ILLINOIS

Key Messages

Temperatures in Illinois have risen about 1.5°F since the beginning of the 20th century. This warming shows seasonal variations, with spring average temperature increasing by about 2°F and summer average temperature increasing very little. Under a higher emissions pathway, historically unprecedented warming is projected during this century.

Precipitation in spring and summer has generally been above average since the mid-1990s, affecting agriculture both positively (adequate soil moisture) and negatively (delays in spring planting). Projected increases in winter and spring precipitation pose a continuing risk of spring planting delays.

Severe flooding and drought have occurred periodically in recent years. Future increases in the frequency and intensity of extreme precipitation events may increase the frequency and intensity of floods, while increases in evaporation rates due to rising temperatures may increase the intensity of naturally occurring droughts.

Illinois's location in the interior of North America and the lack of mountains to the north and south expose the state to incursions of bitterly cold air masses from the Arctic in the winter and warm, humid air masses from the Gulf of Mexico in the summer. Annual average temperature varies widely across the state, with a range of about 10°F from north to south. In northeastern Illinois, Lake Michigan moderates the temperature, causing cooler summers and warmer winters. Topography and urbanization also have local impacts on climate.

Temperatures in Illinois have risen about 1.5°F since the beginning of the 20th century (Figure 1). Temperatures in the 2000s have been higher than in any other historical period, with the exception of comparable temperatures during the early 1930s Dust Bowl era. Warming has been concentrated in winter and spring, while summers have not warmed substantially, a feature characteristic of much of the Midwest (Figures 2a and 2b). The lack of summer warming is reflected in a below average number of very hot days since the mid 1950s (Figure 3a) and no overall trend in very warm nights since the beginning of the 20th century (Figure 3b). The winter warming trend is reflected in a below average number of very cold nights since 1990 (Figure 3c).

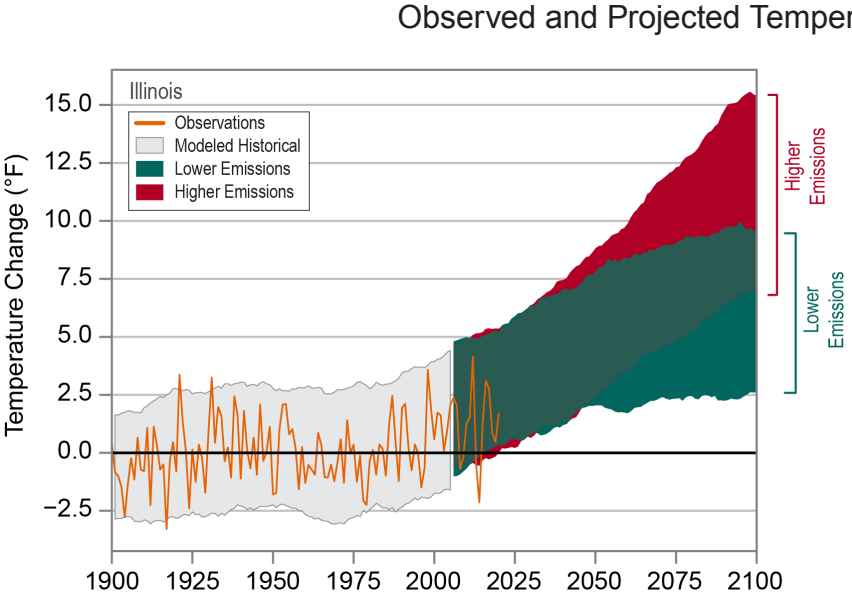

Figure 1: Observed and projected changes (compared to the 1901–1960 average) in near-surface air temperature for Illinois. Observed data are for 1900–2020. Projected changes for 2006–2100 are from global climate models for two possible futures: one in which greenhouse gas emissions continue to increase (higher emissions) and another in which greenhouse gas emissions increase at a slower rate (lower emissions). Temperatures in Illinois (orange line) have risen about 1.5°F since the beginning of the 20th century. Shading indicates the range of annual temperatures from the set of models. Observed temperatures are generally within the envelope of model simulations of the historical period (gray shading). Historically unprecedented warming is projected during this century. Less warming is expected under a lower emissions future (the coldest end-of-century projections being about 2°F warmer than the historical average; green shading) and more warming under a higher emissions future (the hottest end-of-century projections being about 11°F warmer than the hottest year in the historical record; red shading). Sources: CISESS and NOAA NCEI.

