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United States Environmental Protection Agency

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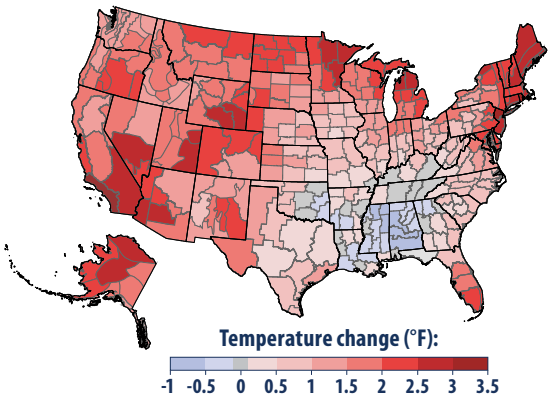
What Climate Change *Means for* California

California's climate is changing. Southern California has warmed about three degrees (F) in the last century and all of the state is becoming warmer. Heat waves are becoming more common, snow is melting earlier in spring—and in southern California, less rain is falling as well. In the coming decades, the changing climate is likely to further decrease the supply of water, increase the risk of wildfires, and threaten coastal development and ecosystems.

Our climate is changing because the earth is warming. People have increased the amount of carbon dioxide in the air by 40 percent since the late 1700s. Other heat-trapping greenhouse gases are also increasing. These gases have warmed the surface and lower atmosphere of our planet about one degree during the last 50 years. Evaporation increases as the atmosphere warms, which increases humidity, average rainfall, and the frequency of heavy rainstorms in many places—but contributes to drought in others.

Greenhouse gases are also changing the world's oceans and ice cover. Carbon dioxide reacts with water to form carbonic acid, so the oceans are becoming more acidic. The surface of the ocean has warmed one degree during the last 80 years. Warming is causing snow to melt earlier in spring, and mountain glaciers are retreating. Even the great ice sheets on Greenland and Antarctica are shrinking. Thus the sea is rising at an increasing rate.



Rising temperatures in the last century. Southern California has warmed more than the rest of the state. Source: EPA, Climate Change Indicators in the United States.

Snowpack

As the climate warms, less precipitation falls as snow, and more snow melts during the winter. That decreases snowpack—the amount of snow that accumulates over the winter. Since the 1950s, the snowpack has declined in California and the nearby states that drain into the Colorado River.

Diminishing snowpack can shorten the season for skiing and other forms of winter tourism and recreation. The tree line may shift, as mountain hemlock and other high-altitude trees become able to grow at higher elevations. A higher tree line would decrease the extent of alpine tundra ecosystems, which could threaten some species.

Water Availability

The changing climate is likely to increase the need for water but reduce the supply. Rising temperatures increase the rate at which water evaporates into the air from soils and surface waters. Rising temperatures also increase the rate at which plants transpire water into the air to keep cool, so irrigated farmland would need more water. But less water is likely to be available, because precipitation is unlikely to increase as much as evaporation. Soils are likely to be drier, and periods without rain are likely to become longer, making droughts more severe. Increasing temperatures and declining rainfall in nearby states have reduced the flow of water in the Colorado River, a key source of irrigation water in southern California.

This 2014 photo shows the dramatic effect of a multi-year drought on Lake Oroville. Credit: Kelly Grow, California Department of Water Resources.

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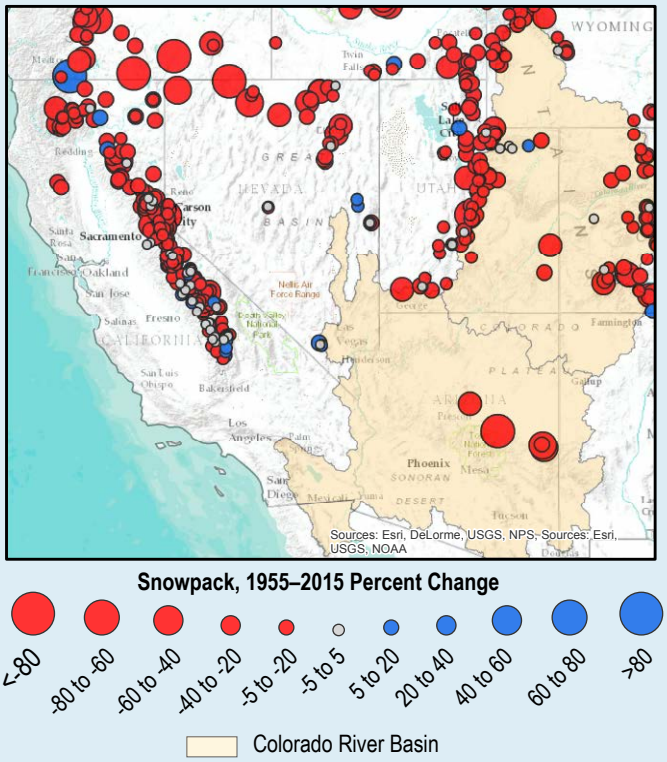
The decline in snowpack could further limit the supply of water for some purposes. Mountain snowpacks are natural reservoirs. They collect the snow that falls during winter and release water when the snow melts during spring and summer. Over the past 50 years, snowpack has been melting earlier in the year. Dams capture most meltwater and retain it for use later in the year. But upstream of these reservoirs, less water is available during droughts for ecosystems, fish, water-based recreation, and landowners who draw water directly from a flowing river.



