NEW HAMPSHIRE

Key Messages

Average annual temperature has increased approximately 3°F in New Hampshire since the early 20th century. Winter warming has been larger than any other season. Under a higher emissions pathway, historically unprecedented warming is projected by the end of the 21st century. Future winter warming will have large effects on snowfall and snow cover.

Precipitation has increased during the last century, with the highest numbers of extreme precipitation events occurring over the last decade. Mean precipitation and precipitation extremes are projected to increase in the future, with associated increases in flooding.

Global sea level has risen about 8 inches since reliable record keeping began in 1880. Sea level is projected to increase another 1 to 4 feet by 2100. Rising sea levels pose significant risks to coastal communities and structures, such as inundation, land loss due to erosion, and greater flood vulnerability due to higher storm surge.

New Hampshire 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. **The climate of the state is characterized by cold, snowy winters and mild summers.** The jet stream is often in the vicinity, particularly in the late fall, winter, and spring, giving the state its highly variable weather patterns. Precipitation is frequent because several preferred storm tracks associated with the jet stream all cross the state. The extreme north and west are the least influenced by the moderating effects of the Gulf of Maine, and thus experience more extreme cold temperatures. The southeast, with its lower elevations and proximity to the Atlantic Ocean, is somewhat warmer. Average annual minimum temperatures in January are colder in the north (Lancaster: 0–5°F) and at higher elevations (Mount Washington: –4°F) compared to the southern portion of the state (Concord: 5–10°F). Coastal communities, such as Portsmouth, are warmer yet with average minimum temperatures ranging from 10°F to 15°F. Average maximum temperatures in July range from 75°F to 80°F in the north, and between 80°F and 85°F in the south. The statewide average annual precipitation is 44.2 inches. Higher amounts of precipitation occur in the south and along the eastern border of the state and less in the west and north.

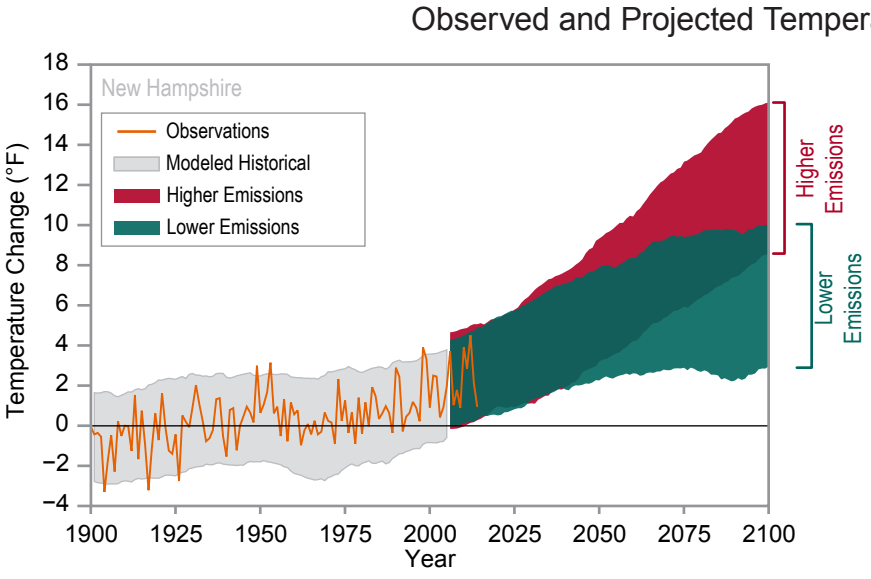

Figure 1: Observed and projected changes (compared to the 1901–1960 average) in near-surface air temperature for New Hampshire. Observed data are for 1900–2014. Projected changes for 2006–2100 are from global climate models for two possible futures: one in which greenhouse gas emissions continue to increase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

[1]Technical details on models and projections are provided in an appendix, available online at: https://statesummaries.ncics.org/nh.

