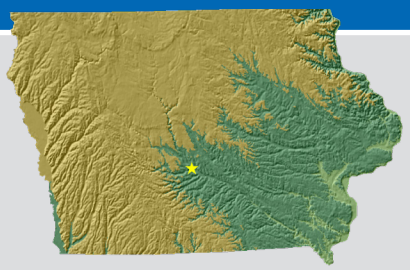

IOWA

Key Messages

Temperatures in Iowa have risen more than 1°F since the beginning of the 20th century. Warming has been concentrated in winter and fall, with a general lack of summer warming. Under a higher emissions pathway, historically unprecedented warming is projected during this century.

Spring precipitation has been above average since 1990, affecting agriculture both positively (adequate soil moisture) and negatively (delays in spring planting). Projected increases in winter and spring precipitation pose a continued risk of spring planting delays.

Severe flooding and drought have occurred periodically in recent years, with major impacts on several communities. 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.

Iowa'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. As a result, its climate is characterized by wide-ranging temperatures.

Temperatures in Iowa have risen more than 1°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 the early 1930s Dust Bowl era. The warming is due to increases in nighttime minimum temperatures; daytime maximum temperatures, however, show no trend. Increases in humidity may be one cause of this asymmetric warming between night and day. The hottest year on record was 2012, with an annual average temperature of 52.1°, which is 4.5°F above the long-term (1895–2020) average. Warming has been concentrated in winter and fall, while summers have not warmed substantially (Figure 2a), a feature characteristic of much of the Midwest. This lack of summer warming is reflected in a below average number of very hot days (Figure 2b) and no overall trend in warm nights (Figure 2c). The winter warming trend is reflected in a below average number of very cold nights since 1990, with the exception of the 2010–2014 period (Figure 2d).

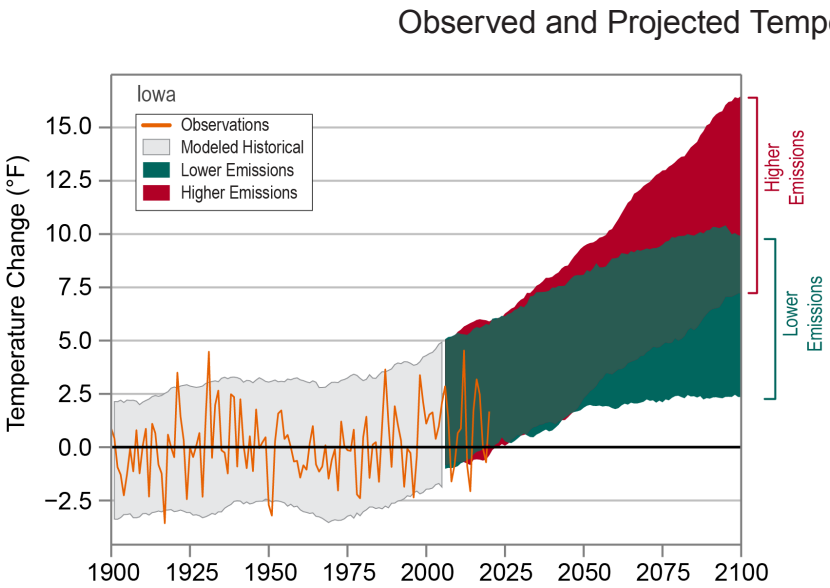

Figure 1: Observed and projected changes (compared to the 1901–1960 average) in near-surface air temperature for Iowa. Observed data are for 1900–2020. Projected changes for 2006–2100 are from global climate models for two possible futures: one in which greenhouse gas emissions continue to increase (higher emissions) and another in which greenhouse gas emissions increase at a slower rate (lower emissions). Temperatures in Iowa (orange line) have risen more than 1°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 12°F warmer than the hottest year in the historical record; red shading). Sources: CISESS and NOAA NCEI.

