

# CLIMATE

## Present Weather and Climate: Average Conditions

*“The Southwest is susceptible to hazardous and costly weather and climate events. The greatest social and environmental impacts come from drought, winter storms, floods, thunderstorms, temperature extremes, and air pollution.”*



### Key Messages

*The influence of the North American monsoon is strongest in Arizona and New Mexico, where up to 50 percent of the average annual precipitation falls from July to September.*

1

The North American monsoon is important during the warm season and is most prominent in Arizona and New Mexico where it produces up to half of the average annual precipitation from July to September.

2

Seasonal and multi-year phenomena, such as the Madden-Julian Oscillation (MJO), El Niño-Southern Oscillation (ENSO), Pacific Quasi-Decadal Oscillation (QDO), and Pacific Decadal Oscillation (PDO) contribute to, but do not fully explain, month-to-month, year-to-year, and decade-to-decade climate variability within the region.

3

The Southwest is susceptible to periods of dryness that can span months to years. The most significant and severe droughts persist for multiple years and result from a diminished frequency or intensity of winter storms.

The fourth chapter of the *Assessment of Climate Change in the Southwest United States* describes baseline characteristics of current climate and hydrologic parameters, such as temperature, precipitation, and snowpack, as well as the factors that contribute to the unique climates of the region. “Present Weather and Climate: Average Conditions” discusses the main factors contributing to regional climate variability and describes important climate hazards and impacts, such as droughts, floods, wildland fires, air quality, and extreme temperatures.

## Characteristics

Winter storms in the Southwest can produce heavy snowfall; heavy rainfall; flooding; high winds; large, abrupt temperature drops; and play an important role in the regional precipitation, runoff, and water balance. With their close proximity to the Pacific Ocean, the coastal ranges and the Sierra Nevada of California experience episodes of heavy precipitation as impressive as any in the United States. Mountains and lowlands in the Southwest interior can experience large, multiday snowstorms that produce hazardous travel and avalanche conditions and play an important role in the regional precipitation, runoff, and water balance.

Strong winds, which in some areas are enhanced by coastal and topographic effects, also occur throughout the region. Severe downslope winds occur along several mountain ranges in the Southwest including the Sierra Nevada, Wasatch Mountains, and Front Range of Colorado. These events can produce severe aircraft turbulence and surface wind gusts that exceed one hundred miles per hour. In Southern California, the Santa Ana winds can produce extreme wildfire behavior and have played important roles in recent megafires.



## Snowpack

A large fraction of the precipitation in the upper-elevations of the Southwest falls as snow, which serves as a natural reservoir for the region's cities, farms, and ecosystems, and enables a vibrant tourism and recreation economy. In the Sierra Nevada and mountains of Utah and Colorado, more than sixty percent of the annual precipitation falls as snow. Fifty to ninety percent of the total runoff occurs during the April to July snowmelt runoff season in most southwestern drainage basins, providing most of the surface water resources for the region.

## Dust and Snow

During the winter and spring, wind-blown dust from lowland regions can accumulate in the mountain snowpack. Because dust is darker than snow, this increases the amount of sunlight absorbed by the snow, leading to an earlier, more rapid snowmelt. In Colorado's San Juan Mountains, large dust accumulations can shorten the duration of snow cover in the spring and summer by several weeks. Modeling studies suggest that this results in a reduced runoff volume in the upper Colorado River Basin.

*Wind-blown dust accumulation in Rocky Mountains snowpack increases the amount of sunlight absorbed by the snow, leading to an earlier, more rapid snowmelt.*  
© Center for Snow and Avalanche Studies

## Precipitation Variability

Southwest precipitation varies from month to month (intraseasonal), year to year (interannual), and decade to decade (interdecadal). In portions of the region, especially California, Nevada, and Arizona, this variability leads to the largest fluctuations relative to the average in annual precipitation and streamflow in the contiguous United States, posing challenges for water-resource management, and drought and flood preparedness.

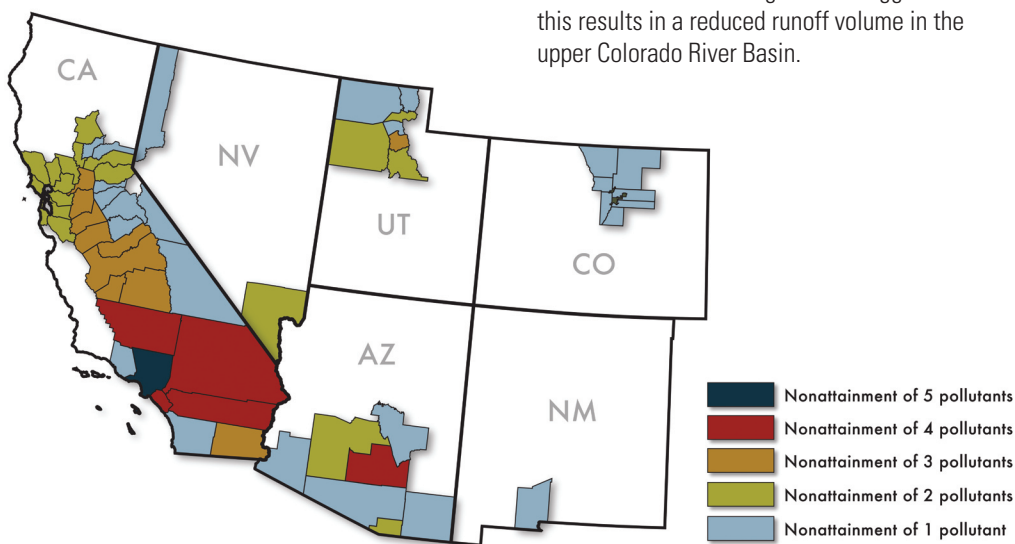
Interannual and interdecadal climate variations in the Southwest are related in part to fluctuations in Pacific sea-surface temperatures over periods of years to decades. The occurrence and transition from long-lasting droughts to periods of above-average precipitation have been linked to these fluctuations in the Pacific Ocean.

ENSO produces a tendency for above-average precipitation over the southern Southwest during El Niño winters and below-average precipitation during La Niña winters. Despite these shifts relative to average, extreme episodic precipitation events can occur in either El Niño or La Niña winters. Opposite precipitation conditions occur simultaneously in the Pacific Northwest.

## Air Quality

The Environmental Protection Agency has designated nonattainment status for National Ambient Air Quality Standards for one or more pollutants, in at least one county in each southwestern state. During the cool season, persistent cold-air pools that form in mountain valleys and basins can trap emissions from vehicles, wood-burning stoves, and industry. During multi-day events, elevated particulate pollution can develop in large urban areas (such as Salt Lake City) or even smaller cities in relatively confined valleys (such as Logan, Utah). Emissions from wildfires can also contribute to particulate matter and wind-blown dust can produce elevated particulate matter levels in some areas.

*Counties designated by the Environmental Protection Agency as nonattainment areas for National Ambient Air Quality Standards in April 2010.*



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