



# DROUGHT IN CALIFORNIA

| Trends and Climate Context

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## Introduction

(Jan 31, 2014) Now in the midst of a three-year drought, California endured its [driest calendar year on record](#) in 2013 and is currently on-track for its [driest water year in nearly 500 years](#). A minor winter storm the last week of January provided little relief. The month-end survey of the state's critically important snow pack revealed [the lowest January water content on record](#).

Climate change is intensifying the drought by driving record-breaking warm temperatures that are evaporating the snow pack and drying out soils. In addition, climate change may be at least partly responsible for the unprecedented high-pressure weather pattern (known as the “ridiculously resilient ridge”) that is blocking storms from the state.

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## Contributors to Drought

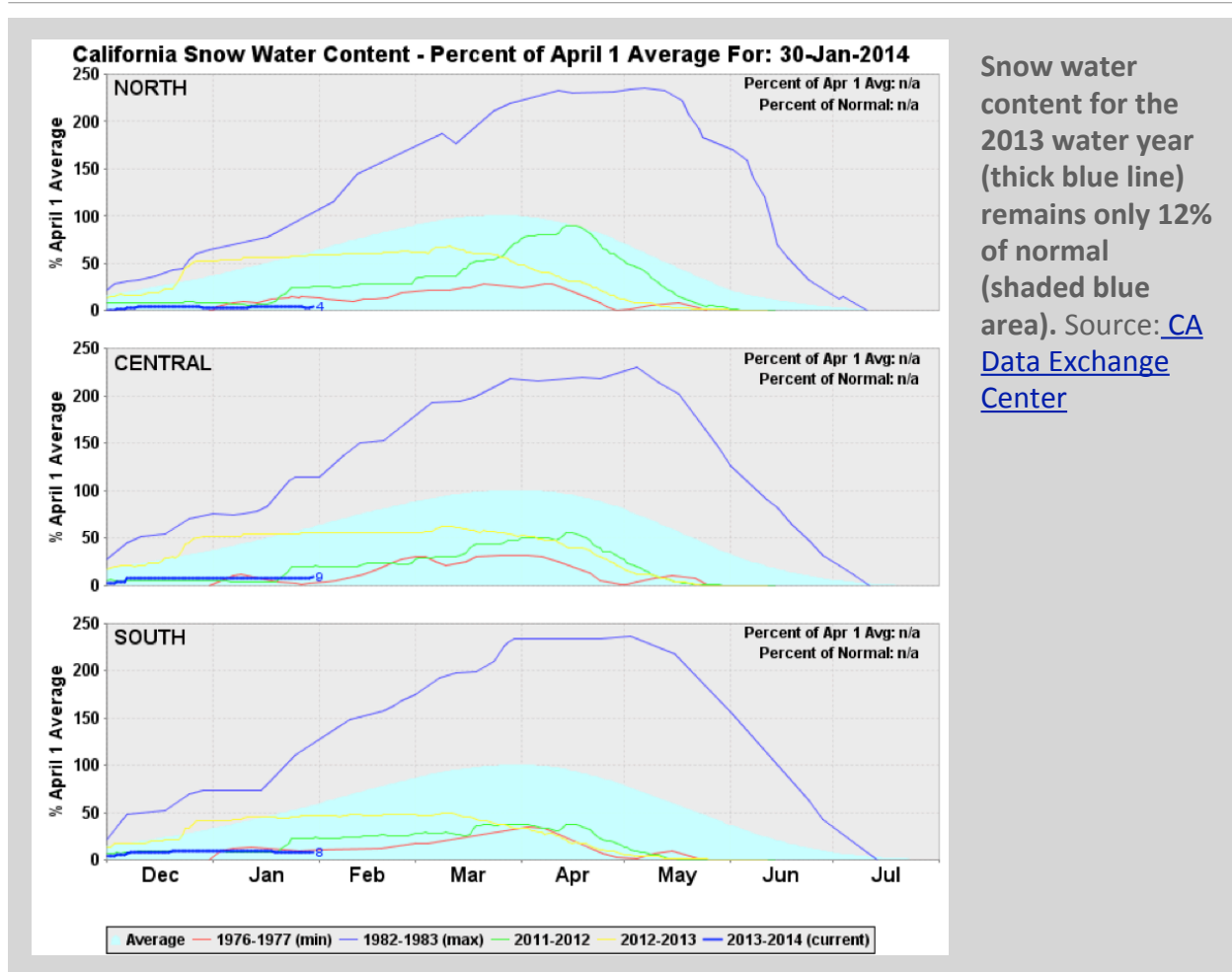
### Loss of Snowpack

Much of California (especially Northern California) relies on [snowpack in the Sierra Nevada Mountains](#) to store water during the winter and slowly release it over the course of the spring and summer. Snowpack provides [about a third](#) of California's total water supply.

After a month of record-breaking temperatures and scant precipitation, late January snowpack levels hit an all-time low: [12% of normal](#). Reservoirs that hold snowpack run-off to carry the state through its summer dry season are now at [critically low levels](#), as snow pack has been near record lows for three years running.

Higher temperatures associated with climate change play a role in intensifying the drought. Warmer conditions mean that mountain snows melt earlier, and the resulting moisture evaporates from soils faster. Dr. Valerie Trouet, Assistant Professor in the Laboratory of Tree-Ring Research at the University of Arizona, [explains](#), “What we are seeing now is fundamentally different from previous mega-droughts, which were driven largely by precipitation. Now, thanks to higher temperatures driven by climate change, droughts are increasingly temperature-driven.”

In line with this trend, California has been experiencing [record high temperatures](#) this winter. For the people of Los Angeles, already accustomed to mild winter weather, [Christmas Day was balmy enough for sunbathing](#) on the beach in Santa Monica.



Snow water content for the 2013 water year (thick blue line) remains only 12% of normal (shaded blue area). Source: [CA Data Exchange Center](#)

### Reduced Precipitation

Over the long-term, changing weather patterns may also be reducing winter precipitation. Records show that over the past century, total annual precipitation in California [has declined](#).