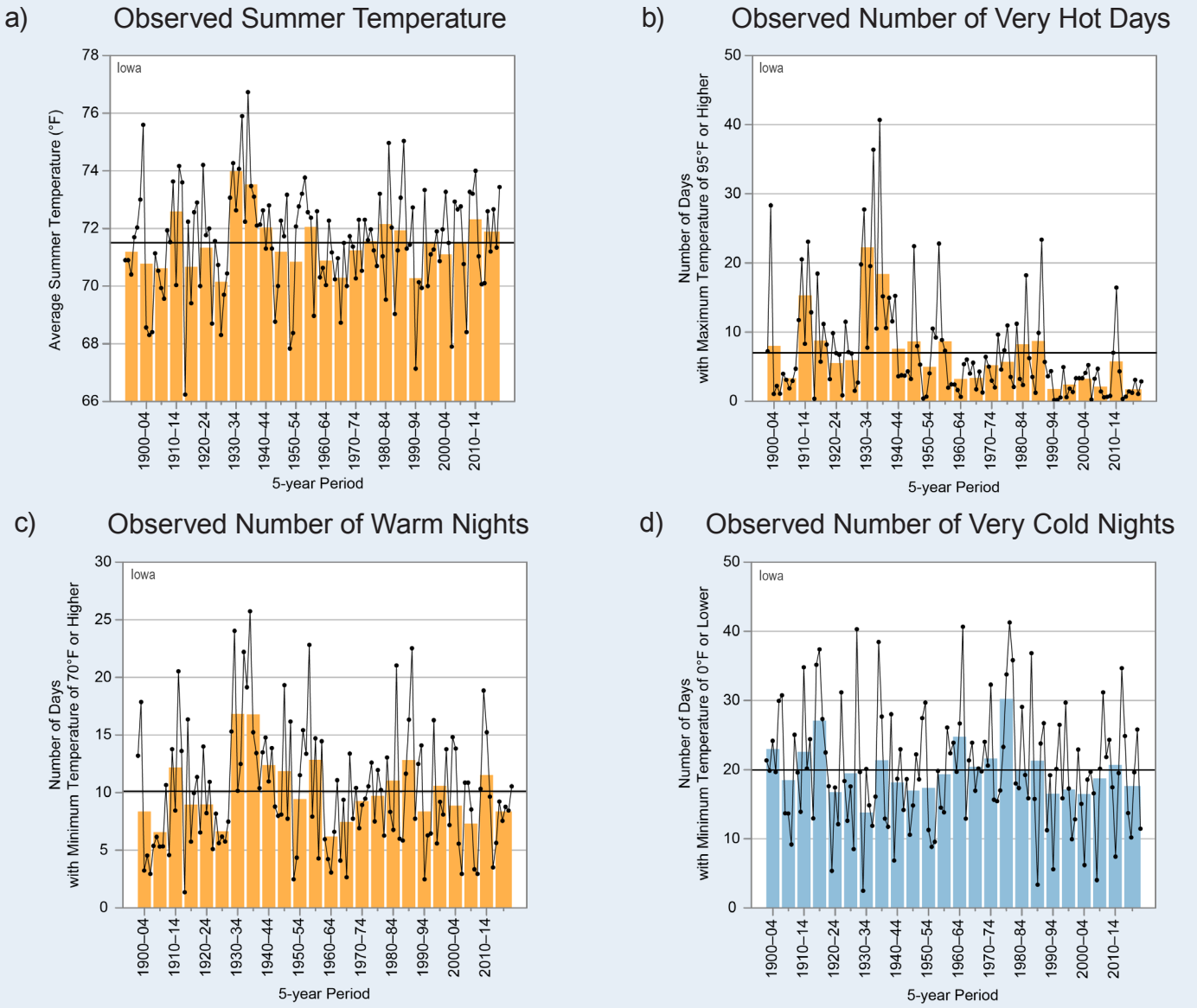

Figure 2: Observed (a) summer (June–August) average temperature, (b) annual number of very hot days (maximum temperature of 95°F or higher), (c) annual number of warm nights (minimum temperature of 70°F or higher), and (d) annual number of very cold nights (minimum temperature of 0°F or lower) for Iowa from (a) 1895 to 2020 and (b, c, d) 1900 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) 71.5°F, (b) 7 days, (c) 10 nights, (d) 20 nights. Summer temperatures have generally been near average since 1995. The number of very hot days has been below average since 1990, while the number of warm nights shows no clear trend. Due to extreme drought and poor land management practices, the summers of the 1930s remain the warmest on record. The number of very cold nights has been below average since 1990, except for the 2010–2014 period. Sources: CISESS and NOAA NCEI. Data: (a) nClimDiv, (b, c, d) GHCN-Daily from 49 long-term stations.

