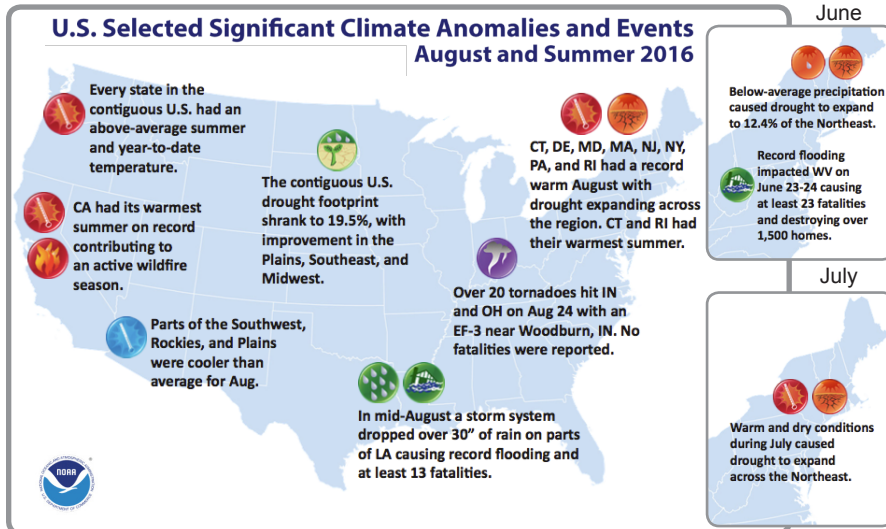


National - Significant Events for June–August 2016



Highlights for the East

Below-normal precipitation and above-normal temperatures led to drought conditions in parts of the region. In West Virginia and Maryland, extreme precipitation resulted in significant flash flooding. See Impacts section for details.

West Virginia saw six more tornadoes than average during summer, while the rest of the region saw a near to below-average number. The Carolinas and Virginia had one tornado, which has only occurred during four other summers since 1950. Regionwide, there were eight fatalities and more than 20 injuries due to lightning. New York's four fatalities in August equalled its lightning fatalities for all of 2006–2015. There were more than 20 damaging wind events and reports of hail up to 3 in. in diameter (tea cup size).

Numerous records were set during summer.

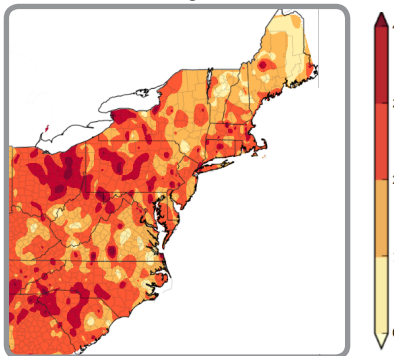
- Beckley, WV: wettest June
- Charleston, SC and Columbia, SC: warmest July and all-time warmest month
- Norfolk, VA: wettest July day on the 31st
- Eight sites: greatest number of 90°F days in either July or August
- Sixteen sites: warmest August
- Florence, SC: driest August
- Williamsport, PA and Bridgeport, CT: warmest summer
- Boston, MA: driest summer

The contiguous U.S. had its fifth warmest summer on record with an average temperature of 73.5°F, 2.1°F above the 20th century average. It was the warmest June on record with an average temperature of 71.8°F, 3.3°F above average, and the 14th warmest July on record with an average temperature of 75.3°F, 1.6°F above average. August's average temperature of 73.6°F was 1.5°F above average. Summer precipitation for the contiguous U.S. was 8.92 inches, 0.60 inches above the 20th century average. The U.S. precipitation total for June was 2.46 inches, 0.47 inches below average, making it the 14th driest June on record. July precipitation was 2.87 inches, 0.09 inches above average. It was the second wettest August on record with 3.47 inches of precipitation, 0.85 inches above average.

Regional - Climate Overview for June–August 2016

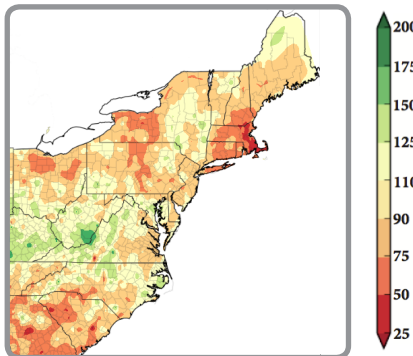
Temperature and Precipitation Anomalies

Departure from Normal Temperature (°F)
June 1–August 31, 2016



The Eastern Region had its second warmest summer on record at 2.2°F above normal. Connecticut and Rhode Island were record warm, with the other fourteen states ranking this summer among their top 15 warmest. June was 0.8°F warmer than normal, with two states ranking this June among their top 20 warmest. The region had its eleventh warmest July at 2.2°F above normal. Twelve states ranked this July among their top 20 warmest. August was record warm at 3.6°F above normal. Eight states had their warmest August on record, with the other states ranking it among their top 10 warmest.