In 2013, a high-pressure zone formed over the Pacific Ocean, diverting precipitation towards Alaska (where the [record warmth and precipitation](#) has caused avalanches). While these zones are common, they normally quickly change position. The current high-pressure “ridge” is unprecedented in modern weather records in that it has remained in place for [13 months](#), held by a large, static bend in the jet stream.

Scientists are beginning to detect a connection between these abnormal jet stream waves and the [warming of the Arctic](#). The Arctic is warming faster than the rest of the globe, reducing the temperature differential on each side of the jet stream. This may cause the [jet stream to slow down](#), which in turn allows it to deviate from its straight path and cause these “stuck in place” weather patterns.

In fact, a [2005 study](#) actually predicted the impact of Arctic warming on Californian precipitation using climate models, which produced a similar high-pressure ridge to the one that has remained in place throughout 2013. For more on the relationship between the jet stream and global warming, please refer to this [Climate Nexus backgrounder](#).

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## The Big Picture

One of the hallmarks of climate change is that, on average, wet regions are getting wetter and dry regions are getting drier ([IPCC AR5 WGI SPM, p.3](#)). The Southwestern U.S. is a naturally dry region, and [experts predict](#) that it will get drier as climate change continues.

There is strong physical evidence to show that in medieval times droughts in California lasted for decades, and [some experts fear that the severity of the current drought](#) could portend a similarly long stretch of very dry conditions. This has further implications for California's drought in that it will limit the ability of Californian cities to compensate by drawing water from other areas.

For example, the Colorado River provides much of the water used by Las Vegas, Los Angeles, and the surrounding farmland. However, the river itself is experiencing drought conditions "[nearly unrivaled in 1,250 years.](#)" The Rocky Mountains [aren't providing the meltwater the river needs](#), any more than the Sierra Nevadas are providing for Northern California. Drought across the entire region means tough questions about how water will be shared.

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## Impacts

In early January, the state [announced](#) that it would likely be able to deliver only five percent of the slightly more than four million acre-feet of State Water Project (SWP) water requested by the 29 public agencies that supply more than 25 million Californians and nearly a million acres of irrigated farmland in 2014. This ties with calendar year 2010 for the lowest initial allocation ever. The 2013 final allocation was only 35%.