Temperatures in New Hampshire have increased approximately 3°F since the beginning of the 20th century (Figure 1). The number of hot days (maximum temperature above 90°F) in New Hampshire has been variable across the period of record (1950–2014) (Figure 2a). However, the greatest number of hot days on record (9 days per year) occurred during the most recent 5-year period of 2010–2014. Since the mid-1990s, the number of warm nights (minimum temperature above 70°F) in New Hampshire has been above average (Figure 2b). The highest 5-year average number of warm nights (about 1.3 days) occurred during 2000–2004 (Figure 2b). The greatest warming has occurred in the winter with an increase of about 4°F since 1900. This is reflected in the number of very cold nights (minimum temperature below 0°F) which has been below average since the mid-1990s. The lowest number of cold nights (about 18 days) occurred during the most recent 5-year period of 2010–2014 (Figure 3). The warmer winters are also reflected in a trend toward earlier ice-out dates on lakes and fewer frost days (minimum temperatures below 32°F).

Annual precipitation for New Hampshire has been well above average in the most recent decade (2005–2014) (Figure 2c).

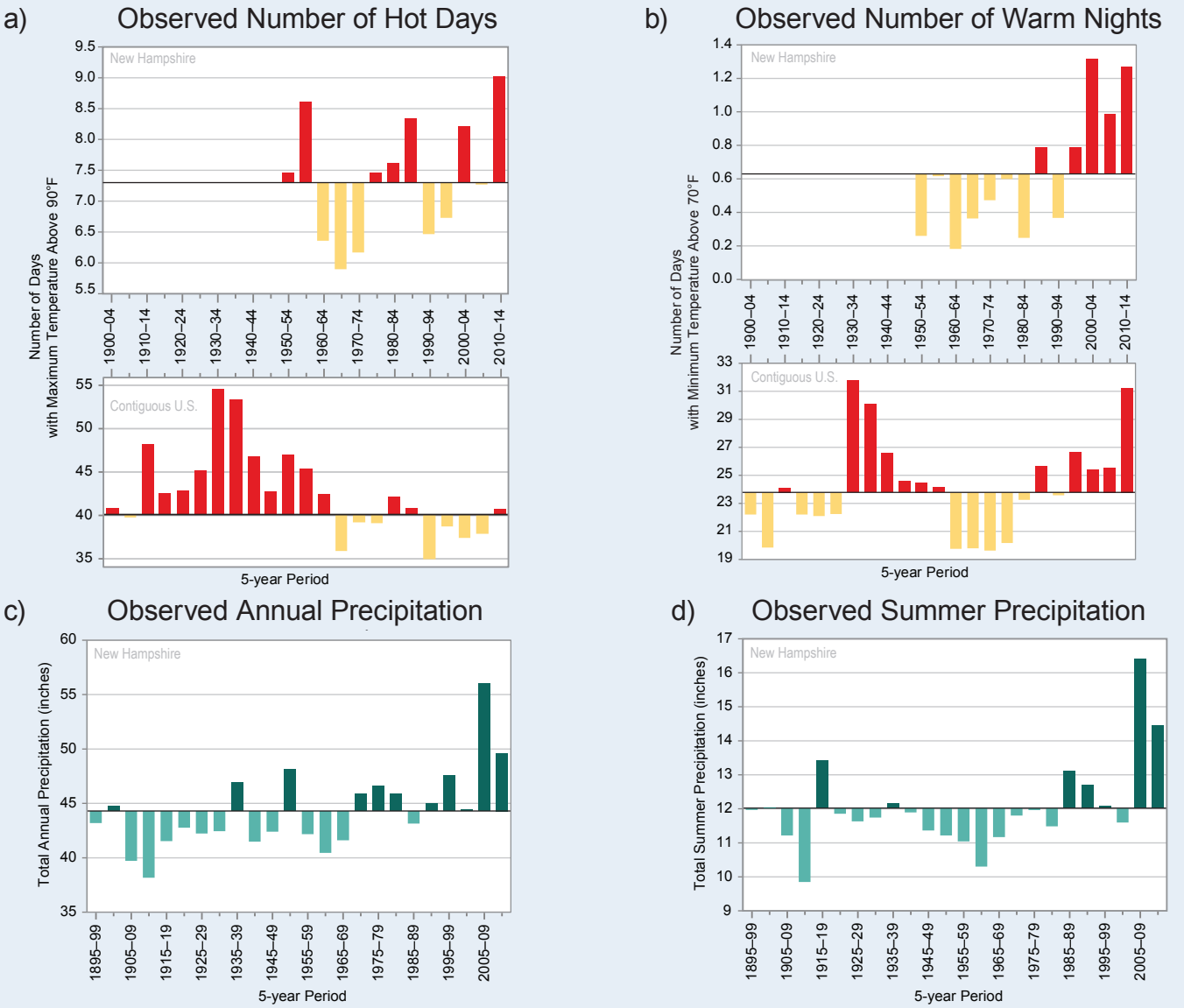

Figure 2: The observed (a) number of hot days (maximum temperature above 90°F), (b) number of warm nights (minimum temperature greater than 70°F), (c) average annual precipitation, and (d) average summer precipitation, averaged over 5-year periods. The dark horizontal lines represent the long-term average. Figures 2a and 2b are based on values from 10 long-term stations. Figures 2c and 2d are based on NCEI's new climate division data set. Values for the contiguous United States (bottom panel) are also shown where appropriate to provide a longer and larger context (long-term stations back to 1900 were not available for New Hampshire). The dark horizontal lines represent the long-term average. There is no overall trend in the number of hot days in New Hampshire; however, the number of warm nights has been above average since the mid-1990s. A significantly larger amount of both annual and summer precipitation has occurred during 2005–2014 than in any previous decade. Source: CICS-NC and NOAA NCEI.

