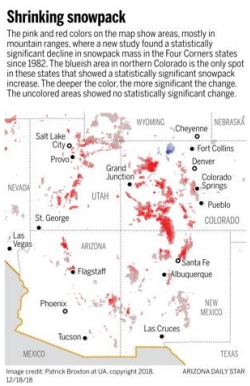
Snowpack in trouble across the West and around the globe, researchers say

By Tony Davis Arizona Daily Star Dec 18, 2018 Updated 5 hrs ago

Rocks that should have been covered in snow jutted out from the landscape in December 2017 at the Crested Butte Mountain Resort in Colorado.

Brian Domonkos / USDA Natural Resource Conservation Service 2017/



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From the Colorado Rockies to the Tibetan Plateau to the Greenland Sea, snowpack that provides billions of people with drinking water is suffering long-term declines, researchers said at a national conference last week.

One of four studies discussed there, in which two University of Arizona researchers were co-authors, found that total snowpack in Colorado River Basin mountain ranges

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declined by 41 percent from 1982 to 2016. That's the same rate as the overall decline that the study found in the worst-hit areas of the Western U.S. over the same period.

The Colorado Basin supplies river water that flows to Lake Mead, which stores Central Arizona Project water that serves drinking water to Tucson and Phoenix. The 41 percent decline amounts to about 7.17 million acre-feet of water — enough to supply the entire CAP for well over four years.

A second study found clear connections between declining snowpack in the West and increased wildfires in high-mountain forested areas dominated by trees such as ponderosa pine and Douglas fir.

A third study, looking globally, concludes that declining snowpack could put the water supplies of more than one-sixth of the world's population at risk.

A fourth study found that the U.S. West's snowpack seasons are being squeezed at both ends, with fall starting later and summer starting earlier.

"Our winters are getting sick," that study's author, Amato Evan of the Scripps Institution of Oceanography in La Jolla, California, said at last week's annual American Geophysical Union conference in Washington, D.C.

"If you gauge the health of winter on how normal snows in the mountains look, it's reasonable to come to (that) conclusion," said Evan, an associate professor of atmospheric and climate science, in a telephone interview.

Evan and two other scientists who discussed their research at the conference, including UA professor of hydrology and atmospheric

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sciences Xubin Zeng, said they believe global warming and other forms of global climate change are at least partly responsible for the snowpack declines.

"We know the reason why — it has to do with global warming. It's rising temperatures. It's the only logical explanation for what is happening," said Evan, an associate professor of atmospheric and climate science.

For one, he said, climate change is the most simple explanation for the declining snowpack, "and usually in questions like this, the simplest answer is the correct one." Second, there have been many climate-model simulations forecasting snowpack declines over this century, and "more alarming, these are the changes we already see," Evan said.

Warming temperature is an important factor in the decline of snowmass, which represents the weight and depth of snowpack, Zeng added. That's because it decreases the percentage of precipitation that falls as snow and increases snow sublimation, a process in which snow transforms into ice and then into water vapor without first melting, he said.

Warming weather over the period Zeng studied, from 1982 to 2016, is linked by itself to about 25 percent of the total snowpack declines found in the study, concluded Zeng and his colleagues. The rest is due to changes in precipitation, in part caused by the fact that more precipitation today falls as rain instead of snow.

Because an unknown amount of the precipitation change is also caused by warming, the total impact of warmer weather on snowpack declines actually exceeds 25 percent.

These researchers say their studies have broken ground in a number of ways. They include looking at snowpack over the entire U.S. and using purely on-the-ground observations, not computer models.

In the UA study, the researchers relied on data from virtually every square inch of the 48 contiguous U.S. states instead of a few hundred or even a few thousand snowpack monitoring stations, as many other researchers have done.

Details of the studies' findings:

- Zeng and two other researchers concluded that snowpack declined 41 percent between 1982 and 2016 on 13 percent of the West's total land area.

The snow season was shortened by an average of 34 days over this period, on about 9 percent of the entire U.S. Most of the declining area was concentrated in the West. The co-authors are Patrick Broxton, a UA associate research scientist in the School of Natural Resources and Environment, and Nicholas Dawson of the Idaho Power Co.

The researchers studied snowpack levels in areas of the U.S. broken into individual squares measuring 6.25 square miles. They looked at four kinds of snowpack data, including U.S. government-run monitoring stations. Their findings were just published in the journal Geophysical Research Letters.

- Evan said based on his study, the weight of the snowpack, commonly called snowmass, has dropped up to 50 percent at monitoring stations around the West from 1982 to 2018.

Generally, the snowpack seasons at high elevations are starting to resemble those at lower elevations, signaling declines at the more important high elevations, his study found. It was published in the Journal of Applied Meteorology and Climatology.

- Speaking of the wildfire study, still unpublished, author Donal O'Leary said, "We're 95 percent confident there's a significant relationship between wildfire and snowpack."

While earlier snowmelt leads to more wildfires in mountain ecosystems, later snowmelt triggers more wildfires in high desert ecosystems containing piñon, juniper and other low-elevation trees and shrubs, said O'Leary, a Ph.D. student at the University of Maryland.

O'Leary said this study provides the first evidence of a positive relationship between snow levels and wildfire based on the classes of vegetation examined.

- Saguar Tamang of the University of Minnesota, author of the global study, said snowfall plays a key role in the functioning of ecosystems, global water supplies and food security.
- Since a warmer world means less winter precipitation falls as snow, that's why such a larger percentage of the global population is at risk, said Tarmang, a Ph.D. candidate.

The Northern Hemisphere's snowfall area has shrunk by 386,000 square miles a decade since 1979, he said.

But in the Southern Hemisphere, the snowfall area has grown at about half that pace in the same period, Tarmang said.

Snowfall's proportion of all annual precipitation is dropping more than 4 percent per decade in some key high mountain areas on the western Tibetan Plateau, middle-east Asia, northern Canada and on the Greenland Sea, he said.

But it's increasing about 2 percent every decade in oceans surrounding the Antarctic region.

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