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United States Environmental Protection Agency

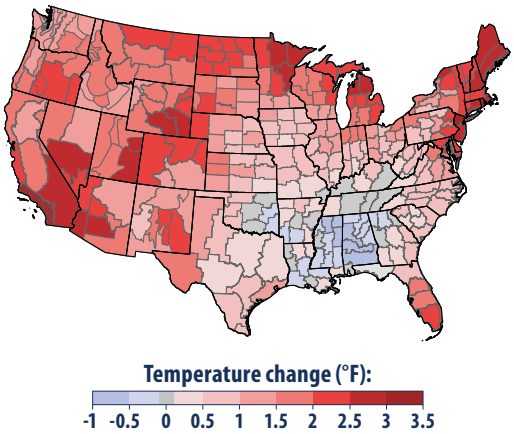
August 2016
EPA 430-F-16-005

What Climate Change *Means for* Arizona

Arizona's climate is changing. The state has warmed about two degrees (F) in the last century. Throughout the southwestern United States, heat waves are becoming more common, and snow is melting earlier in spring. In the coming decades, changing the climate is likely to decrease the flow of water in the Colorado River, threaten the health of livestock, increase the frequency and intensity of wildfires, and convert some rangelands to desert.

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 in the Southwest. 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 been decreasing in Arizona, as well as most mountainous areas in the Colorado River Basin. Diminishing snowpack can decrease water supplies and shorten the season for skiing and other forms of winter tourism and recreation.

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 (or transpires) into the air from soils, plants, and surface waters. Irrigated farmland would thus need more water. But less water is likely to be available, because precipitation is unlikely to increase enough to make up for the additional water lost to evaporation. Annual precipitation has decreased in Arizona during the last century, and it may continue to decrease. So soils are likely to be drier, and periods without rain are likely to become longer, making droughts more severe.

Lake Mead viewed from Hoover Dam in 2009. The white area reveals the drop in water levels over the last decade, during which drought has reduced flows of the Colorado River into the lake. Low lake levels threaten water supplies and hydroelectric power. © Chris Lamie; used by permission.

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, the snowpack throughout the Colorado River Basin has been melting earlier in the year (see map on back page). 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.

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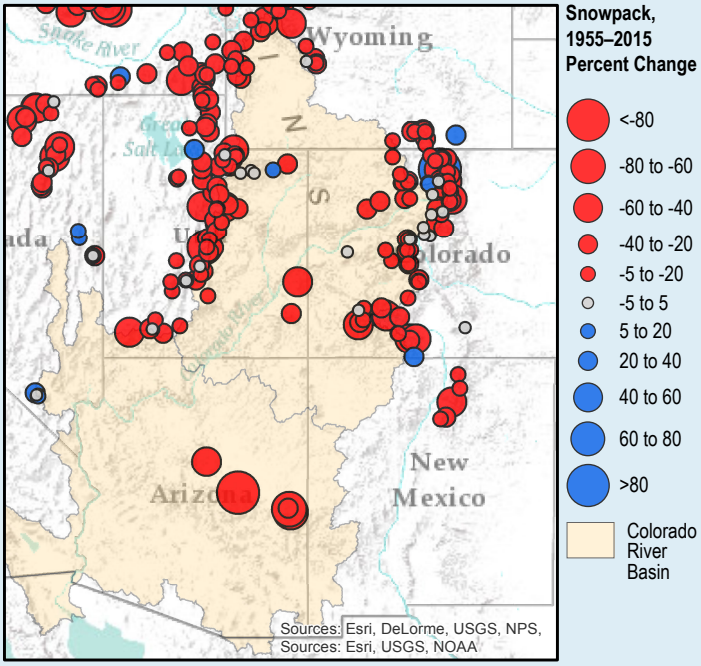

Trends in April snowpack in the Colorado River Basin, 1955–2013. Snowpack has decreased at most sites in the basin and all sites in Arizona. Source: EPA.

Agriculture

Increasing droughts and higher temperatures are likely to affect Arizona's top agricultural products: cattle, dairy, and vegetables. Hot temperatures threaten cows' health and cause them to eat less, grow more slowly, and produce less milk. Livestock operations could also be impaired by fire, the lack of water, and changes in the landscape from grassland to woody shrubs more typical of a desert. Reduced availability of water would also create challenges for irrigated farms, which account for two-thirds of the water used in the state.

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, more than 2 percent of the land in Arizona has burned per decade since 1984. 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 Arizona'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 extend the Sonoran and Chihuahuan deserts to higher elevations and expand their geographic ranges. 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.

In 2011, Arizona experienced the largest wildfire in the state's recorded history, the Wallow Fire (pictured here). It burned more than half a million acres. Two years later, the Yarnell Hill Fire became the state's deadliest wildfire when it took the lives of 19 firefighters. Credit: Eastern Arizona Incident Management Team.

Pests

Warmer and drier conditions make forests more susceptible to pests. Drought reduces the ability of trees to mount a defense against attacks from pests such as bark beetles, which have infested 100,000 acres in Arizona. Temperature controls the life cycle and winter mortality rates of many pests. With higher winter temperatures, some pests can persist year-round, and new pests and diseases may become established.

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. Construction crews may have to increasingly operate on altered time schedules to avoid the heat of the day.

Rising temperatures can 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 Arizona Department of Environmental Quality have been working to reduce ozone concentrations. As the climate changes, continued progress toward clean air will be more difficult.

Tribal Communities

Changing the climate threatens natural resources and public health of tribal communities. Rising temperatures and increasing drought are likely to decrease the availability of certain fish, game, and wild plants on which the Navajo and other tribes have relied for generations. Water may be less available for domestic consumption, especially for those who are not served by either municipal systems or reliable wells, which includes about 30 percent of the people on the Navajo Nation, who must haul water to meet daily needs. Recurring drought and rising temperatures may degrade the land itself. In the Navajo Nation, for example, the Great Falls Dune Field has advanced almost a mile in the last 60 years, threatening roads, homes, and grazing areas. Extreme heat may also create health problems for those without electricity, including about 40 percent of the people on the Navajo reservation.

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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