# OREGON

## Key Messages

**Average annual temperatures have increased approximately 2°F since the beginning of the 20th century. Winter warming has been characterized by rising nighttime temperatures, with the number of very cold nights falling far below average during recent years. Under a higher emissions pathway, historically unprecedented warming is projected by the end of the 21st century.**

**Snowpack plays a critical role in spring and summer water supplies. Projected rising temperatures will lead to more occurrences of rain falling instead of snow, and earlier melting of the snowpack; this could have negative impacts on critical sectors.**

**Precipitation varies greatly across this diverse state and throughout the year. Projected increases in winter precipitation and decreases in summer precipitation will change the dry season availability of water, leading to challenges for water management. Both the frequency of wildfire occurrence and wildfire severity are projected to increase in Oregon.**

Oregon's climate varies widely from eastern to western regions of the state. On the western side, temperatures are generally mild due to the Pacific Ocean's moderating effect. The Pacific Ocean also provides abundant moisture, causing frequent precipitation west of the Cascade Mountains from October to May. Temperatures in the central and eastern portions of the state exhibit a greater annual and diurnal range. The Cascades block the flow of moisture and as a result it is much drier east of the Cascades. Oregon seldom experiences severe thunderstorms, compared to other states in the nation.

**Since the beginning of the 20th century, temperatures have risen approximately 2°F, and temperatures in the 1990s and 2000s have been higher than any other historical period** (Figure 1). The year 2014 was the 3rd warmest and 2015 was the warmest year since records began in 1895 (1934 was the 2nd warmest). During the period of 2005–2009, the state experienced the largest number of extremely hot days (days with maximum

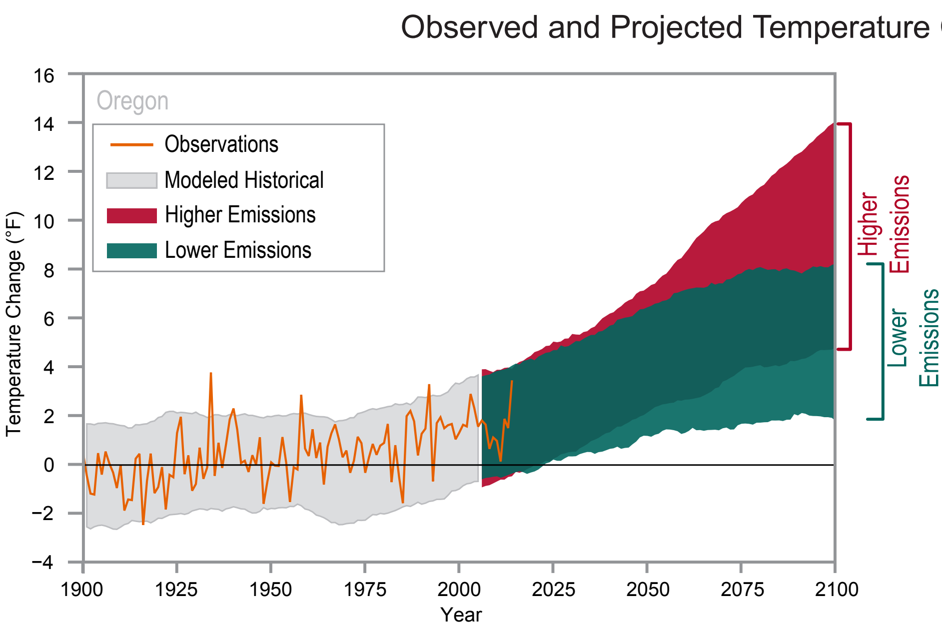


**Figure 1:** Observed and projected changes (compared to the 1901–1960 average) in near-surface air temperature for Oregon. Observed data are for 1900–2014. Projected changes for 2006–2100 are from global climate models for two possible futures: one in which greenhouse gas emissions continue to increase (higher emissions) and another in which greenhouse gas emissions increase at a slower rate (lower emissions)[1]. Temperatures in Oregon (orange line) have risen about 2°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 2°F warmer than the historical average; green shading) and more warming under a higher emissions future (the hottest years being about 10°F warmer than the hottest year in the historical record; 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/or.

temperature above 100°F) in the historical record (Figure 2). In addition to the overall trend of higher average temperatures, the state has experienced below average numbers of very cold nights (days with minimum temperature below 0°F) over the past two decades (Figure 3). The number of days below freezing was lowest during 2000–2004, but has been near average during the last 10 years (Figure 4a). The state rarely experiences warm nights (days with minimum temperature above 70°F) due to the moderating effects of the Pacific Ocean in the west and the low humidity in the east (Figure 4b). Minimum temperatures are increasing at a faster rate than daytime maximums, however, with the summer of 2015 experiencing the warmest minimum temperatures on record.

