

Will El Niño's punch return in March? California snowpack needs renewal of drought-busting storms

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After a dismally dry February, drought-weary Californians are hoping a series of storms predicted to roll through in early March blanket the Sierra Nevada with a much-needed additional layer of snow, building up the state's vital snowpack that all but disappeared last year.

Starting Friday, forecasters are predicting a chance of rain or snow for 10 consecutive days.

How much water those storms might eventually supply to the state's reservoirs depends partly on where they come from -- warmer, wetter storms sweeping across the Pacific generally bring more snow to the mountains than colder, dryer tempests barreling down from the Gulf of Alaska. Cold air generally doesn't hold as much moisture as warm air.



File: Frank Gehrke, chief of the California Cooperative Snow Surveys Program for the Department of Water Resources, holds his snow survey notes after performing the first manual snow survey of the season at Phillips Station near Echo Summit, Calif., Wednesday, Dec. 30, 2015. (Rich Pedroncelli/AP)

Before Mother Nature turned off the tap in February -- leaving many to question what happened to El Niño's drought-busting potential -- the Sierra benefited from colder storms in December and warmer ones in January. What's in store for March?

"Whether they're particularly warm or cold storms remains to be seen," said Daniel Swain, a Stanford University doctoral student who runs the California Weather Blog. "They're certainly storms that would add to the water supply."

Despite the February stall, the Sierra is having a better snow year than at any point since 2011. Statewide,

as of Monday, the snowpack was about 85 percent of normal for this time of year, compared with 19 percent last year, the lowest number on record.

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On Tuesday morning, Frank Gehrke, the chief of California's snow survey program, will measure the depth of the snow piled up at Echo Summit near Lake Tahoe, a monthly winter ritual that helps the state keep tabs on its precious frozen reservoir.

The state takes similar manual readings at more than 200 sites throughout the Sierra. The snowpack supplies about a third of California's water in a typical year. To monitor the frosty resource, the state also deploys surveys, sensors, satellites and aerial flybys.

Things looked much better last month. The Feb. 1 statewide snowpack was 114 percent of normal. Then the rain all but stopped: Most Bay Area cities recorded less than 1 inch in February, including San Francisco (0.98 inch, average 4.46), Oakland (0.30 inch, average 3.95) and San Jose (0.31 inch, average 3.32), the city's ninth driest February since 1893, according to data from the National Weather Service.

In February, El Niño's unusual position created a high pressure ridge that shunted California's much-needed precipitation north to Seattle, said meteorologist Jan Null of Golden Gate Weather Services in Saratoga. This El Niño's warmest water is much farther west than usual.

This warm patch of water is causing air to suddenly rise -- triggering a strong loop of circulating atmosphere, called a "Hadley cell," according to Null and Swain. As the air in that loop falls back to earth, it creates a high pressure ridge -- right off our coast. Few storms can get through.

"Ridges and troughs happen all the time -- and clearly there were troughs in late December and off-and-on in January," Null said.

The storms that came in December arrived before the ridge did, Swain said. "Those were fairly cold storms, and they dumped a lot of snow in the mountains," he added.

The precipitation pattern the state experienced in January -- a relatively warm and wet storm about every other day over several weeks -- was an ideal situation, according to Null. Those squalls came from across the Pacific, he added. They weren't the wet, hot "atmospheric rivers" -- sometimes called Pineapple Express storms -- that can sweep in from the tropics. Pauses between periods of precipitation allow water to run off or soak into soil more slowly, preventing flooding.

The rainy season may still throw a few snowballs California's way, according to Swain. Forecasts show Pacific storms pummeling the state in early March. If March storms do materialize, some may be more helpful than others. Many factors influence how much precipitation actually falls, like the amount of water vapor in the air, wind direction and temperature, Gehrke said.

The critical snowpack measure isn't necessarily its height, Null said, but rather how much water it contains.

Wetter, warmer storms can bring more precipitation to the state.

"The snow ends up being denser and more like what skiers call 'Sierra cement,'" Null said. "It has more water content to it, and that's what will run off into the reservoirs."

Still, warm storms that bring rain instead of snow aren't ideal for pumping up the snowpack.

"If it's raining at all elevations, it's basically going to run off during the storm," Gehrke said. "We would not be building the snowpack, so that water wouldn't be available later in the year."

The snowpack is a convenient place to store water for the summer without prematurely filling reservoirs. Water levels at the state's major reservoirs are below the historic average for this time of year, except for Folsom Lake, 20 miles northeast of Sacramento. The lake is about 15 percent over the historic average -- necessitating the difficult decision to open the reservoir's gates and flood the American River below.

Overfull reservoirs put water managers in a tricky situation, according to Jay Lund, director of the Center for Watershed Sciences at UC Davis. "Folsom is just upstream of the Sacramento metropolitan area, and the Sacramento metropolitan area is one of the most flood-prone cities in the country," Lund said.

"If you're the Army Corps of Engineers, you're really stuck between a rock and a hard place," explained Lund. "You'd really like to keep (the reservoir) full for water supply purposes, but you'd really like to keep it empty due to flood control."

Guidelines drafted by the U.S. Army Corps of Engineers in 1987 demand that Folsom hold no more than 60 percent of its water capacity this time of year to reduce the risk of flooding from heavy storms. So officials have been draining the reservoir, at a rate of almost 50,000 gallons of water per second as of Feb. 25.

If more rain fell as snow, that natural storage could alleviate some of the difficult trade-offs water managers face.

As Gehrke plunges an aluminum rod into the snowpack at Phillips Station on Tuesday, one thing is certain: Regardless of how high the snow reaches, California could use a little more.

"Right now we'd be happy for any storms, of course," he said.

Staff writers Lisa M. Krieger and Mark Gomez contributed to this report. Contact Emily Benson at 408-920-5764. Follow her at [Twitter.com/erbenson1](https://twitter.com/erbenson1).

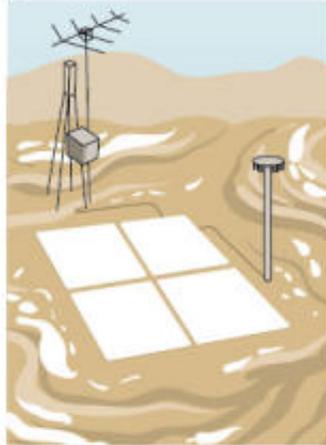
Sizing up the snowpack

State water officials use a three-pronged approach to measuring the Sierra Nevada snowpack. More than 200 manual surveys are done monthly each winter. Data from snow sensors are posted on state Department of Water Resources websites several times a week. And laser-equipped airplanes began surveying the Sierra in 2012.



Snow core procedure

Surveyors drive hollow aluminum rods into the white powder to measure how deep it is. Then they weigh the snow to calculate its water content.



Snow pillows

Flat-panel sensors weigh the overlying snow as it accumulates, broadcasting the data to National Oceanic and Atmospheric Administration satellites.



Aerial survey

Using the laser technology Lidar, flyovers can accurately determine snow depth and, by measuring energy reflection, also predict when snow will begin to melt.

Source: State Department of Water Resources, California Cooperative Snow Surveys Program

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