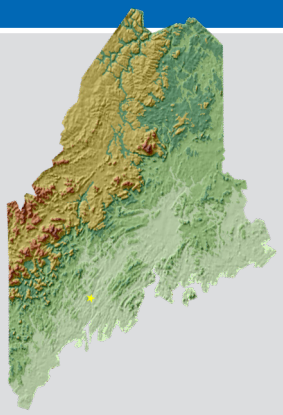
MAINE



Key Messages

Temperatures in Maine have risen almost 3.5°F 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 during this century.

Precipitation since 2005 has averaged 6.6 inches more than during 1895–2004. The number of extreme precipitation events has been near to well above average since 2005 and is projected to increase during this century.

Global sea level is projected to rise, with a likely range of 1–4 feet by 2100. Sea level at Portland has risen by about 7.4 inches since 1912 and is projected to rise another 1–4 feet by 2100.

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

Temperatures in Maine have risen almost 3.5°F since the beginning of the 20th century (Figure 1). Since the mid-1990s, the amount of winter warming (Figure 2a) has been approximately twice that of summer warming (Figure 2b), with persistently above average temperatures occurring since the 1990s. Winter warming is reflected in the number of very cold nights, which has been below average since the late 1990s (Figure 3). However, the number of hot days has not increased (Figure 2c). Winter warming has resulted in earlier lake ice-out dates. On Damariscotta Lake, the average ice-out date during the mid-20th century was mid- to late April; it is now early April. The growing season has also lengthened.

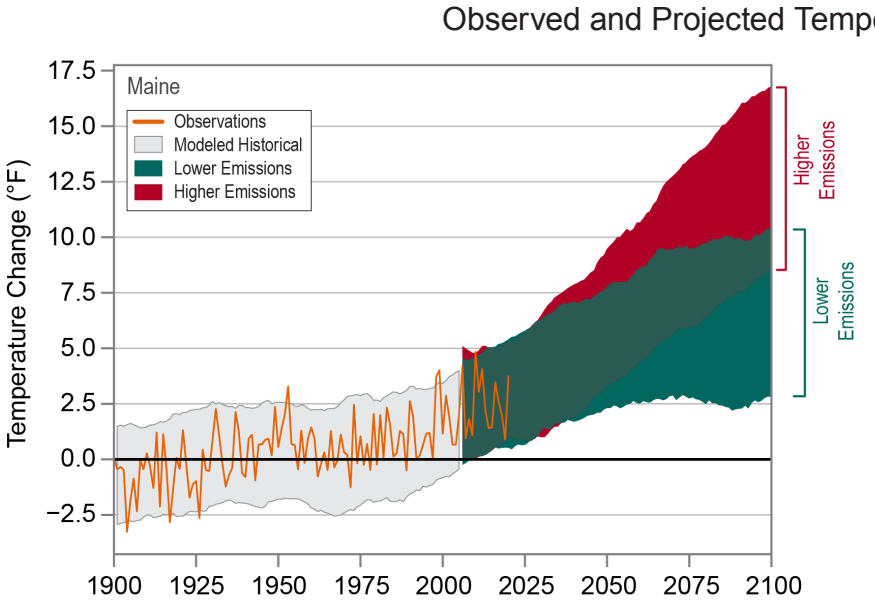


Figure 1: Observed and projected changes (compared to the 1901–1960 average) in near-surface air temperature for Maine. Observed data are for 1900–2020. Projected changes for 2006–2100 are from global climate models for two possible futures: one in which greenhouse gas emissions continue to increase (higher emissions) and another in which greenhouse gas emissions increase at a slower rate (lower emissions). Temperatures in Maine (orange line) have risen almost 3.5°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-year 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.