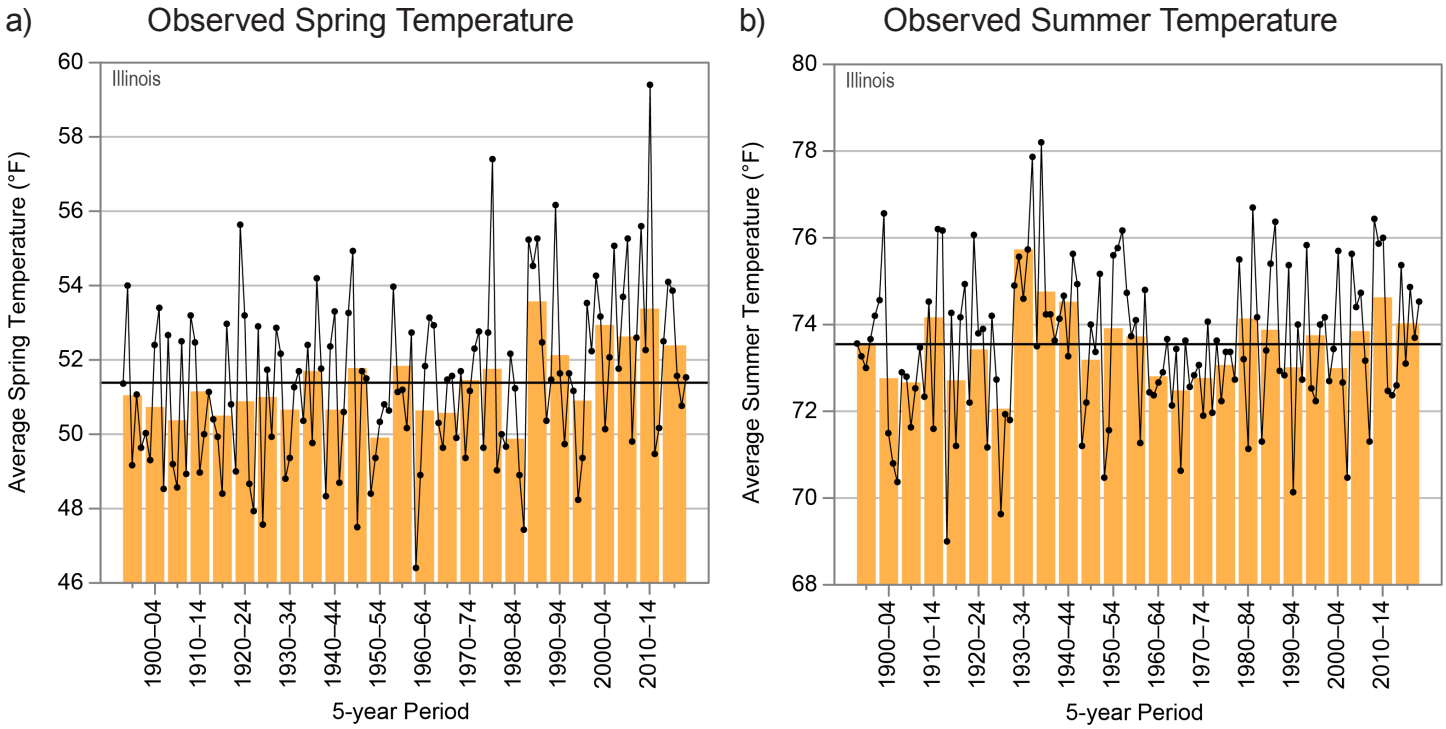

Figure 2: Observed (a) spring (March–May) and (b) summer (June–August) average temperature for Illinois from 1895 to 2020. Dots show annual values. Bars show averages over 5-year periods (last bar is a 6-year average). The horizontal black lines show the long-term (entire period) averages: (a) 51.4°F and (b) 73.6°F. Since 1985, Illinois has experienced the highest springtime temperatures in the historical record. Summer temperatures during the 2010–2014 period reached the highest level since the extreme heat of the 1930s Dust Bowl era. Sources: CISESS and NOAA NCEI. Data: nClimDiv.