The 2010–2014 average of 49 inches was second only to the record-setting average of 56 inches in 2005–2009. The driest multi-year periods were in the 1900s, 1910s, and the 1960s and the wettest in the 1970s and 2000s (Figure 2c). The wettest 5-year period was 2005–2009 and the driest was 1963–1967. A recent state-level analysis for southern New Hampshire found that the rate of increase in annual precipitation from 1970 to 2012 was double to triple the long-term average (1895–2012) because of the high values occurring from 2005 to 2011. Average annual precipitation has increased 7–18% in northern New Hampshire, and from 12–20% in the south. Similar increases in average summer precipitation have been observed in the last decade, with record amounts of summer rainfall occurring during 2005–2009 (averaging 16.5 inches per summer) (Figure 2d). The state experienced the largest number of extreme precipitation events (days with more than 2 inches) during 2005–2009 (about 2.4 events per year), and an above average number during 2010–2014 as well (about 2 events per year) (Figure 4).

Extreme weather events common to New Hampshire include severe coastal storms, winter storms, cold waves, thunderstorms, floods, and tropical cyclones. The Federal Emergency Management Agency (FEMA) made 18 major disaster declarations for New Hampshire in the last decade (2003–2014). The majority of declarations (10 out of 18) were related to severe storms and flooding. **The state's coastline is highly vulnerable to damage from winter coastal storms (commonly referred to as nor'easters) and tropical cyclone (hurricanes and tropical storms) events.** These cyclonic storms often result in wide-scale flooding, property damage, and coastal erosion. Superstorm Sandy in 2012 was the most extreme and destructive event to affect the northeastern United States in 40 years and the second costliest in the Nation's history. The storm surge was the most destructive element of Sandy, with storm surge heights reaching 3.2 feet above normal tide levels in New Hampshire. New Hampshire suffered an estimated $80 million in property losses.

Winter storms are an important feature of the New Hampshire climate. In most years, several snowstorms, depositing 5 or more inches of snow, will affect the state. Winter snowfall totals for 2014–2015 were well above the long-term average across southern portions of the state. For example, Concord received more than 90 inches of snow during the 2014–2015

