



Annual mean precipitation is projected to increase most likely in the winter and spring (Figure 5). Maine is part of a large area in the higher mid-latitudes projected to see increases in precipitation, as well as increases in extreme precipitation events. An increase in the frequency of extreme precipitation events may also result in increased flooding risks and the degradation of surface water quality as greater runoff from more intense storms carries pollutants into freshwater resources.

Sea surface temperatures in the coastal waters of Maine have increased almost 2°F since 1970, and the rate of sea level rise has accelerated. The Gulf of Maine has warmed more than other coastal waters of the United States. Tide gauge records in Portland show a sea level rise of approximately 8 inches since 1912. Changes in ocean and atmospheric circulation have caused temporary destructive increases in

sea level, such as the 6-inch rise along the Maine coast in 2010. **Global sea level is projected to rise another 1 to 4 feet by 2100 as a result of both past and future greenhouse gas emissions from human activities (Figure 6), with greater rises along the Maine coast possible.** Future projections of sea level rise show that some coastal cities and towns in Maine stand to lose up to 30% of their land area. Sea level rise has caused an increase in tidal floods, a rise in water level above the minor flooding threshold (determined locally by NOAA's National Weather Service) to cause nuisance flooding. Nuisance flooding has increased in all U.S. coastal areas, with more rapid increases along the East and Gulf Coasts. These floods can damage infrastructure, cause road closures, and overwhelm storm drains. Nuisance flooding events in Maine are likely to occur more frequently as global and local sea levels continue to rise.

MAINE

KEY MESSAGES

Temperatures have risen about 3°F in Maine since the beginning of the 20th century. Winter temperatures have been increasing about twice as fast as summer temperatures. Under a higher emissions pathway, historically unprecedented warming is projected by the end of the 21st century

Precipitation has increased during the last century. Increases in the frequency and intensity of extreme precipitation events have already occurred and are projected to continue.

Sea level at Portland has risen by about 8 inches since 1912. It is projected to rise another 1 to 4 feet by 2100.

Projected Change in Winter Precipitation

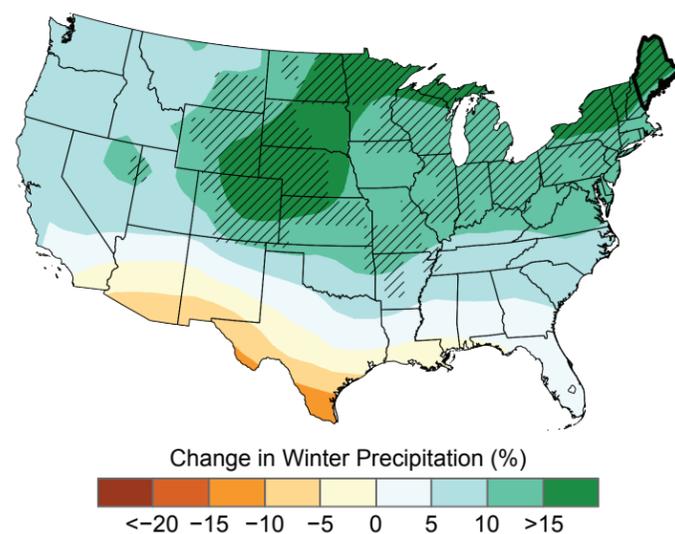


Figure 5: Projected changes (%) in annual winter precipitation for the middle of the 21st century compared to the late 20th century under a higher emissions pathway. Hatching represents areas where the majority of climate models indicate a statistically significant change. Maine is part of a large area in the Northeastern and central United States with projected increases in winter precipitation. Source: CICS-NC and NOAA NCEI.

Past and Projected Changes in Global Sea Level

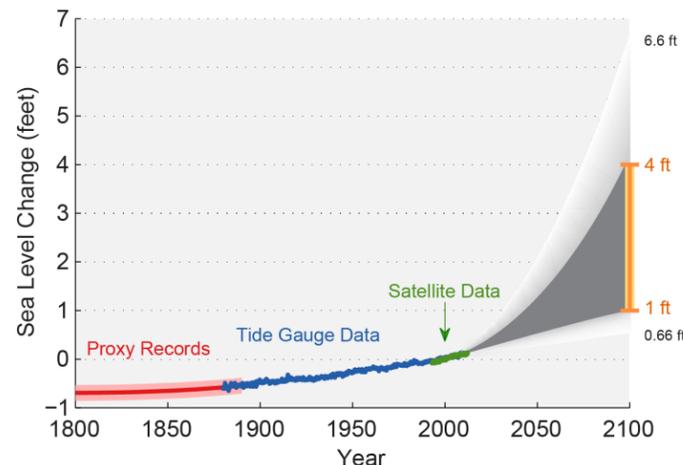


Figure 6: Estimated, observed, and possible future amounts of global sea level rise from 1800 to 2100, relative to the year 2000. The orange line at right shows the most likely range of 1 to 4 feet by 2100 based on an assessment of scientific studies, which falls within a larger possible range of 0.66 feet to 6.6 feet. Source: Mellilo et al. 2014 and Parris et al. 2012.