Statewide annual precipitation has ranged from a low of 25.5 inches in 1901 to a high of 51.2 inches in 1993. The driest multiyear periods occurred in the first half of the 20th century, and the wettest have been observed since the 1970s (Figure 3d). The driest consecutive 5-year interval was 1952–1956, and the wettest was 2007–2011. **Annual precipitation varies widely across the state, ranging from more than 50 inches in the south to less than 35 inches in the north**. For annual snowfall, the pattern is reversed, with the northeastern part of the state averaging more than 40 inches compared to less than 10 inches in the southernmost section. Due to its proximity to Lake Michigan, the Chicago metropolitan area occasionally receives heavy winter precipitation from lake-effect snows.

Agriculture is an important sector of Illinois's economy and is particularly vulnerable to extreme weather conditions. On average, spring and summer precipitation has been above average since the mid-1990s (Figures 4a and 4b). While precipitation during these critical growth seasons is important for adequate soil moisture, it is also vital for proper planting and root development. Poor root development in important state crops, such as corn and soybeans, can lead to reduced plant absorption of nutrients and water from the soil, increased soil erosion, and loss of nutrients from the fields into rivers and streams. Both flooding and droughts have resulted in billions of dollars in losses in recent years. In 2012, a large drought across the Midwest had severe impacts on Illinois. Rainfall totals for May, June, and July were several inches below average, resulting in the third-driest May–July period (after 1936 and 1988) in 126 years of record keeping. By early August, much of the state was in extreme drought. The drought caused major damage to crops, particularly in the southern third of the state.

Illinois has experienced a dramatic increase in the number of 2-inch extreme precipitation events, which can cause severe flooding (Figure 5). In the summer of 1993, persistent heavy rainfall over the upper Midwest caused severe flooding along the Mississippi River. The 1993 flood was one of the greatest natural disasters in U.S. history, causing billions of dollars in damages to homes, businesses, agriculture, and infrastructure. More recently, during April 16–19, 2013, heavy rainfall from a slow-moving storm system caused severe flooding across parts of northern and central Illinois, with some areas receiving up to 10 inches of rain. This event,

