Kentucky’s central location in the eastern half of the United States, yet some distance from ocean bodies of water, results in a climate that is characterized by moderately large variations in temperature and abundant precipitation. Summers vary from warm to hot and humid, while winters are cool with occasional episodes of very cold Arctic air. Average daily high temperatures for July range from 86°F in the east to 90°F in the west, while average daily high temperatures for January range from 38°F in the north to 44°F in the south. Temperatures fall below 0°F for about three days per year in the north and one day in the south. Kentucky’s elevation ranges from 400 feet above sea level along the Mississippi River in the west to more than 4,100 feet at the peak of Black Mountain in the southeast, although most of the state is below 1,000 feet above sea level. Average annual precipitation ranges from about 42 inches in the north to around 52 inches in the southern portion of the state. The wettest year on record is 2011 with 64 inches of precipitation while the driest year was 1930 with 29 inches.

Figure 1: Observed and projected changes (compared to the 1901–1960 average) in near-surface air temperature for Kentucky. Observed data are for 1900–2014. Projected changes for 2006–2100 are from global climate models for two possible futures: one in which greenhouse gas emissions continue to increase (higher emissions) and another in which greenhouse gas emissions increase at a slower rate (lower emissions). Temperatures in Kentucky (orange lines) were highest in the 1930s, and lowest in the 1960s through the 1980s. Temperatures have risen about 2°F since the 1960s, but have not exceeded the levels of the 1930s. Shading indicates the range of annual temperatures from the set of models. Observed temperatures are generally within, but on the lower end of, the envelope of model simulations of the historical period (gray shading). Historically unprecedented warming is projected during the 21st century. Less warming is expected under a lower emissions future (the coldest years being about as warm as the hottest year in the historical record; green shading) and more warming under a higher emissions future (the hottest years being about 11°F warmer than the hottest year in the historical record; red shading). Source: CICS-NC and NOAA NCEI.

Technical details on models and projections are provided in an appendix, available online at: https://statesummaries.ncics.org/ky.
Figure 2: The observed (a) number of extremely hot days (annual number of days with maximum temperature above 100°F), (b) average winter and summer temperature, (c) annual precipitation, and (d) summer precipitation, averaged over 5-year periods. These values in Figure 2a are averages from seven long-term reporting stations. The values in Figures 2b, 2c, and 2d are from NCEI’s version 2 climate division dataset. The dark horizontal lines represent the long-term average. Summer and winter temperatures have been above average since the 1990s. Due to extreme drought and poor land management practices, the summers of the 1930s remain the warmest on record. Annual precipitation has been above average since the 2000s. The driest 5-year period was 1940–1944 and the wettest was 2011–2015. Source: CICS-NC and NOAA NCEI.
Kentucky has not seen a significant overall increase in temperatures since the early 20th century, similar to the rest of the southeastern United States. In Kentucky, the hottest period on record occurred during the 1930s, followed by a substantial cooling with the 1960s being about 2°F cooler than the 1930s (Figure 1). Since the 1960s, temperatures have risen about 2°F and have approached but not exceeded the highs of the 1930s. The hottest year on record is 1921, but two recent years (2012 and 1998) rank second and third, respectively. Because of the cooling that occurred in the middle of the 20th century, the southeastern United States is one of the few regions globally that has experienced little to no overall warming since 1900. The United States as a whole has warmed by about 1.5°F since 1900, though it also cooled from the 1930s into the 1960s, but not by nearly as much as Kentucky. Potential causes for this difference in warming rates have been the subject of research, but this phenomenon has not been fully explained.

The greatest number of extremely hot days occurred in the early 1910s and the 1930s, with the record high of 26 days above 100°F in 1936. In the latter half of the 20th century, the number of such days was near or below average, while the past decade has been close to average (Figure 2a). Recent winters have been characterized by a below average number of extreme cold events. None of the top 10 coldest winters have occurred in the last three decades. Also, the number of very cold nights (minimum temperature below 0°F) has been below average since 1990 (Figure 3). Mean winter temperatures have been near to above the long-term average during that same time (Figure 2b). For 2010–2014, both the number of very warm nights (minimum temperature above 75°F) (Figure 4) and annual average summer temperatures (Figure 2b) were well above the long-term average, but not as high as recorded during the 1930s.

