

Low snowpacks of 2014, 2015 may become increasingly common with warmer conditions

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A composite image of the Western hemisphere of the Earth. Credit: NASA

Oregon experienced very low snowpack levels in 2014 and historically low snowpack levels in 2015; now a new study suggests that these occurrences may not be anomalous in the future and could become much more common if average temperatures warm just two degrees (Celsius).

The low snowpack levels were linked to warmer temperatures and not a lack of precipitation, the researchers say. Based on simulations of previous and predicted snowpack, the study suggests that by mid-century, years like 2015 may happen about once a decade, while snowpack levels similar to 2014 will take place every 4-5 years.

Results of the study, which was supported by the National Aeronautics and Space Administration (NASA) and the National Science Foundation, have just been published in the journal *The Cryosphere*.

"It is a cautionary tale," said lead author Eric Sproles, who conducted much of the research as a doctoral student at Oregon State University and has been working as a hydrologist in Chile. "California received a lot of attention for its drought, but the economic and environmental impacts from those two low-snowpack years were profound in the Pacific Northwest."

"We set out to learn whether they were just off years, or if they would be likely to happen more often with increased warming. Unfortunately, the data show these will become more commonplace."

The key, Sproles said, is what happened in the Cascade Mountains at an elevation of around 4,000 feet - a level that frequently is the boundary between rain and snow. In 2014, winter precipitation in the mountain region was 96 percent of normal and overall temperatures were 0.7 degrees (C) warmer than normal. But temperatures in that snow zone were 2.7 degrees (C) warmer than average.

The winter of 2014 led to drier springtime conditions and moderate to severe drought throughout western Oregon. That pattern was even stronger in 2015. A fair amount of precipitation still fell - 78 percent of normal - but temperatures in the snow zone were 3.3 degrees (C), or 5.9 degrees (F) warmer than average.

On March 1 of 2015, 47 percent of the snow monitoring sites in the Willamette River basin registered zero "snow water equivalent" - the amount of water stored in snowpack.

"The result was a significantly reduced stream flow in the summer, water quality concerns in the Willamette Valley, an increase in wildfires, high fish mortality and a dreadful season for ski resorts," said Sproles, who worked with Anne Nolin and Travis Roth in the College of Earth, Ocean, and Atmospheric Sciences on the project. "Hoodoo Ski Area was open for only a few weekends in 2013-14, and in 2015, they suspended operations in mid-January - the shortest season in their 77-year history."

Detroit Reservoir in the adjacent Santiam basin had reservoir levels that were as much as 21 meters (or 68 feet) below capacity, and was plagued by high levels of harmful blue-green algae concentrations.

The study focused on the McKenzie River basin, which has a major influence on the Willamette River - all the way to Portland. In fact, during summer months nearly 25 percent of the water in the Willamette at its confluence with the Columbia River originates from the McKenzie. As much as 60 to 80 percent of the volume of the Willamette River in the summer originates from precipitation that fell above 4,000 feet.

"The study shows how incredibly sensitive the region's snowpack is to increasing temperatures," Sproles said. "The low snow years took place even though precipitation wasn't that bad. But when it falls as rain instead of snow, it loses that ability to function as a natural reservoir in

the mountains."

The typically consistent flow of the McKenzie River in the summer of 2015 was only at 63 percent of its median flow.

"We don't really know yet the impact of the 2015 low snowpack because some of the water takes as long as seven years to percolate through the ground and end up in the Willamette River," Sproles said.

A comparatively cold and wet winter has made many Oregonians forget about the low-snowpack years of 2014 and 2015, Sproles said, but the region has been in a La Niña cycle - which is typically colder and wetter - and is expected to move toward neutral conditions by the end of February.

"It seems like much of the state has been socked with snow and ice this winter," Sproles said, "but despite that, snowpack for the Sandy and Hood River basins is only 110 percent of normal and the Willamette basin snowpack is 124 percent of normal. That is certainly positive, but it seems like those numbers would be a lot higher considering what kind of winter we've had in the valley."

More information: Eric A. Sproles et al, Future snow? A spatial-probabilistic assessment of the extraordinarily low snowpacks of 2014 and 2015 in the Oregon Cascades, *The Cryosphere* (2017). [DOI: 10.5194/tc-11-331-2017](https://doi.org/10.5194/tc-11-331-2017)

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