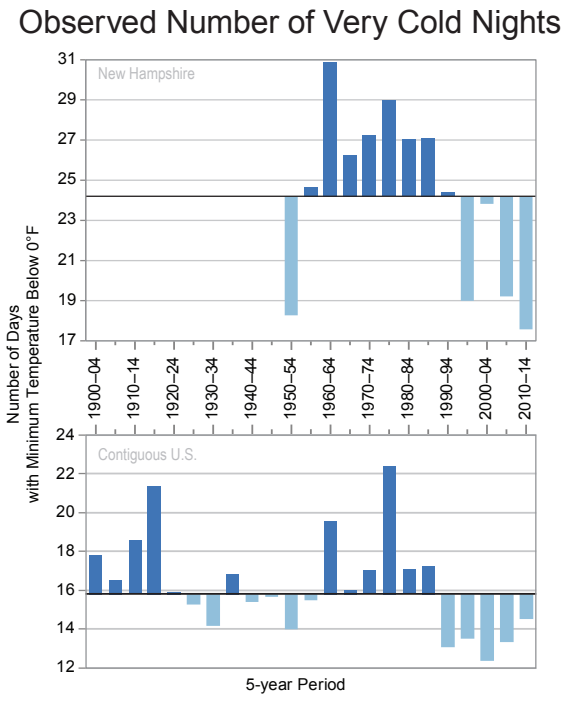

Figure 3: The observed number of very cold nights (annual number of days with minimum temperature below 0°F) for 1900–2014, averaged over 5-year periods; these values are averages from 10 long-term reporting stations. The number of very cold nights for the contiguous United States (bottom panel) is also shown to provide a longer and larger context. The dark horizontal lines represent the long-term average. Long-term stations back to 1900 were not available for New Hampshire. Since the mid-1990s, very cold days have been below the long-term average. The lowest number of cold days occurred during 2010–2014. Source: CICS-NC and NOAA NCEI.

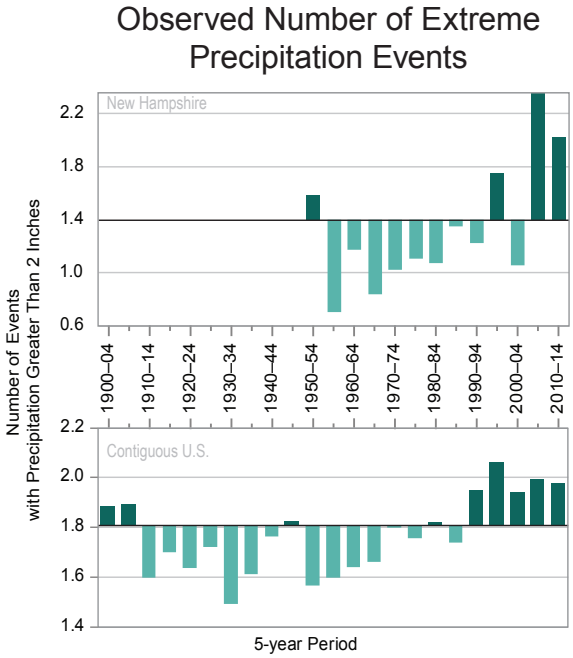

Figure 4: The observed number of extreme precipitation events (annual number of events with greater than 2 inches) for 1900–2014, averaged over 5-year periods; these values are averages from 17 long-term reporting stations. The number of extreme precipitation events for the contiguous United States (bottom panel) is also shown to provide a longer and larger context. The dark horizontal lines represent the long-term average. Long-term stations back to 1900 were not available for New Hampshire. The number of extreme precipitation events has been the highest during the last decade. Source: CICS-NC and NOAA NCEI.

winter compared to the long-term average of about 60 inches. However, the winter of 2007–2008 holds the record for the highest seasonal snowfall in Concord (119 inches). **Although these recent winters were snowy, overall snowfall has been declining at a majority of stations.** The number of snow-covered days is also decreasing throughout the state.

Under a higher emissions pathway, historically unprecedented warming is projected by the end of the 21st century (Figure 1). Even under a pathway of lower greenhouse gas emissions, average annual 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. Heat waves are projected to increase in intensity while cold waves are projected to become less intense. In response to cold season warming, the state can expect more precipitation falling as rain compared to snow, earlier lake ice-out dates, and a decline in days with snow cover. This has implications for winter tourism. Southern New Hampshire is projected to experience between 23 (lower emissions pathway) and 54 days (higher emissions pathway) with maximum temperatures above 90°F by 2070–2099, while in the north, the number of hot days is projected to be between 14 (lower emissions) and 38 days (higher emissions) per year.