### Agriculture

Overall, this drought could increase the prices of staples such as meat, milk, fruit and vegetables around the country. In fact, the [price of milk futures rose to its highest point](#) on record in January, which is a signal that demand remains high as producers are struggling with drought conditions.

According to the USDA, long-term drought on a national level has forced ranchers to thin their livestock herds "[to the lowest level in decades.](#)" One cattleman interviewed by *The San Francisco Chronicle* said that he was considering [selling nearly 40% of his cattle](#).

California produces [nearly half of the nation's fruits, nuts and vegetables](#). According to the California Department of Food and Agriculture, the state holds 80,500 farms and ranches, which together generate more than [\\$100 billion in economic activity](#). According to industry group California Farm Water Coalition, [lost revenue for farming and associated businesses like trucking and processing could reach \\$5 billion in 2014 alone](#).

Based on Governor Jerry Brown's request that the public, business, and government agencies reduce their water use by 20%, [farmers will likely have to choose between](#) pumping more local groundwater, changing crops or leaving their land fallow as water availability decreases and prices increase.

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Winemakers are concerned about how the drought will affect their grapes. One winemaker said that his vineyard saw [less than two inches of rain in 2013](#), while 12 inches per year is average. The drought has caused the reservoirs at Shafer Vineyards in Napa Valley to dry up for the [first time in 30 years](#). Vineyards that use water for frost protection are also in jeopardy.

### **Fisheries**

Based on previous droughts, it is likely that the [fisheries along the Sacramento-San Joaquin River Delta will suffer](#) as water is directed towards urban and agricultural uses. As they have in the past, [agricultural agencies and environmentalists might file lawsuits](#) to protect their rights to water for crops and fish habitat.

The famed [Coho salmon run of Central California](#) will also likely suffer due to the lack of rain this winter. Coho salmon are endangered, and the starkly lower water levels means that they cannot migrate up the coastal rivers and creeks to spawn, which will severely threaten the next generation of salmon.

### **People and the Economy**

[The state warned](#) on January 28, 2014 that seventeen communities across the state were in danger of running out of water within 60 to 120 days. Federal officials are [considering seizing water](#) stored by some California to serve users with senior water rights. As an example of the overall financial toll drought can take, the 2012 national drought cost the U.S. [\\$30 billion](#).

Over the last few years, California has been riding an economic resurgence following the 2008 recession; but as Governor Jerry Brown warned in his annual address to the State Legislature in January, the severity and uncertainties over the current [drought threaten to slow this recovery](#).

Droughts are also known to [threaten human health](#) by making air pollution worse and increasing respiratory health issues for people with conditions like allergies and asthma.

### **Wildfires**

Early snowmelt leaves the Sierras vulnerable to fire. There have been fires around Lake Tahoe for this reason in the past, and one small fire nearby in Nevada already in 2014. [Fire officials are on edge](#), saying "Normally in the area where we have this fire we have 5 to 10 feet of snow... [But] We have no snow in the area." In Southern California, lack of precipitation exacerbates fire as well. [Red-flag fire warnings](#) have been issued in Southern California this January, and the Colby fire has burned over 1,900 acres.

[The EPA has warned](#) that "more frequent and more severe droughts" are associated with the observed increases in wildfires, especially in the Southwestern U.S. Over the last few decades, the American West has had nearly [four times as many wildfires](#) as it did in the preceding decades, and these fires have burned more than six times the land area and lasted almost five times as long.

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## Energy Generation

In a non-drought year, California typically gets [15%](#) of its total power from hydroelectric generation. The drought could dramatically cut this figure, with potentially significant consequences for homes and businesses. [Estimates show](#) that in 2013, California's hydropower generation fell by over 22% compared to 2012, and water levels in energy-generating reservoirs are still dropping.

Reductions in hydropower generation have been costly in the past. An [analysis by the Pacific Institute](#) estimated that the 2007-09 drought [cost Californian ratepayers \\$1.7 billion](#) to replace lost hydropower with natural gas generation. The analysis also concluded, "some of the drought's most direct and costly impacts were to air quality and California electricity ratepayers."