

## The Washington Post

CAPITAL WEATHER GANG

# Study finds climate change is bringing more intense rains to U.S.

Atmospheric scientists noted the trend was prevalent in nearly every region of the country

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When it rains, it pours.

A paper published Tuesday in the journal *Geophysical Research Letters* finds that it's raining harder in most of the United States. The study, written by researchers at Northwestern University, tied the results to climate change and to warmer air's ability to hold more water.

The findings echo the fundamental laws of physics and thermodynamics, as well as the evidence from decades of research, and highlight the real-time effect that humans are having on the weather and climate.

The research offers confirmation of what atmospheric scientists have been warning of for years: a warmer world is, on balance, a wetter world. And as global temperatures continue to rise, an uptick in precipitation extremes is expected.

# Climate change is causing heavier rains

What the study finds is consistent with a basic tenet of atmospheric physics: For every degree Fahrenheit that air temperature rises, the atmosphere can hold 4 percent more water; this is known as the Clausius-Clapeyron relationship. Where storm clouds develop and the atmosphere is sufficiently moist, it means a warmer climate will support more intense rainfall.

The study reports “consistent shifts from lower to higher daily precipitation intensities, particularly in the central and eastern United States.” The authors compared rainfall over two periods — 1951 to 1980 and 1991 to 2020 — to see how patterns evolved.

“When it’s raining, it’s raining more,” said Ryan Harp, the author lead author on the study, in an interview. “But what we also did was ... we were able to verify some of the expectations we had based on modeling studies.”

In other words, most similar studies to date had centered on projections made by forward-running computer models fed with historical data. This is among the first that, on a nationwide level, examine observed daily rainfall trends.

“I think during that process we were a little surprised that this paper hasn’t been written before,” said Daniel Horton, a study co-author and a professor at Northwestern University, in an interview. “We know that precipitation should be increasing ... but we just wanted to do a very straightforward paper that says, ‘Yep, we’re seeing it.’”

Harp said the fact that reality matched simulations lends credence to climate models.

“People should in general be trusting in climate models,” he said. “We’re constantly working to improve them to the best of our abilities.”

## Not necessarily more rain overall, and not everywhere

In the study, the authors examined daily data from more than 1,700 weather stations distributed in the Lower 48. Each had to have a continuous record dating back to at least 1951 to be included in the study.

In the eastern United States, the researchers observed a 4.5 to 5.7 percent increase in average daily rainfall on days when it rained. That does not say there are more days with rain, or more rain overall.

“That doesn’t necessarily give us the whole story,” Harp said. “There may be places where precipitation intensity is increasing but frequency is decreasing. We might not know if there’s an overall increase or decrease. That’s one thing that we’re working on.”

Greg Carbin, the head of forecast operations at the National Weather Service Weather Prediction Center, who was not involved in this research, appreciated that the study touched on the “paradox of potentially fewer precipitation days with higher-intensity precipitation occurring on those days.”

Carbin has noted a trend of more rain falling on fewer days in his analysis of recent precipitation.

“Overall, the area covered by the count of 1-inch rainfall days was lower than in recent years across large parts of the central and eastern U.S.,” Carbin wrote in an email. “In fact, moderate to severe drought has plagued areas of the Northeast, and extreme to exceptional drought is now expanding across part of the central U.S. Nonetheless, we have had extreme rainfall events occur in St. Louis, Dallas, eastern Kentucky, and, most recently, with Hurricane Ian in Florida.”

Despite strong trends in the central and eastern United States, the authors noted that there were a few places where rainfall did not appear to be growing more intense. The paper does detail “mixed signals in the western U.S.,” but for reasons the authors are still trying to identify.

“That [trend] didn’t hold true for the western U.S.,” said Harp, especially in the Pacific Northwest. He explained that changes in the overall placement of weather systems are “suppressing” any tendency for heavier precipitation in the West. A slight change in the location at which high and low pressure systems are anchored can have an enormous bearing on steering currents, and subsequently on how much precipitation falls in a given location.

## Changing precipitation trends poses societal challenges

With the planet continuing to warm, a continued increase in rainfall intensity can be expected. That spells concern over whether existing infrastructure can handle the downpours of the future.

Communities may need to turn to simulated precipitation events of the future to guide building decisions, Horton said.

The past summer was a testament to the extent to which climate-supercharged downpours can wreak havoc on major metropolitan areas. During a five-week span in July and August, five 1,000-year rain events — or extremely heavy rainfall episodes that have a 0.1 percent chance of happening in any given year — occurred across the nation.

“Recent years have seen some remarkable high-end precipitation events,” Carbin said.