Percent of Normal Precipitation (%)
June 1–August 31, 2016

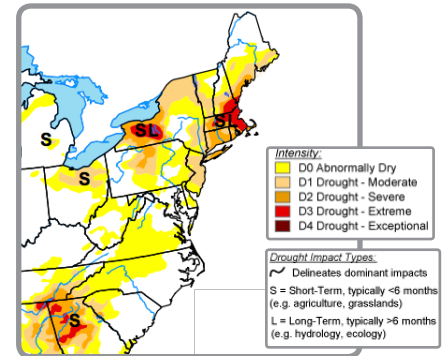


The Eastern Region received 93% of its normal summer precipitation. Twelve states were drier than normal, with four ranking this summer among their top 20 driest. The region received 89% of normal June precipitation, with four states having a top 20 driest June. Conversely, West Virginia had its thirteenth wettest June. The region also received 89% of normal July precipitation. Two states ranked this July among their top 20 driest, while New Jersey had its fourteenth wettest. August precipitation was 97% of normal, with eleven states being drier than normal. New Jersey had its eighth driest August on record.

Normals based on 1981–2010

Drought in the East

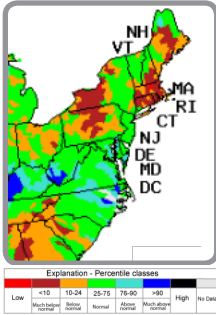
U.S. Drought Monitor
September 15, 2016



At the beginning of June, 1% of the Northeast was in a drought. Conditions deteriorated during summer and early fall so that by mid-September 37% of the Northeast was in a moderate, severe, or extreme drought. It was the first time some counties had experienced extreme drought since at least 2000 when Drought Monitor data began. Drought advisories, watches, and warnings were in place for several states. Parts of Ohio and the Carolinas were also in a drought during summer. Drought conditions expanded in these areas during June and July, but eased slightly during August.

Regional - Impacts and Updates for June–August 2016

Drought



Monthly streamflow compared to historical streamflow for July 2016. Credit: USGS WaterWatch.

Streamflow and groundwater were at near to record low levels in New England and New York during summer. Reservoir levels were also below normal. Due to water shortages, more than 290 water systems in [New Hampshire](#) and [Massachusetts](#) had water restrictions in early September. A few reports indicated low water levels led to [fish deaths in some rivers](#) and that it could impact river ecology for several years.

Many farmers irrigated, but some water sources dried up. Crops such as corn and soybeans were stressed and stunted, with yields and quality expected to be lower than usual. Slow growth of pastures forced some farmers to supplement with winter feed. Crop losses in Massachusetts for producers participating in USDA Farm Service

Agency programs exceeded \$13 million as of late August. Over 50% of hay crops were lost. Increased irrigation and labor costs also impacted the agriculture economy. Farmers in many of the drought areas became eligible for federal aid.

There was also increased fire risk and activity. In late July, Massachusetts had more lightning strike fires than usual and moisture in dead vegetation was historically low, meaning fires could start easily and spread rapidly. The drought made fighting fires more labor intensive.



Drought-stressed corn in Lewis County, NY. Credit: Joe Lawrence.

Extreme Precipitation



Damage from flash flooding in southern West Virginia on June 23. Credit: WV Dept. of Transportation.

Parts of southern West Virginia saw 8+ inches of rain on June 23. This made it a 1-day 1,000-year storm for these areas, meaning rainfall of that magnitude has a 0.1% chance of occurring in a given year. Record or near record water levels occurred on some rivers. For example, the Elk River at Queen Shoals in Kanawha County crested 14.37 ft. above flood stage and 1.37 ft. above its previous record set in 1888. Significant flash flooding damaged or destroyed

thousands of homes. The floods caused nearly \$47 million in damage to hundreds of roads and bridges and several million dollars in damage to the agriculture industry. It was the state's third deadliest flooding event.