There is no overall trend in average annual precipitation in Kentucky for the 118-year period of record (Figure 2c), although it has generally been near to above average since 1990. The annual

![Observed Number of Very Cold Nights](image)

**Figure 3:** The observed number of very cold nights (annual number of days with minimum temperature below 0°F) for 1900–2014, averaged over 5-year periods; these values are averages from seven long-term reporting stations. The number of very cold nights was near or above average from 1960 to 1989, but has since remained below average. The dark horizontal line is the long-term average (1900–2014) of 2.5 days per year. Source: CICS-NC and NOAA NCEI.

![Observed Number of Very Warm Nights](image)

**Figure 4:** The observed number of very warm nights (annual number of nighttime minimum temperature above 75°F) for 1900–2014, averaged over 5-year periods; these values are averages from seven long-term reporting stations. The number of very warm nights has generally been near to below average since 1990, with the exception of an above average number of such events during the most recent 5-year period (2010–2014). The dark horizontal line is the long-term average (1900–2014) of 0.8 days per year at the typical station. Source: CICS-NC and NOAA NCEI.
number of extreme precipitation events (greater than 2 inches of precipitation) has been highly variable but with an overall upward trend (Figure 5). The 5-year average number of extreme precipitation events was the highest during the most recent period (2010–2014) with an average of 3.5 events per station each year, compared to the long-term average of 2.2. Summer precipitation has been near average in the 2000s (Figure 2d). Deficient precipitation coupled with hot temperatures during the summer months can give rise to drought. For example, extreme drought conditions in western Kentucky during the summer of 2012 were exacerbated by a heat wave in late June and early July, during which time high temperatures rivaled those experienced in the 1930s.

Extreme weather events in Kentucky include flood-producing heavy rain, severe thunderstorms, tornadoes, and winter ice and snowstorms. Heavy rain from severe thunderstorms can often lead to flash flooding in the state in low-lying areas and in urban areas where the prevalence of impermeable surfaces (such as roads, roofs, and parking lots) accelerates storm runoff to ditches and streams. In addition to flooding, high wind, hail, and tornadoes associated with severe thunderstorms are important weather hazards common to Kentucky. In the most recent 11 years (2005–2015), there have been 19 FEMA disaster declarations in the state, most of which were for severe storms, tornadoes, and flooding-related events. Kentucky experiences a relatively high number of tornado-associated thunderstorm events each year (these events accounted for 53% of all FEMA declarations from 2005 to 2015). Between 1991 and 2010, there was an average of about 21 tornadoes per year. On March 2, 2012, 19 tornadoes touched down in Kentucky, including one of EF4 and four of EF3 intensity, resulting in 22 fatalities. In April 2011, 42 tornadoes were reported, which superseded an earlier April record of 29 tornadoes during the Super Outbreak of 1974.

Under a higher emissions pathway, historically unprecedented warming is projected by the end of the 21st century. (Figure 1). Even under a lower pathway of greenhouse gas concentrations, temperatures are projected to most likely exceed historical record levels by the middle of the 21st century. However, there is a large range of temperature increases under both pathways, and under the lower pathway, a few projections are only slightly warmer than historical records, an outcome that would be realized if observed temperatures continue to follow the lower end of model projections (Figure 1). Heat waves are projected to be more intense in the future, resulting in increased risk of heat-related illness and deaths, especially for urban residents. Cold waves are projected to be less intense.

Winter and spring precipitation is projected to increase in Kentucky by mid-century under a higher emissions pathway (Figure 6)—part of a large area of increased precipitation projected for the northern and central United States. Changes in summer and fall precipitation are uncertain, however. The number and intensity of heavy precipitation events is also projected to increase for the region, continuing recent trends. At the same time, the intensity of future droughts is projected to increase because higher temperatures in combination with naturally
occurring periods of below average rainfall will lead to temperature-caused increases in evaporation. Thus, both floods and droughts may be more intense in the future, with important implications for the region’s and state’s economies, including agriculture, industry, tourism, and natural resource management.

**Figure 6:** Projected changes (%) in spring precipitation by the middle of the 21st century relative to the late 20th century under a higher emissions pathway. Hatching represents areas where the majority of climate models indicate a statistically significant change. Kentucky is part of a large area of projected increases in the Northeast and Midwest. Source: CICS-NC and NOAA NCEI.