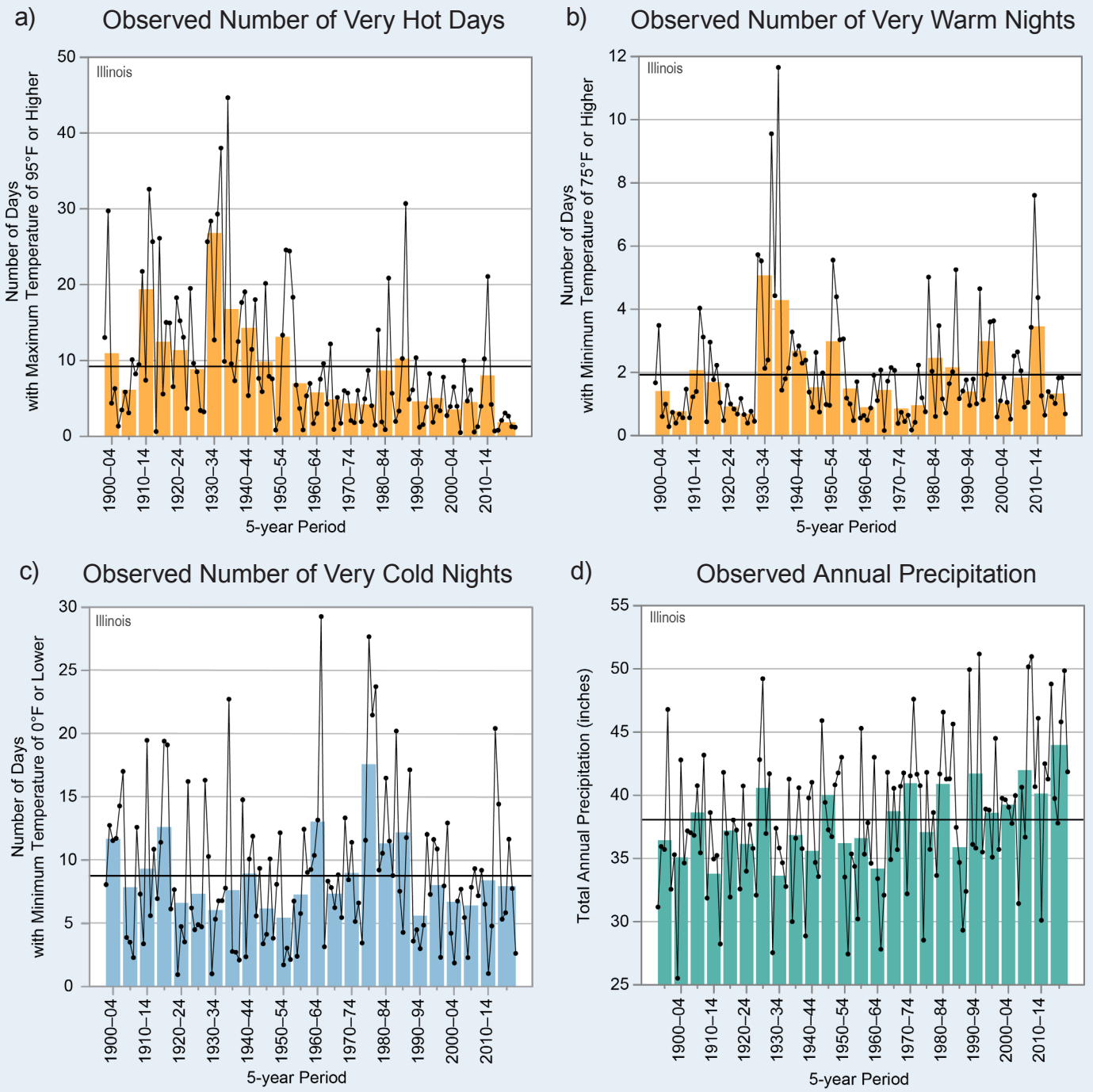

Figure 3: Observed (a) annual number of very hot days (maximum temperature of 95°F or higher), (b) annual number of very warm nights (minimum temperature of 75°F or higher), (c) annual number of very cold nights (minimum temperature of 0°F or lower), and (d) total annual precipitation for Illinois from (a, b, c) 1900 to 2020 and (d) 1895 to 2020. Dots show annual values. Bars show averages over 5-year periods (last bar is a 6-year average). The horizontal black lines show the long-term (entire period) averages: (a) 9.2 days, (b) 1.9 nights, (c) 8.8 nights, (d) 38.1 inches. The number of very hot days has generally been below average since 1955. The number of very warm nights shows no clear trend; however, the number of very cold nights has been below average since 1990. Annual precipitation varies widely but has been above average since 1990. Sources: CISESS and NOAA NCEI. Data: (a, b, c) GHCN-Daily from 34 long-term stations, (d) nClimDiv.

which contributed to the second-wettest January–June on record in the state, caused planting delays and diminished revenue for many farmers. Illinois has also struggled with urban flooding caused by heavy rains falling on impervious surfaces (e.g., roads, sidewalks, and driveways) and inadequate infrastructure. A recent report found that more than 90% of urban flooding damage claims from 2007 to 2014 were outside the mapped floodplain.

Illinois experiences storms during all seasons. During February 1–3, 2011, one of the most powerful winter

