

# Reduced Sierra Nevada snowmelt runoff to threaten California agriculture

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Warmer average winter temperatures are leading to a diminished snowpack in the Sierra Nevada range. In a new study in the *Proceedings of the National Academy of Sciences*, UCI researchers examine the impact on this source of much of the water consumed by Californians. Credit: Laurie Huning / UCI

An estimated three-quarters of the water used by farms, ranches and dairies in California originates as snow in the Sierra Nevada mountain range, but the future viability of that resource is projected to be at heightened risk due to global climate change.

In a study published today in *Proceedings of the National Academy of Sciences*, University of California, Irvine researchers argue that a 1.0 degree Celsius increase in the global average winter [temperature](#) will lead to a 20 percent jump in the likelihood of below-average snow accumulation in the high country, resulting in lower spring runoff. In this article, the authors describe how snow water equivalent, an important measure of water availability, and the elevation of the snowpack respond to different levels of warming.

The scientists from UCI's Henry Samueli School of Engineering said that historically, 2.0 degrees of average winter warming can cause the probability of below-average snow water equivalent to climb to 40 percent.

"Changes in average temperature around the world will have an impact on how widespread and long lasting the seasonal mountain snowpack will be," said lead author Laurie Huning, UCI postdoctoral scholar in civil & environmental engineering. "In general, we have found that warmer conditions will decrease the amount of water stored in the mountain snowpack, forcing its center of mass to higher elevations."

The researchers analyzed historical data to quantify the volume and the extent of the Sierra snowpack, finding that warmer temperatures should cause the bulk to gradually shrink and be concentrated at higher elevations over time. For example, under a 1.5 degree Celsius temperature increase, there is a nearly 80 percent likelihood that the center of mass of the mountain snowpack will inch above 8,300 feet in elevation; the probability goes to 90 percent with 2.0 degrees of heating.

"The Paris Agreement calls for nations to band together to keep this century's temperature increases within a global 2 degree Celsius threshold above pre-industrial levels," said Huning. "Our results show that even a change in the Sierra Nevada's winter temperature from 1.0 to 1.5 degrees Celsius can threaten the natural water storage capability of the range. Similar responses may also been seen in other mountain ranges that provide melt runoff to much of the western United States."

The researchers said the impact will vary depending on what sector of the Sierra Nevada range is being observed, identifying the northwestern quarter to be most threatened.

"In addition to the resources used in the state's agricultural sector, the Sierra Nevada [snowpack](#) also provides about 60 percent of the water supply for the people of Southern California," said co-author Amir AghaKouchak, associate professor of civil & environmental engineering, and Earth system science. "Our study has shown that this important natural water storage mechanism that supports our economy and the lives of millions is highly sensitive to change from global warming."

**More information:** Laurie S. Huning et al. Mountain snowpack response to different levels of warming, *Proceedings of the National Academy of Sciences* (2018). [DOI: 10.1073/pnas.1805953115](https://doi.org/10.1073/pnas.1805953115)

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