Annual mean precipitation is projected to continue to increase for New Hampshire over this century, particularly during the winter (Figure 5). This trend is characteristic of a large area of the Northern Hemisphere in the higher middle latitudes projected to see increases in precipitation as well as increases in heavy precipitation events. The frequency of extreme precipitation events is also expected to more than double in the region by the end of the 21st century under a higher emissions pathway. Above average precipitation amounts and more frequent extreme precipitation events may also result in increased flooding risks. The intensity of naturally occurring droughts is projected to increase because of an increased rate of depletion of soil moisture depletion during dry spells from higher temperatures.

Since 1880, global sea level has risen by about 8 inches. Coastal communities in Portsmouth are particularly vulnerable to sea level rise and coastal storm surge. From 1926 to 2001, tidal gauge records showed sea level in Portsmouth Harbor rose nearly half a foot (5.3 inches), nearly the same as the global average. **Globally, sea level is projected to rise another 1 to 4 feet by 2100** as a result of both past and future emissions from human activities (Figure 6). 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 New Hampshire are likely to occur more frequently as global and local sea levels continue to rise. Sea level rise also contributes to increases in coastal erosion and saltwater intrusion.

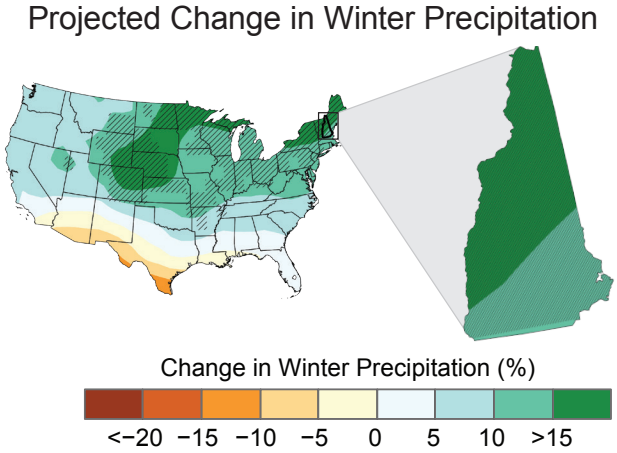

Figure 5: Projected change in winter precipitation (%) for the middle of the 21st century relative to the late 20th century under a higher emissions future. Hatching represents portions of the state where the majority of climate models indicate a statistically significant change. Annual winter precipitation is projected to increase in New Hampshire. Source: CICS-NC and NOAA NCEI.

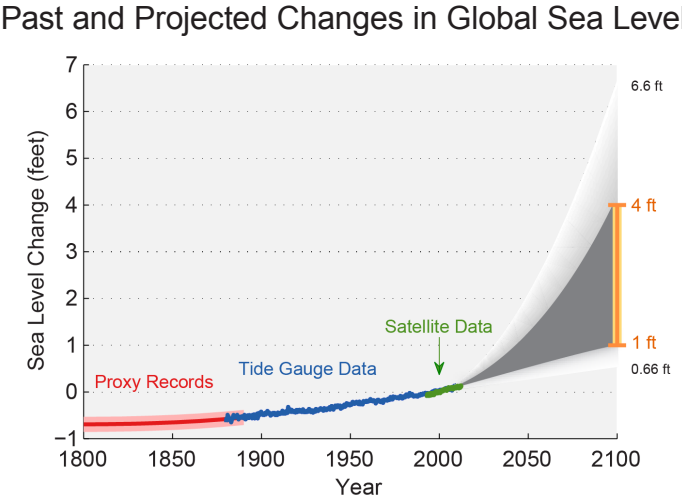

Figure 6: Estimated, observed, and possible future amounts of global sea level rise from 1800 to 2100, relative to the year 2000. The orange line at right shows the most likely range of 1 to 4 feet by 2100 based on an assessment of scientific studies, which falls within a larger possible range of 0.66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