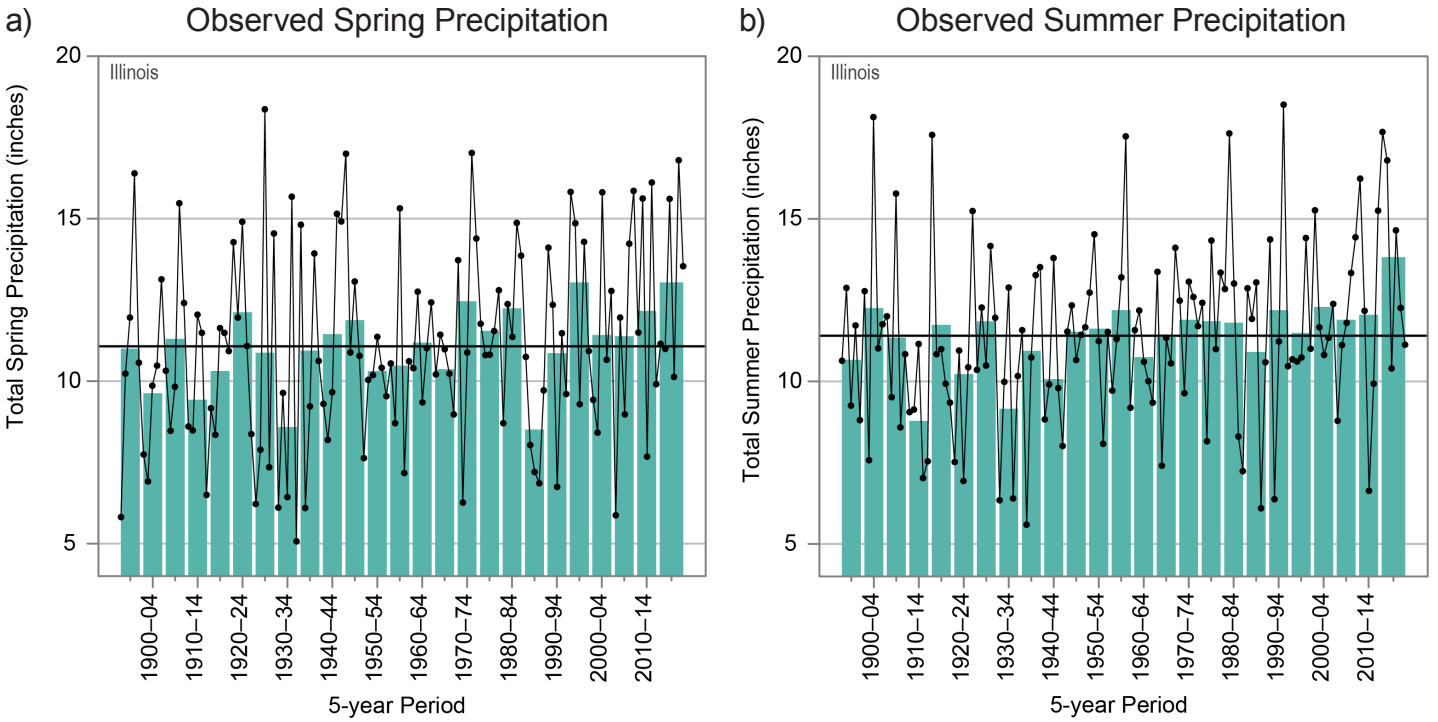

Figure 4: Observed (a) total spring (March–May) and (b) total summer (June–August) precipitation for Illinois from 1895 to 2020. Dots show annual values. Bars show averages over 5-year periods (last bar is a 6-year average). The horizontal black lines show the long-term (entire period) averages: (a) 11.1 inches and (b) 11.4 inches. Seasonal precipitation varies widely. Since 1995, Illinois has experienced above average spring and summer precipitation. Sources: CISESS and NOAA NCEI. Data: nClimDiv.

storms in history hit Illinois. Antioch, which normally averages only one snowfall greater than 6 inches per year, received the greatest accumulation of 27 inches. Chicago O'Hare International Airport recorded wind gusts of more than 60 mph and 20.2 inches of snow, the third-largest snowfall accumulation for the city in 120 years of record keeping. More than 9.8 million Illinois residents were in areas that received 12 or more inches of snow. Severe thunderstorms occur frequently during late spring and early summer. These storms can occasionally cause tornadoes, which sometimes cause major damage and loss of life. On August 10, 2020, a powerful derecho traveled through Illinois, producing widespread damaging winds. There were 15 tornadoes across northeastern Illinois, with several affecting the Chicago metropolitan area.

Water levels in the Great Lakes have fluctuated over a range of 3 to 6 feet since the late 19th century (Figure 6). Higher lake levels were generally noted in the late 19th century, the early 20th century, and the 1940s, 1950s, 1980s, and the late 2010s. Lower lake levels were observed in the 1920s and 1930s and again in the 1960s. For Lake Michigan–Huron, lower levels occurred during the first decade of this century. Lake levels have risen rapidly since 2013, with the highest levels since 1886 observed in 2020.