Precipitation varies widely across Iowa, with the southeastern portion of the state receiving around 38 inches annually compared to only 26 inches in the northwest. Much of Iowa's precipitation falls in summer, averaging about 14 inches in the central part of the state. Spring precipitation has been above average since 1990 (Figure 3a), which can make it difficult for farmers to plant crops. Summer and annual precipitation has also been above average since 2005 (Figures 3b and 4), which has benefited crop production but also increased flooding. Iowa's planting season, which runs from April into June, has been particularly wet in recent years, averaging about 2.8 inches above the long-term average of 12 inches since 2008. Statewide annual precipitation has ranged from a low of 20.2 inches in 1910 to a high of 47.9 inches in 1993. Snowfall also varies across the state, ranging from more than 40 inches in the north to about 20 inches in the south. For most of the state, more than 40% of the annual precipitation occurs on the 10 wettest days of the year, a percentage that rises to

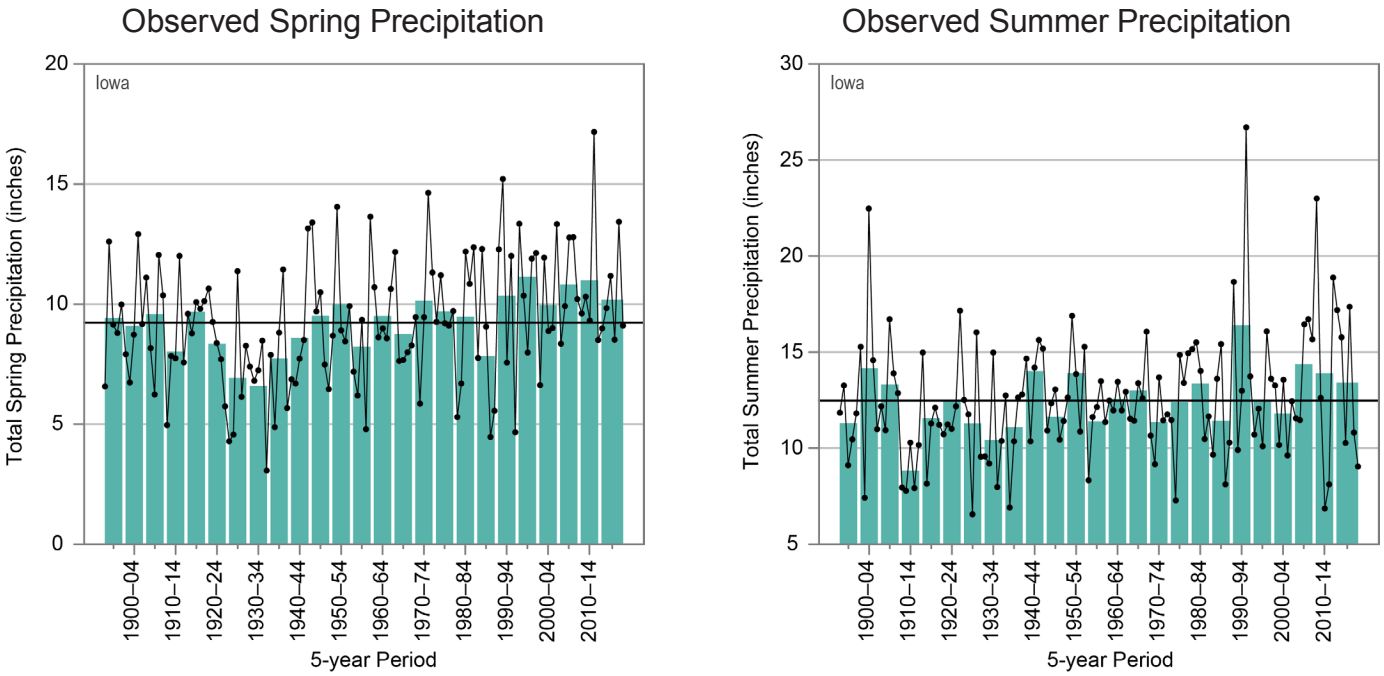

Figure 3: Observed (a) total spring (March–May) and (b) total summer (June–August) precipitation for Iowa from 1895 to 2020. Dots show annual values. Bars show averages over 5-year periods (last bar is a 6-year average). The horizontal black lines show the long-term (entire period) averages: (a) 9.2 inches and (b) 12.5 inches. Spring and summer precipitation has been above average since 1990 and 2005, respectively. Sources: CISESS and NOAA NCEI. Data: nClimDiv.

more than 48% in the western portion. **The frequency of 2-inch extreme precipitation events has increased**, with the highest number occurring during the past 16 years (Figure 5).

Agriculture is an important sector of Iowa's economy and is particularly vulnerable to extreme weather conditions. Both flooding and droughts have resulted in billions of dollars in losses in recent years. Following abnormally dry conditions in 2011, Iowa experienced severe drought conditions in 2012 and then very dry conditions again in 2013. Below average rainfall totals for the critical growth months of July and August were 6.4, 4.1, and 3.2 inches in 2011, 2012, and 2013, respectively (the long-term average for July–August rainfall is 7.8 inches). This 3-year period was unlike any other 3-year period dating back to 1895 and superseded the dry years of the Dust Bowl era. By the end of September 2012, much of the state was in extreme drought, with portions in the northwest experiencing exceptional drought conditions extending into 2013.