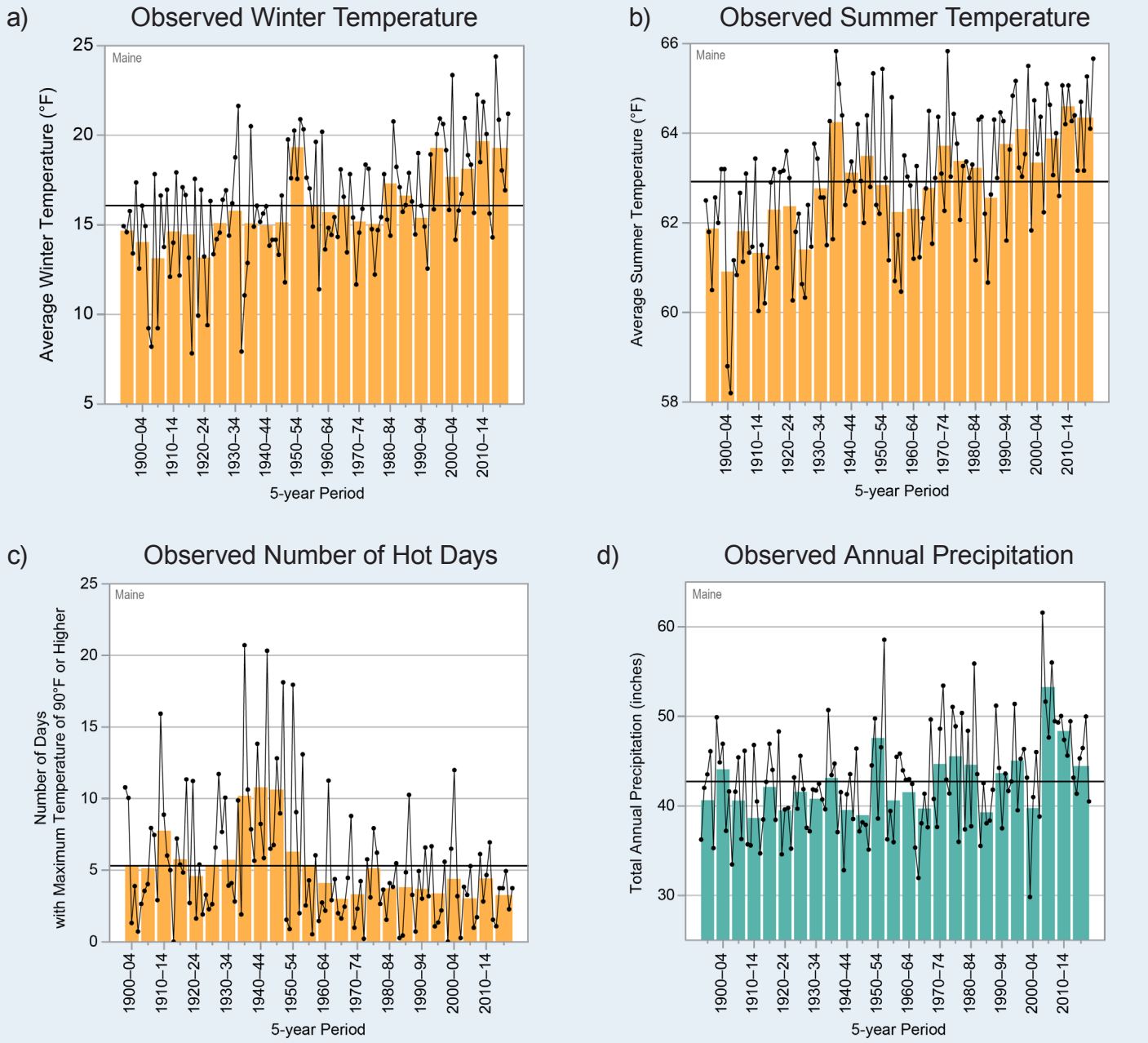


Figure 2: Observed (a) winter (December–February) average temperature, (b) summer (June–August) average temperature, (c) annual number of hot days (maximum temperature of 90°F or higher), and (d) total annual precipitation for Maine from (a, b, d) 1895 to 2020 and (c) 1900 to 2020. Dots show annual values. 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 for Maine: (a) 16.1°F (b) 62.9°F, (c) 5.3 days, (d) 42.7 inches. Summer and winter temperatures have been above average since the mid-1990s, with the highest multiyear averages for both occurring during the 2010–2014 period. Annual precipitation has been above average for the past 16 years (2005–2020). Sources: (a–d) CISESS and NOAA NCEI. Data: (a, b, d) nClimDiv, (c) GHCN-Daily from 3 long-term stations.

Total annual precipitation in Maine reached a historically high multiyear average during the 2005–2009 period (Figure 2d). In the harsh winter months, average accumulated snowfall ranges from 40 to 80 inches across the Southern Interior and Northern Interior climate divisions, with the northern tip of the state receiving up to 100 inches. The annual number of 2-inch extreme precipitation events has varied over the period of record, but the 10-year interval from 2005 to 2014 had a record number (nearly double the long-term average; Figure 4), similar to the rest of the northeastern United States.

Maine has also been experiencing more short-term dry periods, with extreme drought occurring in 2002, 2016, and 2020. Drought conditions in 2020 contributed to more than 900 wildfires, the most Maine has seen in a decade.