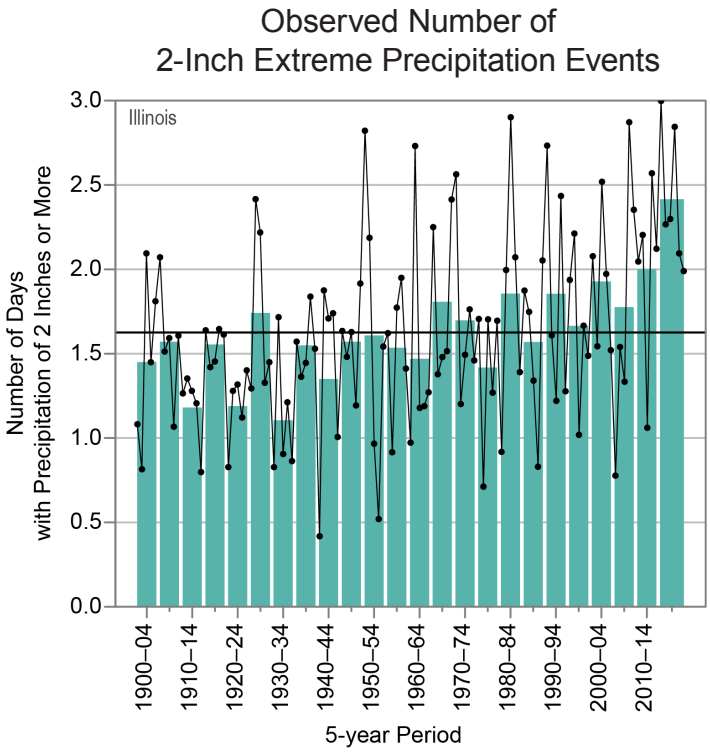

Figure 5: Observed annual number of 2-inch extreme precipitation events (days with precipitation of 2 inches or more) for Illinois from 1900 to 2020. Dots show annual values. Bars show averages over 5-year periods (last bar is a 6-year average). The horizontal black line shows the long-term (entire period) average of 1.6 days. A typical reporting station experiences 1 to 2 events per year. The number of 2-inch extreme precipitation events has been above average since 1990. During the most recent 6-year period (2015–2020), Illinois experienced a record-high number of more than 2 events per station per year. Sources: CISESS and NOAA NCEI. Data: GHCN-Daily from 41 long-term stations.

Under a higher emissions pathway, historically unprecedented warming is projected during this century (Figure 1). Even under a lower emissions pathway, annual average temperatures are projected to most likely exceed historical record levels by the middle of the century. However, a large range of temperature increases is projected under both pathways, and under the lower pathway, a few projections are only slightly warmer than historical records. During July 12–16, 1995, Chicago experienced a severe heat wave—the worst weather-related disaster in the city's history. Over a 5-day period, more than 700 people died. In addition to daytime highs of 90°F or higher (including 2 days of 100°F or higher), nighttime temperatures dropped only into the 80s (°F). Furthermore, the heat index, which considers both temperature and humidity, reached values of 105°F or more for 42 hours during the event. Values of 105°F or higher are considered dangerous by the National Weather Service. An analysis shows that the number of hours above critical thresholds of the heat index were the highest on record (Figure 7). If temperatures continue rising, future heat waves are likely to be more intense. High temperatures combined with high humidity pose risks to human health, particularly for residents of Chicago and other urban areas. By contrast, the intensity of cold waves is projected to decrease.

Increases in precipitation are projected for Illinois, most likely during the winter and spring (Figure 8). The frequency and intensity of extreme precipitation events are also projected to increase, potentially increasing the frequency and intensity of floods. Springtime flooding in particular could pose a threat to Illinois's important agricultural economy by delaying planting and reducing yields.

The intensity of future droughts is projected to increase even if precipitation increases. Rising temperatures will increase evaporation rates and the rate of soil moisture loss. Thus, future summer droughts, a natural part of Illinois's climate, are likely to be more intense.

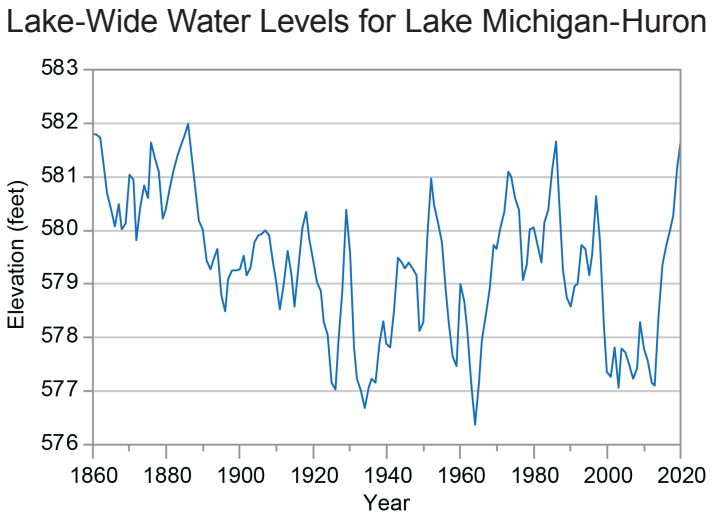

Figure 6: Annual time series of the average water levels for Lake Michigan–Huron from 1860 to 2020. Water levels in the Great Lakes have fluctuated widely over the years. Lake Michigan–Huron levels were very low during 2000–2013 but have since risen rapidly to the highest levels since 1886. Source: NOAA GLERL.