**Regional precipitation varies widely across the state and from year to year, with areas west of the Cascades also experiencing a large variation in rainfall amounts between seasons.** Portions of the Coast Range receive in excess of 100 inches of precipitation annually, while some of the desert areas in the eastern part of the state receive less than 10 inches. Statewide annual precipitation has ranged from a low of about 22 inches in 1930 to a high of about 49 inches in 1996, and precipitation can fluctuate greatly between years. When averaged over 5-year periods, precipitation has ranged from 26.2 inches annually during the driest period on record (1928–1932) to 39.5 inches during the wettest period on record (1995–1999) (Figure 4c). Long-term periods of wet and dry spells can have critical impacts on water supplies.

**Unlike many areas of the United States, Oregon has not experienced an upward trend in the frequency of extreme precipitation events** (Figure 4d). The number of heavy rain events (more than 2 inches of precipitation) has been highly variable over the historical record (since 1900). The past two decades have included the 5-year periods with the highest frequency of extreme rain events (1995–1999) and the lowest frequency (2000–2004).

**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

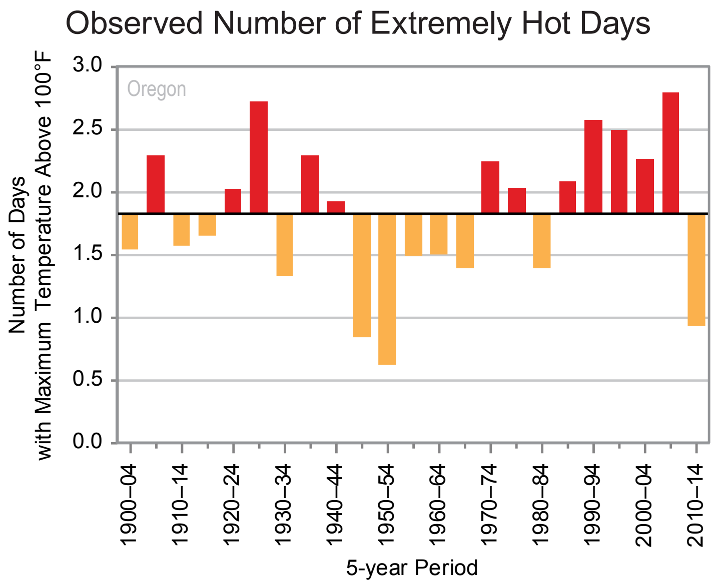


**Figure 2:** The observed number of extremely hot days (annual number of days with maximum temperature above 100°F) for 1900–2014, averaged over 5-year periods; these values are averages from 14 long-term reporting stations. The dark horizontal line represents the long-term average. The number of extremely hot days has been mostly above the long-term average since the late 1980s, reaching a historic peak in 2000–2004. However, the number was below average during the most recent 5-year period. Source: CICS-NC and NOAA NCEI.

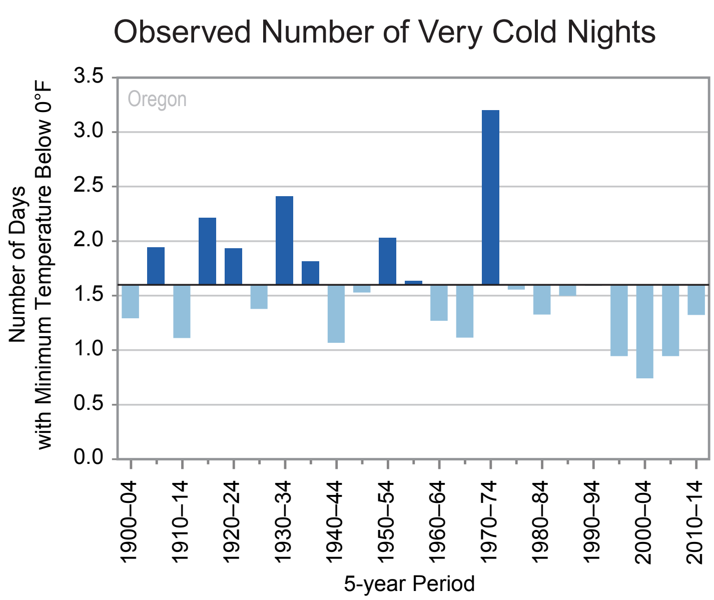


**Figure 3:** The observed number of very cold nights (annual number of days with minimum temperature below 0°F) for 1900–2014, averaged over 5-year periods; these values are averages from 14 long-term reporting stations. The dark horizontal line represents the long-term average. Since 1995, Oregon has experienced a below average number of very cold nights, indicative of the winter warming occurring in the region. Source: CICS-NC and NOAA NCEI.