Maine is located on the eastern margin of the North American continent. Its northerly latitude and geographic location exposes the state to both the moderating and moistening influence of the Atlantic Ocean, as well as the effects of the hot and cold air masses from the interior of the continent. Also, Maine is located within the primary storm track of the mid-latitudes. **Maine's climate is characterized by cold, snowy winters and mild summers. Mean annual winter temperatures range from 25°F in the far south to less than 15°F in the northern and interior portions of the state. Mean annual summer temperatures range from near 60°F in the far north to near 70°F in the south.** Maine is approximately 90% forested with over 3,500 miles of coastline, making forestry, seafood, hunting and fishing, tourism and ecosystem services all sensitive to a changing climate.

Temperatures in Maine have increased nearly 3°F since the beginning of the 20th century (Figure 1). Since the mid-1990s, the amount of winter warming has been approximately twice that of summer warming, with record high temperatures occurring in the last five years (2010–2014) (Figure 2a). The winter warming is reflected in a below average number of very cold nights (nights with minimum temperatures below 0°F) (Figure 3) over the last two decades (1995–2014). However, there has not been an increase in the occurrence of hot days (days with maximum temperature above 90°F) (Figure 2b). Winter warming has resulted in earlier ice-out dates on lakes. On Damariscotta Lake, the average ice-out date has changed from mid to late April in the early and middle part of the 20th century to early April now. The growing season has lengthened.

Observed and Projected Temperature Change

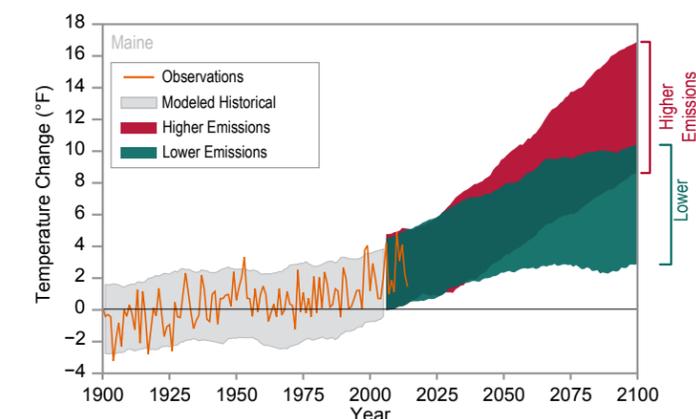


Figure 1: Observed and projected changes (compared to the 1901–1960 average) in near-surface air temperature for Maine. Observed data are for 1900–2014. Projected changes for 2006–2100 are from global climate models for two possible futures: one in which greenhouse gas emissions continue to increase (higher emissions) and another in which greenhouse gas emissions increase at a slower rate (lower emissions)¹. Temperatures in Maine (orange line) have risen nearly 3°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 the 21st century. Less warming is expected under a lower emissions future (the coldest years being about 3°F warmer than the historical average; green shading) and more warming under a higher emissions future (the hottest years being about 16°F warmer than the historical average; red shading). Source: CICS-NC and NOAA NCEI.

¹Technical details on models and projections are provided in an appendix, available online at: <https://statesummaries.ncics.org/me>.