Heat and cold waves, droughts, 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. 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. Observed wind speeds from nor'easters are commonly equal to or greater than those from hurricanes that have reached Maine. Nor'easters are prevalent in most years in winter, spring, and fall, while landfalling hurricanes are very rare. Since 1861, only 3 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 during this century (Figure 1). Even under a lower emissions pathway, temperatures are generally projected to 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. The intensity of cold waves is projected to decrease, while heat waves are projected to increase in intensity, potentially raising the importance of such events in this normally moderate summer climate.

Precipitation is projected to increase. Maine is part of a large area in the higher mid-latitudes that is projected to see increases in winter (Figure 5) and spring precipitation. The frequency of extreme precipitation events is also projected to increase, potentially resulting in increased flooding risks and the degradation of surface water quality as greater runoff from more intense storms carries pollutants into freshwater resources.

Since 1900, global average sea level has risen by about 7–8 inches. It is projected to rise another 1–8 feet, with a likely range of 1–4 feet, by 2100 as a result of both past and future emissions from human activities (Figure 6). **Greater rises along the Maine coast are possible**. Sea surface temperatures in the coastal waters of Maine have increased by almost 2°F since 1970. The Gulf of Maine has warmed faster than 99% of the global

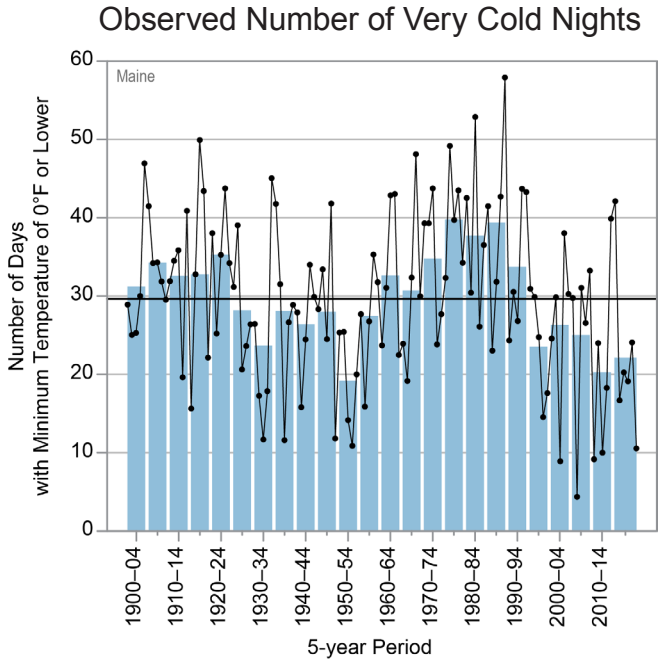


Figure 3: Observed annual number of very cold nights (minimum temperature of 0°F or lower) for Maine from 1900 to 2020. Dots show annual values. Bars show averages over 5-year periods (last bar is a 6-year average). The horizontal black line shows the long-term (entire period) average of 29.6 nights. Periods of very cold nighttime temperatures have occurred episodically throughout the period of record, notably in the 1970s and 1980s. Since the mid-1990s, the number of very cold nights has been below average, reflecting winter warming. Sources: CISESS and NOAA NCEI. Data: GHCN-Daily from 3 long-term stations.

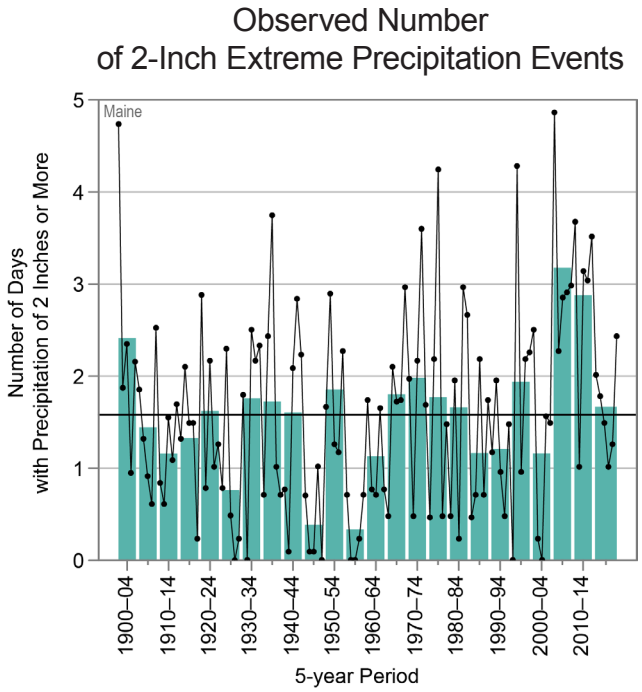


Figure 4: Observed annual number of 2-inch extreme precipitation events (days with precipitation of 2 inches or more) for Maine from 1900 to 2020. Dots show annual values. Bars show averages over 5-year periods (last bar is a 6-year average). The horizontal black line shows the long-term (entire period) average of 1.6 days. A typical reporting station experiences 1 to 2 events per year. Maine experienced a record number of 2-inch extreme precipitation events during the 2005–2009 and 2010–2014 periods. Sources: CISESS and NOAA NCEI. Data: GHCN-Daily from 3 long-term stations.