Extreme rainfall fell in Howard and Montgomery Counties in Maryland on July 30. Ellicott City received 5.92 inches of rain in 2 hours, making it a 1,000-year event. The heavy rainfall led to a rapid rise of the Patapsco River, with preliminary data showing a rise of 13.13 ft. in 1.5 hours. Significant flash flooding damaged numerous buildings and hundreds of vehicles. There were two fatalities.

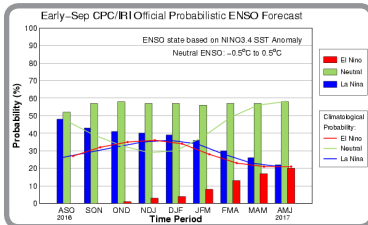
Numerous heavy rain and flash flooding events occurred across the region, including Raleigh, NC; Columbia, SC; and Princeton and Hunterdon County, NJ.



Damage to a store in Ellicott City, MD from flash flooding on July 30. Credit: National Weather Service (LWX).

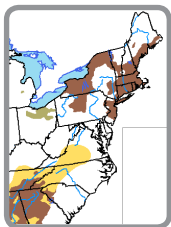
Regional - Outlook for Autumn 2016

ENSO



While sea surface temperatures were generally below average in the equatorial Pacific Ocean during August, El Niño/Southern Oscillation (ENSO) neutral conditions were observed. NOAA's Climate Prediction Center says there is a [55–60% chance of ENSO-neutral conditions](#) continuing during fall and winter 2016–17. The [chances of La Niña have decreased](#) to around 35–40%.

Drought & Fire



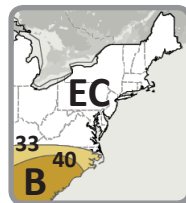
Drought persists
Drought remains but improves
Drought removal likely
Drought development likely

The U.S. Drought Outlook for September 15–December 31 from NOAA's Climate Prediction Center calls for drought conditions to persist in the Northeast and western Carolinas, develop in parts of the Carolinas and Virginia, and improve in Ohio (left).

The [National Interagency Fire Center](#) says the potential for significant wildland fires

is above normal in November and December for most of the Carolinas and Virginia and near normal for the rest of the region.

Precipitation and Temperature



B: Below-normal #: Probability of EC: Equal chances below-normal

NOAA's Climate Prediction Center is calling for an increased chance of below-normal precipitation from October–December for the Carolinas and equal chances

elsewhere (above). The October–December temperature outlook indicates an increased chance of above-normal temperatures for most of the Northeast, Ohio, and northern Virginia.

Atlantic Hurricane Season

In early September, tropical cyclone Hermine caused rough seas from the Carolinas to New England. In Virginia and the Carolinas, up to 11 inches of rain and/or high tides caused flooding. Three tornadoes touched down in eastern North Carolina. Gusty winds downed trees and wires, leading to power outages.

Through September 1, there were eight named tropical systems in the Atlantic Basin, including three hurricanes, one of which was a major hurricane. [On average](#), there are five named storms, including two hurricanes by late August, with the first major hurricane in early September. NOAA's [August hurricane outlook](#) calls for a 70% chance of 12–17 named storms, with 5–8 of those becoming hurricanes, and 2–4 of those becoming major hurricanes. Those numbers are slightly higher than the [original outlook from May](#).

Eastern Region Partners

- National Oceanic and Atmospheric Administration www.noaa.gov
- National Centers for Environmental Information www.ncei.noaa.gov
- National Weather Service, Eastern Region www.weather.gov
- NOAA Fisheries Science Centers and Regional Offices, Atlantic www.nmfs.noaa.gov
- Office for Coastal Management www.oceanservice.noaa.gov
- NOAA Research, Climate Program Office and Geophysical Fluid Dynamics Lab www.research.noaa.gov
- NOAA National Sea Grant Office www.seagrant.noaa.gov
- NOAA's North Atlantic, South Atlantic, and Great Lakes Regional Collaboration Teams www.regions.noaa.gov
- Climate Prediction Center www.cpc.noaa.gov
- National Operational Hydrologic Remote Sensing Center www.nohrsc.noaa.gov
- Northeast Regional Climate Center www.nrcc.cornell.edu
- Southeast Regional Climate Center www.sercc.com
- National Integrated Drought Information System www.drought.gov
- Carolinas Integrated Sciences and Assessments www.cisa.sc.edu
- Consortium on Climate Risk in the Urban Northeast www.ccrun.org
- Cooperative Institute for North Atlantic Research www.cinar.org
- Eastern Region State Climatologists www.stateclimate.org