Thousands of miles of rivers flow through Iowa, which is bordered by the Mississippi River to the east and the Big Sioux and Missouri Rivers to the west. **With many of these waterways located alongside cities and farmland, flooding is a severe hazard**. From 1955

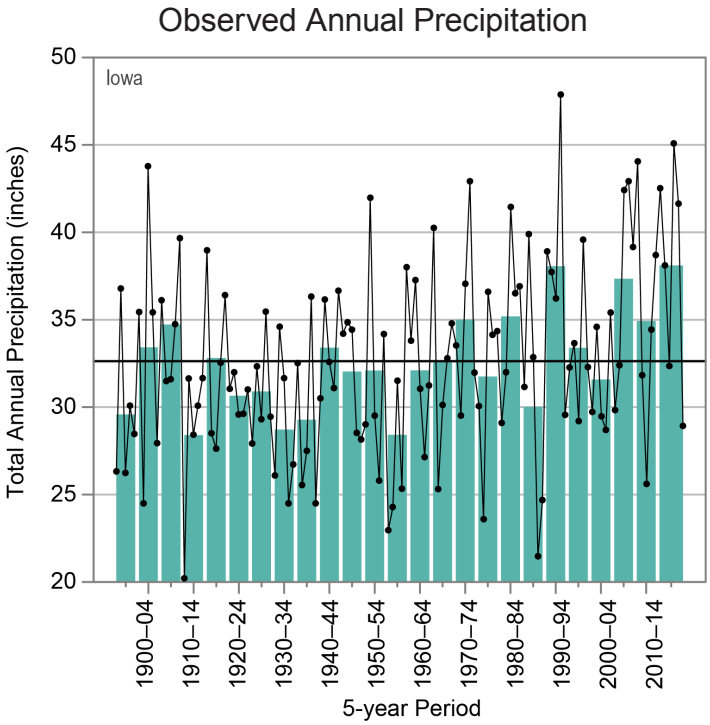

Figure 4: Observed total annual precipitation for Iowa from 1895 to 2020. Dots show annual values. Bars show averages over 5-year periods (last bar is a 6-year average). The horizontal black line shows the long-term (entire period) average of 32.6 inches. Annual precipitation over the past 16 years has generally been several inches above average. The wettest consecutive 5-year interval was 2006–2010, while the driest was 1952–1956. Sources: CISESS and NOAA NCEI. Data: nClimDiv.

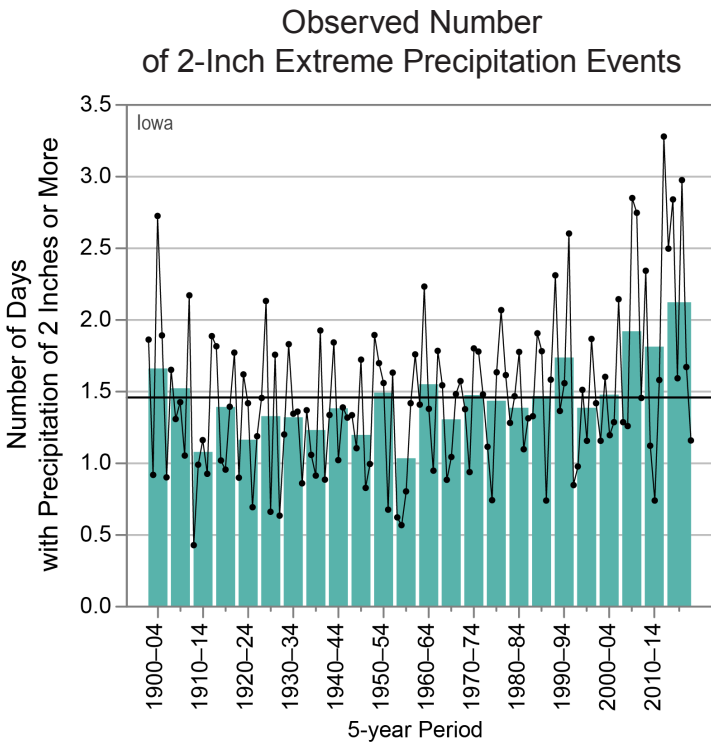

Figure 5: Observed annual number of 2-inch extreme precipitation events (days with precipitation of 2 inches or more) for Iowa from 1900 to 2020. Dots show annual values. Bars show averages over 5-year periods (last bar is a 6-year average). The horizontal black line shows the long-term (entire period) average of 1.5 days. A typical station experiences 1 to 2 events per year. Multiyear averages since 2005 are the highest in the historical record. Sources: CISESS and NOAA NCEI. Data: GHCN-Daily from 45 long-term stations.