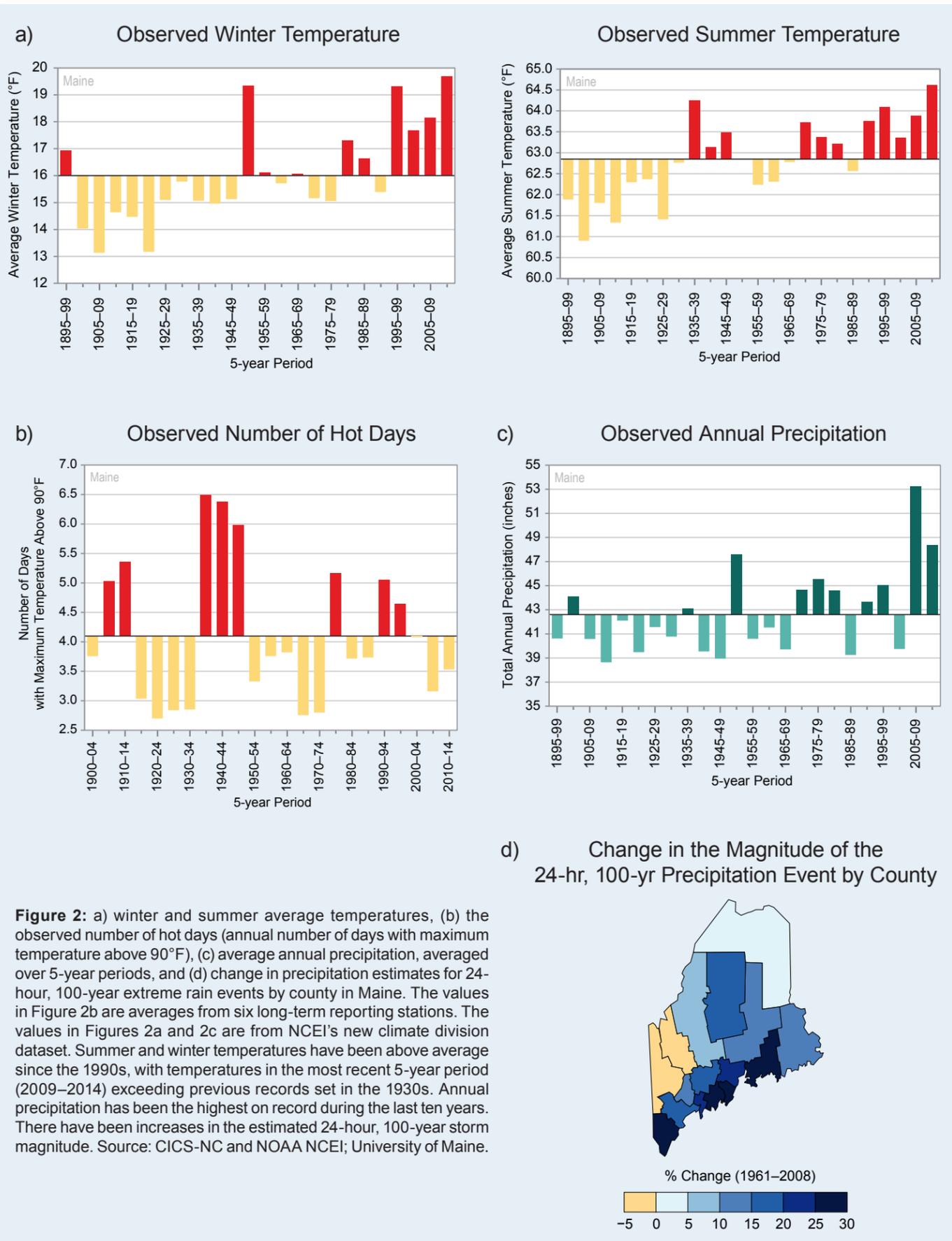


Figure 2: a) winter and summer average temperatures, (b) the observed number of hot days (annual number of days with maximum temperature above 90°F), (c) average annual precipitation, averaged over 5-year periods, and (d) change in precipitation estimates for 24-hour, 100-year extreme rain events by county in Maine. The values in Figure 2b are averages from six long-term reporting stations. The values in Figures 2a and 2c are from NCEI's new climate division dataset. Summer and winter temperatures have been above average since the 1990s, with temperatures in the most recent 5-year period (2009–2014) exceeding previous records set in the 1930s. Annual precipitation has been the highest on record during the last ten years. There have been increases in the estimated 24-hour, 100-year storm magnitude. Source: CICS-NC and NOAA NCEI; University of Maine.

Mean annual precipitation in Maine has exhibited historically high values over the last 10 years (2005 to 2014) (Figure 2c). In the harsh winter months, average accumulated snowfall ranges between 10 and 80 inches from the Southern Interior to the Northern climate division, with the northern tip of the state receiving up to 125 inches. The number of extreme precipitation events (number of days with more than 2 inches) has been variable over the period of record, but the last decade (2005–2014) has seen a record number of such events (double the long-term average, Figure 4), similar to the rest of the northeastern United States. The estimated magnitude of the 24-hr, 100-year rainstorm has increased since 1961 (Fig. 2d), in some areas by more than 20%.