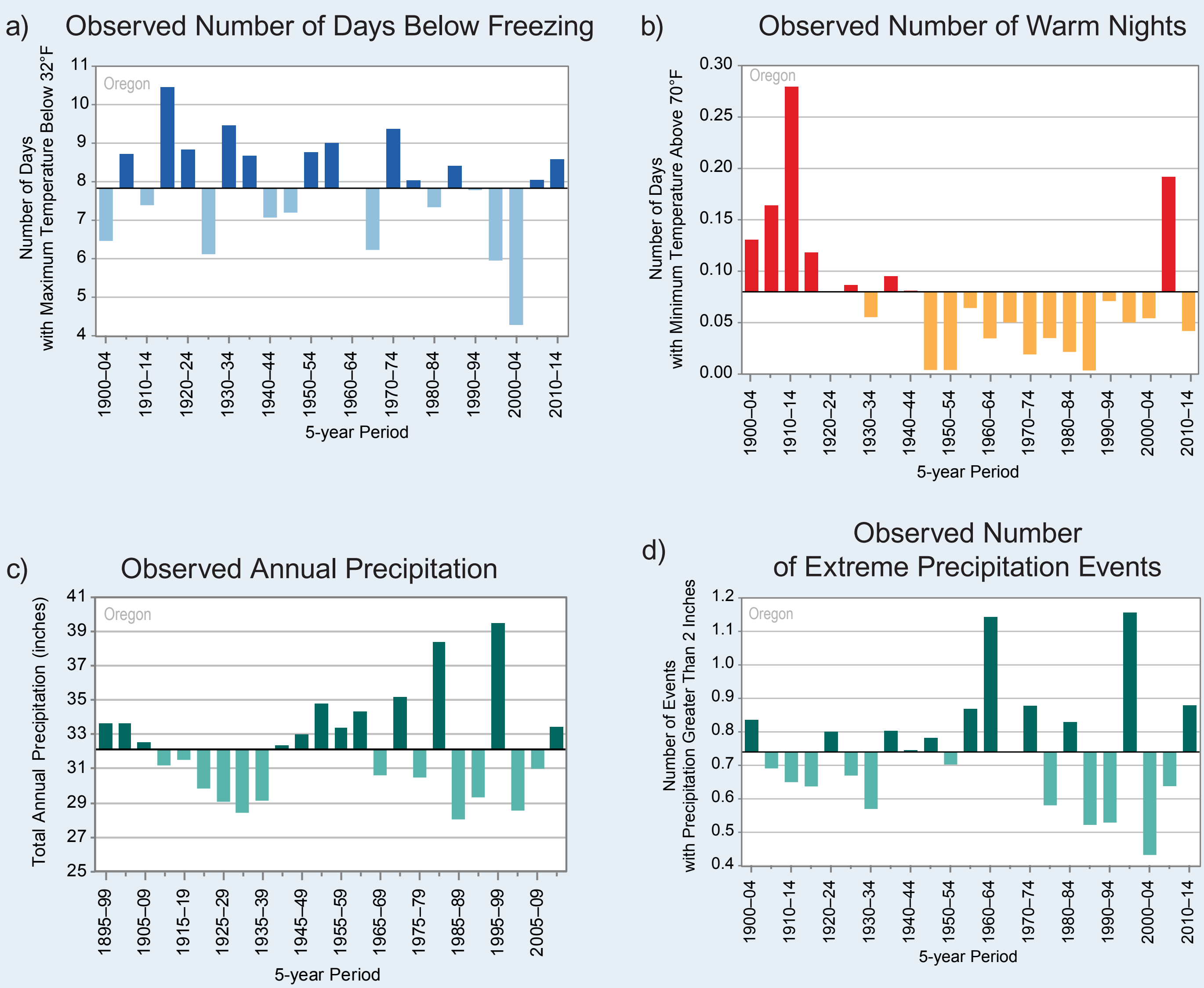


**Figure 4:** The observed number of (a) days below freezing (annual number of days with maximum temperature below 32°F), (b) warm nights (annual number of days with minimum temperature above 70°F), (c) annual precipitation, and (d) extreme precipitation (annual number of days with precipitation greater than 2 inches), averaged over 5-year periods. The values in Figures 4a, b, and d are averages from long-term reporting stations, 14 for temperature and 15 for precipitation. The values in Figure 4c are from NCEI's version 2 climate division dataset. The dark horizontal line represents the long-term average.From 1995 to 2004, Oregon experienced a below normal number of days below freezing. However, the number of days below freezing has been above average in recent years. The observed number of warm nights does not exhibit a trend, although the 2005–2009 period experienced the second highest number on record. Annual precipitation varies widely, and precipitation during the most recent decade (2010–2014) has been near the long-term average. Observing stations record extreme precipitation events on average every 1-2 years, however, the last two decades have seen 5-year periods with both the highest (1995–1999) and lowest (2000–2004) frequency of extreme rain events. Source: CICS-NC and NOAA NCEI.

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 (Figure 1).

Projected rising temperatures will increase the average lowest elevation at which snow falls (the snow line, or snow level) by about 300 feet per degree of warming. **This will increase the likelihood that precipitation will fall as rain instead of snow, reducing water storage in the snowpack, particularly at lower elevations which are now on the margins of reliable snowpack accumulation.** Since most of Oregon's precipitation falls during the winter months, the snowpack at higher elevations is an important source of water during the drier summer months (Figure 5). Higher spring temperatures will also result in earlier melting of the snowpack, further decreasing water availability for critical sectors such as agriculture and recreation.