Trends in April snowpack in California and the Colorado River Basin, 1955–2013. Snowpack has decreased at most monitoring sites in California and the basin. Source: EPA.

Agriculture

About 90 percent of crops harvested in California are grown on farms that are entirely irrigated, so a sustained decrease in the amount of water available for irrigation would force farmers to either reduce the acreage under cultivation or shift away from the most water-intensive crops. But even if sufficient water is available, rising temperatures could transform California's agriculture. Fruit trees and grape vines need a certain number of "chilling hours" during which temperatures are between 32° and 50°F in the winter before they can flower. Suitable areas for growing wine grapes are likely to shift north, and the area capable of consistently producing grapes for the highest-quality wines is likely to shrink by more than 50 percent during the next 75 years. Chilling will be insufficient in much of California for the types of fruit trees found in the state today. The yields of most grain crops currently grown in the state are likely to decline as well. Livestock may also be affected: higher temperatures cause cows to eat less, grow more slowly, and produce less milk, and in extreme cases, it may threaten their health.

Warming and drought threaten economically vital California crops, such as grapes. Credit: Caitlyn Kennedy, NOAA Climate.gov.

Wildfires and Changing Landscapes

Higher temperatures and drought are likely to increase the severity, frequency, and extent of wildfires, which could harm property, livelihoods, and human health. On average, 4 percent of the land in California has burned per decade since 1984. In 2003, the Old, Grand Prix, and Padua wildfires destroyed 800 homes in southern California, forced 100,000 residents to be evacuated, and cost $1.3 billion. Wildfire smoke can reduce air quality and increase medical visits for chest pains, respiratory problems, and heart problems.

The combination of more fires and drier conditions may expand deserts and otherwise change parts of California's landscape. Many plants and animals living in arid lands are already near the limits of what they can tolerate. A warmer and drier climate would generally expand the geographic ranges of the Sonoran, Mojave, and Great Basin deserts. In some cases, native vegetation may persist and delay or prevent expansion of the desert. In other cases, fires or livestock grazing may accelerate the conversion of grassland to desert in response to a changing climate. For similar reasons, some forests may change to desert or grassland.

Human Health

Hot days can be unhealthy—even dangerous. Certain people are especially vulnerable, including children, the elderly, the sick, and the poor. High air temperatures can cause heat stroke and dehydration, and affect people's cardiovascular, respiratory, and nervous systems. Higher temperatures are amplified in urban settings where paved and other surfaces tend to store heat. Warming can also increase the formation of ground-level ozone, a component of smog that can contribute to respiratory problems. EPA and the California Air Resources Board have been working to reduce ozone concentrations. As the climate changes, continued progress toward clean air will be more difficult.

Sea Level Rise

Sea level is likely to rise between one and four feet in the next century. Even a 16-inch rise could threaten coastal highways, bridges, and the San Francisco and Oakland airports. A rise of three feet would increase the number of Californians living in places that are flooded by a 100-year storm from about 250,000 today to about 400,000. Along some ocean shores, homes will fall into the water as beaches, bluffs, and cliffs erode; but along shores where seawalls protect shorefront homes from erosion, beaches may erode up to the seawall and then vanish. The sea could also submerge wetlands in San Francisco Bay and other estuaries, which would harm local fisheries and potentially remove key intertidal feeding habitat for migratory birds.

The sources of information about climate and the impacts of climate change in this publication are: the national climate assessments by the U.S. Global Change Research Program, synthesis and assessment products by the U.S. Climate Change Science Program, assessment reports by the Intergovernmental Panel on Climate Change, and EPA's *Climate Change Indicators in the United States*. Mention of a particular season, location, species, or any other aspect of an impact does not imply anything about the likelihood or importance of aspects that are not mentioned. For more information about climate change science, impacts, responses, and what you can do, visit EPA's Climate Change website at www.epa.gov/climatechange.

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