends and Scenarios for the U.S. National Climate Assessment. Part 1. Climate of the Northeast U.S., NOAA Technical Report NESDIS 142-1, 79 pp.

Observed Regional Climate Trends

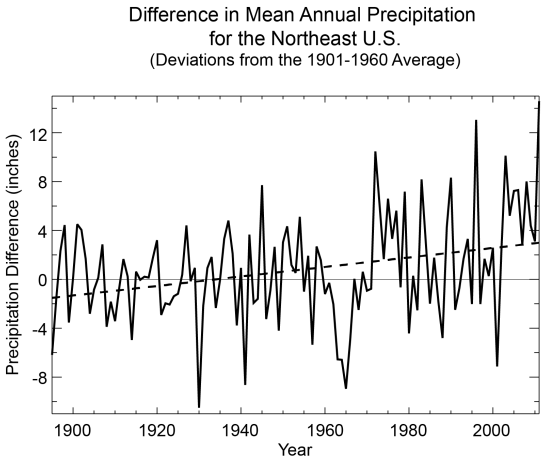
This section summarizes the observed climate trends of the Northeast U.S., primarily focusing on temperature and precipitation, as well as additional climate features, including heat waves, extreme precipitation, and sea level rise. These historical data are primarily from the National Weather Service's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

Temperature

- Temperatures across the Northeast have generally remained above the 1901-1960 average over the last 30 years. Warming has been more pronounced during the winter and spring seasons. Trends are upward and statistically significant (at the 95% confidence level) for each season, as well as for the year as a whole.
- Since the mid-1980s there has been a general increase in freeze-free season length for the region. The last occurrence of 32°F in the spring has been happening earlier and the first occurrence of 32°F in the fall has been happening later.

Precipitation

- Average annual precipitation shows a clear shift towards greater amounts and more variability since 1970 (see figure). Precipitation totals in the Northeast are increasing and trends are statistically significant for fall season and for the year as a whole. However, there is no overall trend for summer.



Extremes

- The number of cold waves in the Northeast was high early in the 20th century. However, since 1985, the frequency of cold spells has been below the long-term average. There is no overall trend in heat waves, although there have been a moderately high number of hot spells in recent years.
- There has been substantial decade-to-decade variability in the number of extreme precipitation events since about 1935. However, since 1996 the number of extreme events has been high.

Additional Climate Features

- Overall warming is further evidenced by later dates when ice coverage closes northeastern lakes to navigation, as well as by increases in lake surface water temperature and decreases in average snow depth.
- The rise in sea level along the Northeast coast has accelerated during the 20th century, rising by 1.2 inches per decade on average.

[1] Maine, New Hampshire, Vermont, Massachusetts, Rhode Island, Connecticut, New York, New Jersey, Pennsylvania, Delaware, Maryland, West Virginia, and Washington D.C.

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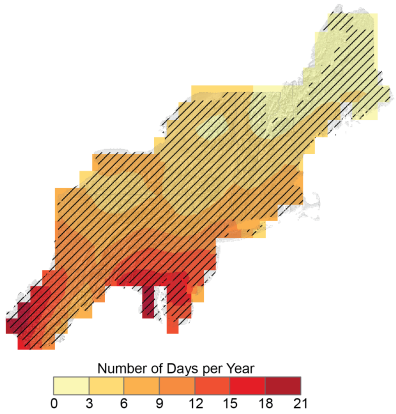
Future Regional Climate Scenarios

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 a statistically-significant increase in annual mean temperature (for all future time periods and both emissions scenarios), with little spatial variation across the Northeast 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.
- NARCCAP simulations indicate increases in the number of hot days (maximum temperature of more than 95°F) throughout the region (see figure), with the largest increases in southern and western areas.
- The number of days below freezing is simulated to decrease by 20 to 23 days across most of the region by the NARCCAP models.
- The freeze-free season is simulated by the NARCCAP models to lengthen across the region by mid-century, with increases in most areas of 3 to 4 weeks. Cooling degree days are simulated to increase throughout the region, with the largest increases occurring in southernmost areas. Heating degree days are simulated to decrease throughout the Northeast.

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



Precipitation

- CMIP3 models are mostly in agreement that annual mean precipitation will increase across the region under both emissions scenarios. Seasonal changes simulated by NARCCAP indicate an increase in precipitation for winter, spring, and fall, but a decrease for summer (see figure).
- 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.
- NARCCAP simulations indicate an increase in the number of wet days (precipitation exceeding 1 inch) throughout the Northeast, with the greatest increases occurring in parts of New York. These simulated increases are statistically significant in the most northern areas.
- The NARCCAP simulated change in the number of consecutive dry days (precipitation of less than 0.1 inches) is not statistically significant in any part of the region, with little change simulated over the majority of the region, and slight decreases indicated for southern areas.

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