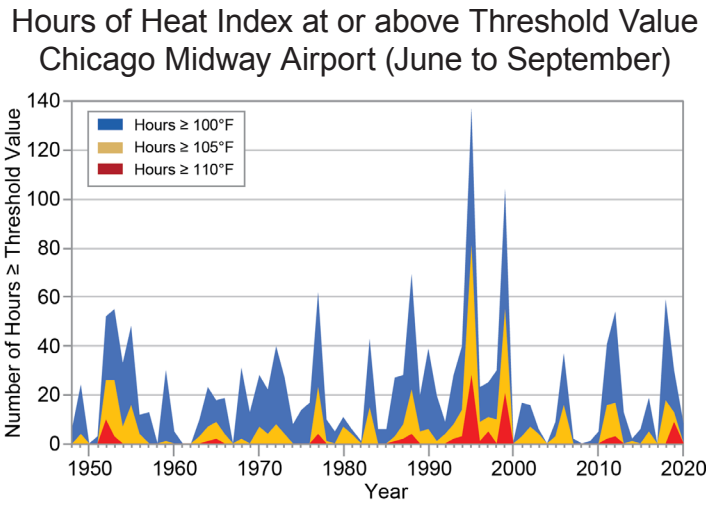

Figure 7: Observed annual number of hours with heat index values at or above selected thresholds (100ºF, 105ºF, and 110°F) for Chicago Midway International Airport from 1948 to 2020. The number of hours at or above the three thresholds reached record-high levels during the 1995 heat wave (137, 81, and 28 hours, respectively). Source: CISESS and NOAA NCEI. Data: Integrated Surface Database.

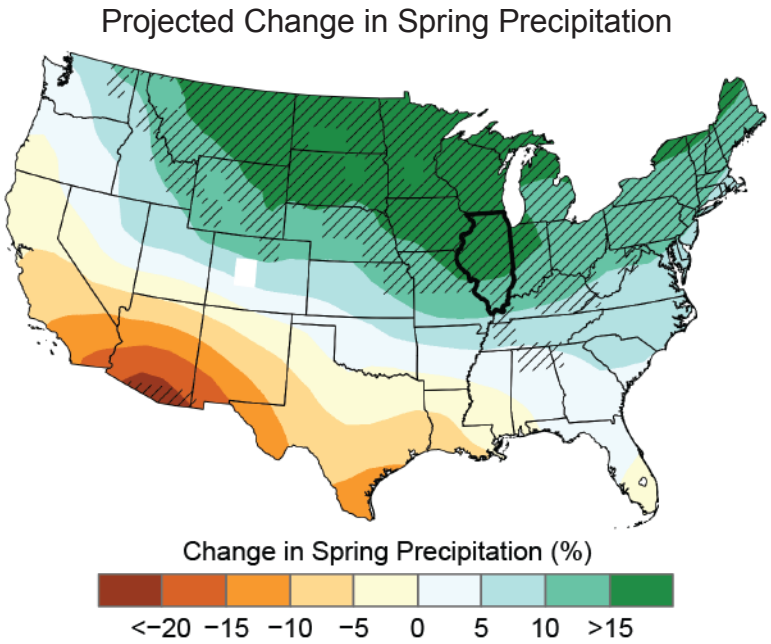

Figure 8: Projected changes in spring (March–May) precipitation (%) for the middle of the 21st century compared to the late 20th century under a higher emissions pathway. The whited-out area indicates that the climate models are uncertain about the direction of change. Hatching represents areas where the majority of climate models indicate a statistically significant change. Spring precipitation in Illinois is projected to increase in the range of 10% to greater than 15% by 2050. These increases are part of a large area of projected increases across the northern United States. Sources: CISESS and NEMAC. Data: CMIP5.

Technical details on observations and projections are available online at https://statesummaries.ncics.org/technicaldetails.