ocean. Tide-gauge records in Portland show a sea level rise of approximately 7.4 inches since 1912. Changes in ocean and atmospheric circulation have caused temporary, destructive increases in sea level, such as the 5-inch rise along the Maine coast in 2010. Future projections of sea level rise show that some coastal cities and towns could lose up to 30% of their land area.

Sea level rise has caused an increase in tidal floods associated with nuisance-level impacts. Nuisance floods are events in which water levels exceed the local threshold (set by NOAA's National Weather Service) for minor impacts. These events can damage infrastructure, cause road closures, and overwhelm storm drains. Nuisance flooding has increased in all U.S. coastal areas, with more rapid increases along the East and Gulf Coasts. Nuisance flooding events in Maine are likely to occur more frequently as global and local sea levels continue to rise.

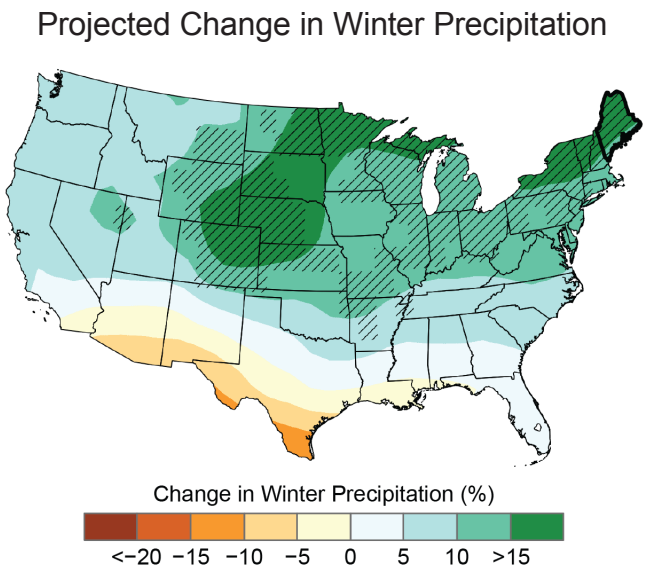


Figure 5: Projected changes in total winter (December–February) precipitation (%) for the middle of the 21st century compared to the late 20th century under a higher emissions pathway. Hatching represents areas where the majority of climate models indicate a statistically significant change. Maine is part of a large area in the northeastern and central United States with projected increases in winter precipitation. Sources: CISESS and NEMAC. Data: CMIP5.

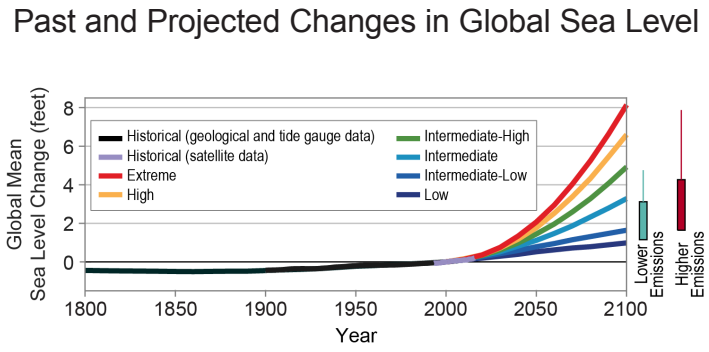


Figure 6: Global mean sea level (GMSL) change from 1800 to 2100. Projections include the six U.S. Interagency Sea Level Rise Task Force GMSL scenarios (Low, navy blue; Intermediate-Low, royal blue; Intermediate, cyan; Intermediate-High, green; High, orange; and Extreme, red curves) relative to historical geological, tide gauge, and satellite altimeter GMSL reconstructions from 1800–2015 (black and magenta lines) and the very likely ranges in 2100 under both lower and higher emissions futures (teal and dark red boxes). Global sea level rise projections range from 1 to 8 feet by 2100, with a likely range of 1 to 4 feet. Source: adapted from Sweet et al. 2017.

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