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SCIENCE

High risk: Warming could set stage for more fatal avalanches

Kylie Mohr, E&E News reporter • Published: Friday, March 5, 2021

A skier was killed in an avalanche in the backcountry south of Vail, Colo., on Feb. 4. Rescuers estimated the avalanche was 700 feet wide and ran 1,000 vertical feet. Vail Ski Patrol/Colorado Avalanche Information Center

It's been a bad year for deadly avalanches in the West, and scientists say climate change will only bring more dangerous snowpack conditions.

"The trend is headed towards more deadly avalanche conditions," said Brian McInerney, a former hydrologist with the National Weather Service in Salt Lake City. "It's important that we wrap our minds around, 'This is our future.'"

That affects not only backcountry skiers, but also anyone living in an avalanche path or commuting on roadways under them.

February was a grim month, with 26 people dying in avalanches, **according** to the Colorado Avalanche Information Center. That's more deaths in a month than some entire winters bring.

The United States has seen 33 avalanche deaths so far in the 2020-21 season, only three shy of the entire 2009-10 season, which was the deadliest in the past dozen years. And there are months more of winter conditions in the high alpine to go.

In one week in mid-February, two snowboarders and a snowmobiler were killed by avalanches in the outdoor mecca of Jackson Hole, Wyo. Days later and thousands of miles away, residents of a neighborhood in downtown Juneau, Alaska, were told to evacuate due to potentially historic avalanches. While the event didn't occur, the city's emergency program manager **told** public radio station KTOO that he'd "never forecasted an extreme avalanche condition" before.

Many variables influence whether a slope will slide and how big the slide will be. Terrain, recent precipitation, wind and temperature can all be involved, as well as human decisionmaking.

But homing in on changing weather patterns provides clues to how the snowpack is getting scarier in the West. Warmer temperatures could mean more wet slides of slushy snow as well as a sequence of events that makes for a touchier snowpack throughout a season.

"The question we get all the time is if climate change is going to impact the way avalanches unfold throughout a given season," said Brian Lazar, deputy director of the Colorado Avalanche Information Center. "The short answer is yes, but it's a little more nuanced than that."

'Intimately tied to the weather'

Warmer winters and earlier rain-on-snow events in the spring could lead to wet avalanche activity. 2008 **research** by Lazar and others, published in the journal *Cold Regions Science and Technology*, predicts wet slides will start

happening earlier than historical averages in the Aspen, Colo., ski area by 2030. And wet slides are expected to get progressively earlier in the decades after that.

"If the climate is changing, then the weather that characterizes that climate is changing," Lazar said. "And avalanches are intimately tied to the weather."

But wet avalanches are not what's killing people this year. Dry slab avalanches, in which lots of new snow breaks off on a weak crust beneath it, have often been the culprit. Those conditions depend on how the snowpack structure stacks up throughout the season.

In a warming climate, meteorologists like McInerney are seeing early periodic snows in October and November followed by long periods of high pressure. High-pressure systems tend to result in clear skies.

As the Arctic warms faster than the rest of the globe, the jet stream is more sinuous and "wiggly," McInerney said, which is driving high-pressure systems to set up more and more over the western United States.

A 2019 study published in *Geophysical Research Letters* **found** that the systems are "stalling" due to climate change. This means snowpacks are taking longer to accumulate and there are more dry days between storms, creating ample opportunities for the snowpack to weaken.

Think of snow crystals like fingers. Hold your hands up and connect your fingers. That's what snow looks like when it comes out of the sky. Continuous snow makes for an ideal and stable snowpack, with existing layers bonding to new snow.

Then make a fist. That's what snow crystals look like when they've sat and warmed up. Linkage is now more difficult.

"When you don't have successive storms like we used to, these crystals turn into a fist, and they don't bond well," McInerney said of the analogy. "If you picked them up in your gloves, you'd see sugar snow."

Atmospheric rivers — long, narrow plumes of moisture coming from the tropics — or other infrequent but intense storms are then bringing lots of moisture. Dense, heavy snow loads up on the slopes.

And as the climate warms, the atmosphere's ability to hold water vapor increases. **Studies** show that moisture content increases by 7% for every 1 degree Celsius temperature increase.

If a healthy snowpack is a balanced layer cake, a storm with higher moisture content than what's already on the ground results in an upside-down cake. High-density snow on top of lower-density snow is more prone to slide.

Benjamin Hatchett, an assistant research professor of atmospheric sciences and a climatologist at the Western Regional Climate Center, studies the connection between atmospheric rivers and avalanche deaths. While the full effect of a changing climate on atmospheric rivers is unknown, a 2018 study in *Geophysical Research Letters* has **predicted** they will occur slightly less often in the future but will be longer and wider and bring more moisture when they do occur.

Hatchett **found** in a 2017 study published in the *Journal of Hydrometeorology* that atmospheric river conditions were present in a third of western U.S. avalanche deaths.

"We're stacking the deck with persistent dry spells and also intermittent really big storms," Hatchett said. "Multiplying those two things, you get a greater avalanche hazard. We have large-scale climate changes that shift or stack the odds differently for individual weather events."

This leaves forecasters like Lazar, who compares current year activity to previous year activity, with less certainty.

"Now we're running into situations you may not have a historical analog to compare to," he said.

Twitter: **@thatsMohrlikeit** | Email: **kmohr@eenews.net**