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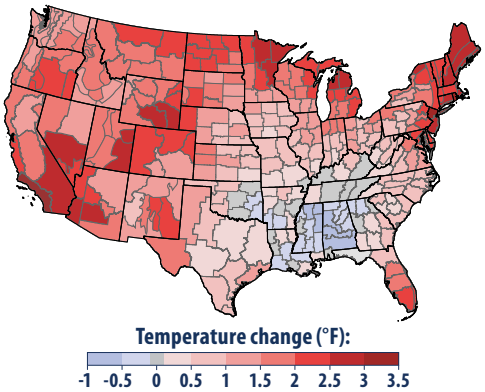
What Climate Change *Means for* Colorado

Colorado's climate is changing. Most of the state has warmed one or two degrees (F) in the last century. Throughout the western United States, heat waves are becoming more common, snow is melting earlier in spring, and less water flows through the Colorado River. Rising temperatures and recent droughts in the region have killed many trees by drying out soils, increasing the risk of forest fires, or enabling outbreaks of forest insects. In the coming decades, the changing climate is likely to decrease water availability and agricultural yields in Colorado, and further increase the risk of wildfires.

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 about one degree during the last 80 years. Warming is causing snow to melt earlier in spring.



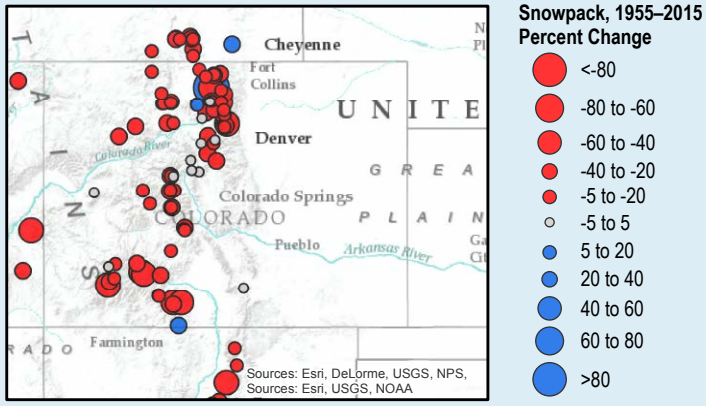
Rising temperatures in the last century. The last decade was the warmest on record throughout the West. Source: EPA, Climate Change Indicators in the United States.

Snowpack

Changes in temperature and precipitation are affecting snowpack—the amount of snow that accumulates on the ground. In most of the West, snowpack has decreased since the 1950s, due to earlier melting and less precipitation falling as snow. The amount of snowpack measured in April has declined by 20 to 60 percent at most monitoring sites in Colorado.

Diminishing snowpack can shorten the season for skiing and other forms of winter tourism and recreation. It also enables subalpine fir and other high-altitude trees to grow at higher elevations. The upward movement of the tree line will shrink the extent of alpine tundra and fragment these ecosystems, possibly causing the loss of some species.

Mount Evans in late August with Summit Lake in the foreground. During the winter, the mountain is covered by snowpack, which melts during spring and summer. The water runs off the mountain into streams that eventually flow into the South Platte River. These streams are an important part of the water supply for cities and towns along the Front Range. By August, little of the snowpack remains, as shown in the photo. As climate warms, even less snow will remain at this time of year. Credit: Boilerinbtown, Creative Commons.



Trends in April snowpack in Colorado, 1955–2013. The snowpack has declined at most monitoring sites in Colorado. Source: EPA.

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Water Availability

Throughout the West, much of the water needed for agriculture, public supplies, and other uses comes from mountain snowpack, which melts in spring and summer and runs off into rivers and fills reservoirs. Over the past 50 years, snow has been melting earlier in the year, and more late-winter precipitation has been falling as rain instead of snow. Thus, water drains from the mountains earlier in the year. In many cases, dams capture the meltwater and retain it for use later in the year. But upstream of these dams, less water is available during droughts for ecosystems, fish, water-based recreation, and landowners who draw water directly from a flowing river.

Rising temperatures also increase the rate at which water evaporates (or transpires) into the air from soils and plants. Unless rainfall increases to the same extent as evaporation, soils become drier. As a result, the soil retains more water when it rains, and thus less water runs off into rivers, streams, and reservoirs. During the last few decades, soils have become drier in most of the state, especially during summer. In the decades to come, rainfall during summer is more likely to decrease than increase in Colorado, and periods without rain are likely to become longer. All of these factors would tend to make droughts more severe in the future.

Agriculture

Changing the climate is likely to have both positive and negative effects on Colorado's farms and ranches. Livestock and field crops in the eastern part of the state rely primarily on ground water pumped from the High Plains Aquifer, which is becoming depleted. About 20 percent of crop land in eastern Colorado is irrigated. Higher evaporation rates will increase irrigation demands and reduce natural recharge of the aquifer, further lowering the water table. Reduced water availability will force some farms to switch from irrigation to dry land farming, which typically cuts yields in half. Increasingly severe heat waves would harm livestock. Even where ample water is available, higher temperatures would reduce yields of corn.

Shorter winters are likely to reduce yields of winter wheat. Colorado is currently the fourth largest grower of winter wheat, which is an important source of food for livestock. Increased concentrations of carbon dioxide, however, may increase yields of wheat enough to offset the impact of higher temperatures. Warmer and shorter winters may allow for a longer growing season, which could allow two crops per year instead of one in some instances.

Wildfires

Higher temperatures and drought are likely to increase the severity, frequency, and extent of wildfires in Colorado, which could harm property, livelihoods, and human health. In 2013, the Black Forest Fire burned 14,000 acres and destroyed over 500 homes. Wildfire smoke can reduce air quality and increase medical visits for chest pains, respiratory problems, and heart problems. The size and number of western forest fires have increased substantially since 1985.

In 2013, Colorado experienced the most destructive wildfire (the Black Forest Fire, shown here) and the second-largest wildfire (the West Fork Fire Complex) in the state's recorded history. Credit: National Wildfire Coordinating Group.

Pests

Warmer, drier conditions also make forests more susceptible to pests. Temperature controls the life cycle and winter mortality rates of pests such as the mountain pine beetle. With higher winter temperatures, some pests can persist year-round, and new pests and diseases may become established. Drought also reduces the ability of trees to mount a defense against attacks from beetles and other pests. A mountain pine beetle outbreak in 2006 covered nearly half of Colorado's forests and killed nearly five million lodgepole pines.

In the northern Williams Range Mountains, beetles have killed more than 80 percent of mature lodgepole pines over many square kilometers. Credit: USGS.

Human Health

Extreme temperatures and heat events 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. Certain people are especially vulnerable, including children, the elderly, the sick, and the poor.

Rising temperatures also increase the formation of ground-level ozone, a key component of smog. Ozone has a variety of health effects, aggravates lung diseases such as asthma, and increases the risk of premature death from heart or lung disease. EPA and the Colorado Department of Public Health and Environment have been working to reduce ozone concentrations. As the climate changes, continued progress toward clean air will be more difficult.

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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