Heat waves and cold waves, droughts and severe rainstorms, nor'easters, ice storms, and tornadoes are all part of Maine's normal climate. In general, nor'easters cause more disruption than any other type of extreme weather in Maine. Nor'easters are cold-season coastal storms that can generate a tremendous amount of precipitation (in the form of snow, sleet, or freezing rain), strong winds, coastal flooding, and damage to infrastructure. Wind speeds from nor'easters are commonly equal to or greater than wind speeds observed in hurricanes that have reached Maine. Nor'easters are prevalent in most years in winter, spring, and fall, while a landfalling hurricane is very rare. Since 1861, only three hurricanes have reached Maine with hurricane force winds, the last being Gloria in 1985. Since 2007, weather-related disasters have been declared in every county in Maine.

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 generally projected to 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 (Figure 1). The intensity of cold waves is projected to decrease while greater intensity of heat waves may increase the importance of such events in this normally moderate summer climate.

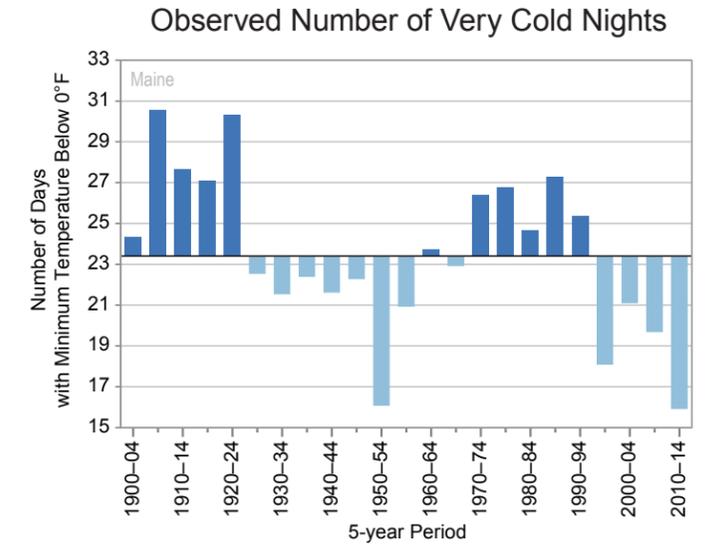


Figure 3: The observed number of very cold nights (annual number of days with minimum temperature below 0°F) for 1900–2014, averaged over 5-year periods; these values are averages from six long-term reporting stations. Periods of very cold nighttime temperatures have occurred episodically throughout the period of record. Since a period of above average number of very cold nights in the 1970s and 1980s, the observed number of such days has been below average, reflecting winter warming. The dark horizontal line is the long-term average (1900–2014) of 23.5 days per year. Source: CICS-NC and NOAA NCEI.

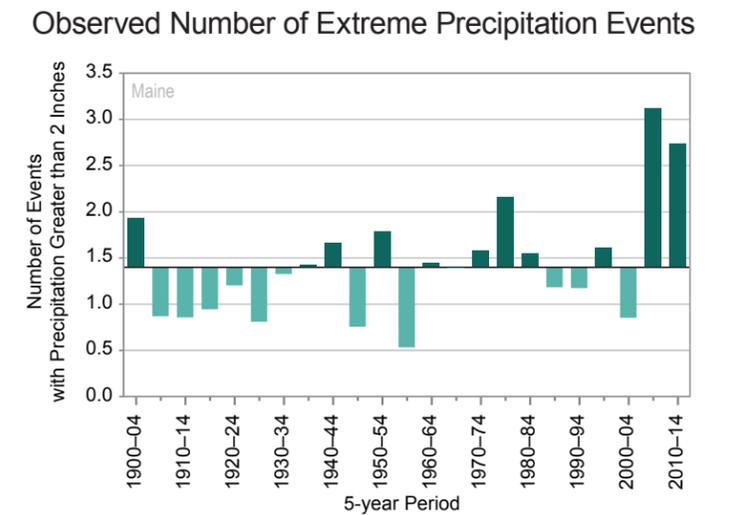


Figure 4: The observed number of extreme precipitation events (annual number of daily events with greater than 2 inches) for 1900–2014, averaged over 5-year periods; these values are averages from five long-term reporting stations. Maine has experienced an above average number of days with more than 2 inches of rain over the last decade. The dark horizontal line is the long-term average (1900–2014) of 1.4 days per year. Source: CICS-NC and NOAA NCEI.