**Although projections of overall annual precipitation are uncertain, winter precipitation is projected to increase** (Figure 6) **while summer precipitation is projected to decrease.** When combined with increasing temperatures leading to a higher proportion of precipitation falling as rain, water available during the dry season from snowmelt is projected to decrease and pose challenges for water management. These changes are of particular concern for areas that rely on hydroelectric power, and for regions that depend on the availability of irrigation water from snowmelt-fed basins. For example, the 2015 snow drought caused hundreds of million dollars in crop losses, as well as negatively impacting local fish populations.

Wildfires are also of particular concern for the state, and have become more severe and costly in recent years. The Long Draw fire in 2012 was the state's largest wildfire since the 1860s, burning over half a million acres in southeastern Oregon. **Drier summers, along with higher temperatures and earlier melting of the snowpack, are projected to lead to an increase in the frequency and severity of wildfires**.

**Increasing temperatures raise concerns for sea level rise in coastal areas.** Since 1880, global sea level has risen by about eight inches. It is projected to rise another one to four feet by 2100 as a result of both past and future emissions due to human activities (Figure 7). Due to the movement of tectonic plates on the ocean floors, the Oregon coast is rising, a phenomenon known as "uplift." In some parts of the Oregon coast, the uplift is exceeding the rate of sea level rise; consequently, sea level has dropped in these locations. However, the rate of sea level rise is projected to exceed the rate of uplift along the entire Oregon coast by the mid-21st century, resulting in sea level rise for all locations.

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 events in Oregon are likely to occur more frequently as global and local sea levels continue to rise.

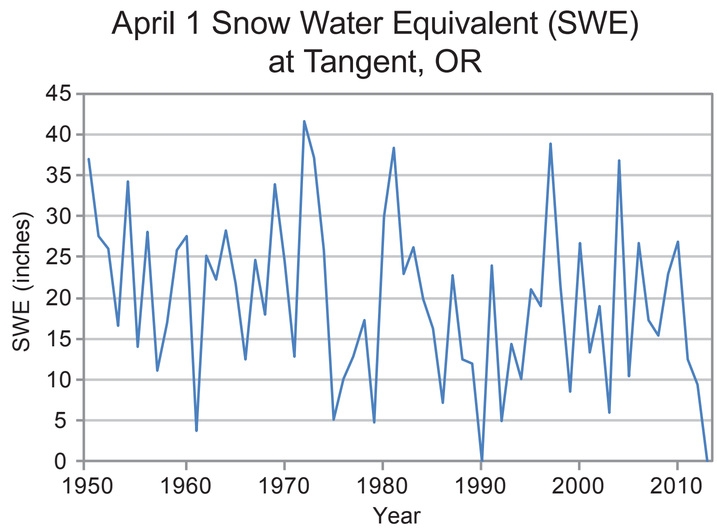


**Figure 5:** Variations in the annual April 1 snow water equivalent at the Tangent Snow Course site, located near Bend, OR. Snow water equivalent (SWE) is the amount of water contained within the snowpack. SWE is highly variable from year to year. There was no snowpack in 2015 due to unusually low precipitation and warm temperatures during the first three months of the year. Source: USDA Natural Resources Conservation Service.