to 1997, Iowa was ranked first in state losses due to flooding. During the first two weeks of June 2008, heavy rainfall on soil already saturated from unusually wet conditions caused record flooding along multiple rivers. Numerous long-term stations reported more than 10 inches during the 2-week period, and levels on the Cedar River exceeded the previous record by more than 11 feet. Of the state's 99 counties, 83 were declared disaster areas, and damages were estimated at almost $10 billion. Snowmelt, as well as ice jams, can also cause flooding. In June 2011, runoff from a record winter snowpack in the Rocky Mountains accompanied by heavy rains caused major flooding along the entire length of the Missouri River. The region around Hamburg was particularly hard hit, where levee failures forced evacuation of the town and farmland flooding caused extensive agricultural losses.

Iowa experiences damaging storms during all seasons. During winter months, snowstorms and ice storms are a frequent hazard. During December 8–9, 2009, a strong storm produced heavy snowfall across the state, with multiple long-term stations reporting more than 15 inches. Wind gusts of more than 50 mph produced large snow drifts and caused widespread whiteout conditions. The blizzard conditions were compounded by bitter cold on December 9, with temperatures below 10°F and wind chills below 0°F across large portions of the state. Thunderstorms capable of producing floods, hail, and tornadoes are common in the warmer months. On May 25, 2008, an EF-5 tornado killed 8 people and destroyed nearly 200 homes in Parkersburg. This was the strongest tornado to hit the state since June 13, 1976. One of the most destructive thunderstorms to ever affect the state occurred on August 10, 2020. A powerful derecho produced widespread winds greater than 100 mph, causing extensive damage to millions of acres of corn and soybean crops across central Iowa and severe damage to homes, businesses and vehicles, particularly in Cedar Rapids.

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 this 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. Intense heat waves can occur in Iowa, often accompanied by high humidity. Heat waves are projected to become more intense, and impacts on human health could be significant. However, cold waves are projected to be less intense.

Increases in precipitation are projected for Iowa, most likely during the winter and spring (Figure 6). Increases in the frequency and intensity of extreme precipitation are also projected, potentially increasing the frequency and intensity of floods. Springtime flooding in particular could pose a threat to Iowa'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, periodic summer droughts, a natural part of Iowa's climate, are likely to be more intense in the future.

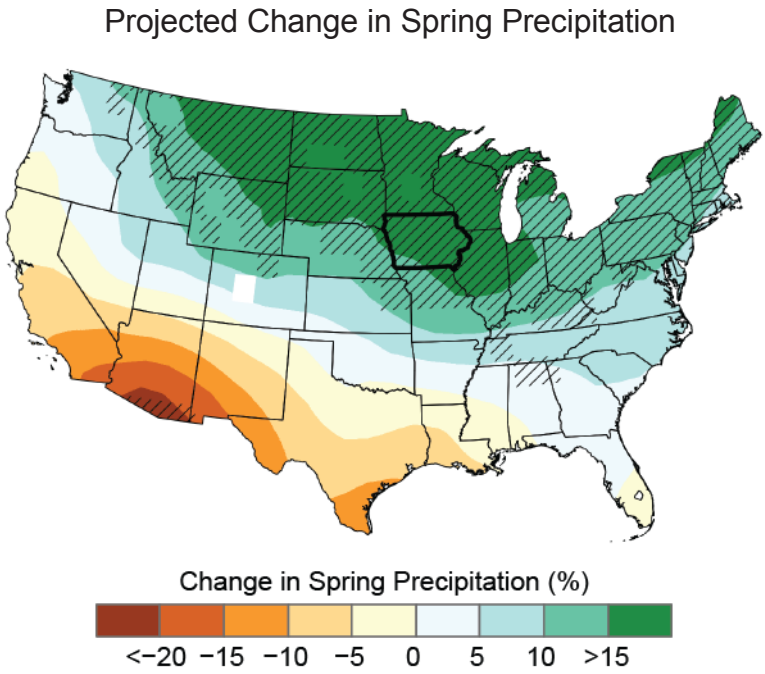

Figure 6: Projected changes in spring (March–May) precipitation (%) for the middle of the 21st century compared to the late 20th century under a higher emissions pathway. The whited-out area indicates that the climate models are uncertain about the direction of change. Hatching represents areas where the majority of climate models indicate a statistically significant change. Iowa is part of a large area of projected increases in the Northeast and Midwest. Sources: CISESS and NEMAC. Data: CMIP5.

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