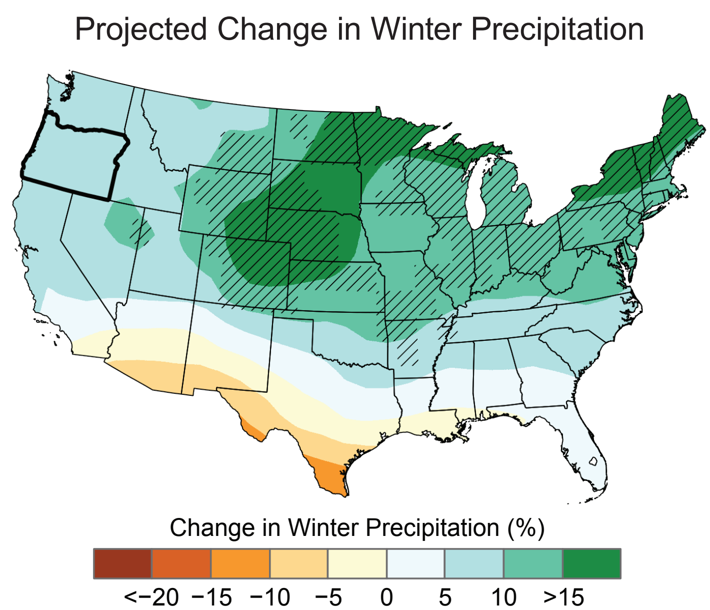


**Figure 6:** Projected changes in winter precipitation (%) for the middle of the 21st century compared to the late 20th century under a higher emissions pathway. Hatching represents areas where the majority of climate models indicate a statistically significant change. Precipitation in the winter is projected to increase across the entire state of Oregon. Source: CICS-NC, NOAA NCEI, and NEMAC.

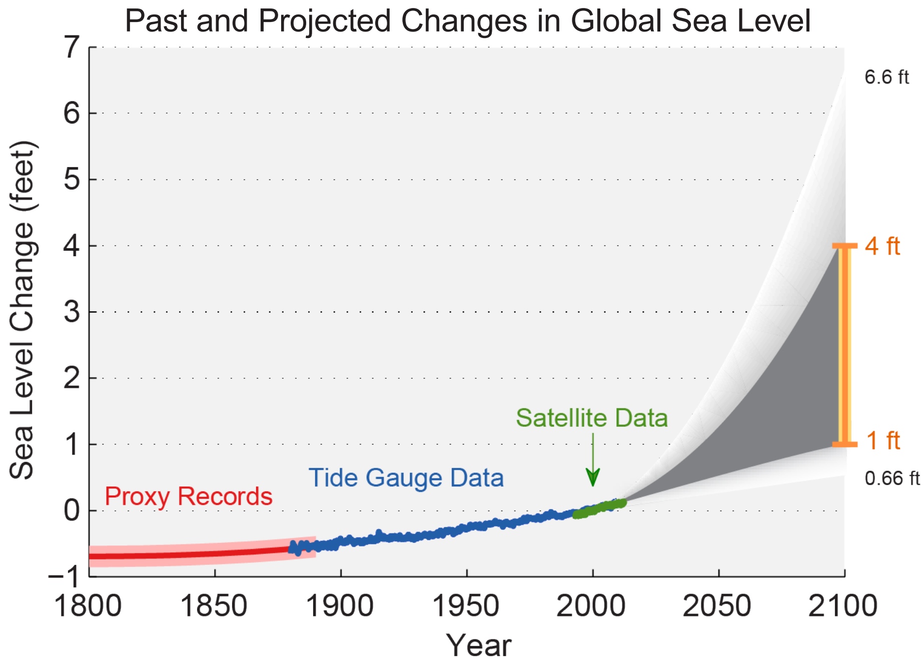


**Figure 7:** Estimated, observed, and possible future amounts of global sea level rise from 1800 to 2100, relative to the year 2000. The orange line at right shows the most likely range of 1 to 4 feet by 2100 based on an assessment of scientific studies, which falls within a larger possible range of 0.66 feet to 6.6 feet. Source: Melillo et al. 2014 and Parris et al. 2012.