Wildfire smoke can reduce raindrops to meaningless drizzle, study says. Here's how

August 16 2021, by Katie Camero

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When wildfires burn, they catapult smoke into the atmosphere. These plumes are loaded with tiny particles that act as magnets for water droplets sitting in clouds—the more smoky particles ejected into the sky, the more rain comes down.

So, researchers assumed that more wildfires equal more rainfall. But a

new study flipped those assumptions upside down. Turns out, the murky relationship between wildfire smoke and cloud formation only holds true for clouds high in the atmosphere.

For those closer to the ground, the mingling of smoky particles may actually make it less likely that rain will fall, triggering a cascade of reactions that fuel instead of calm fire activity on land, particularly in the Western U.S.

The study was published July 26 in the journal *Geophysical Research Letters*.

"As humans have perturbed the composition of the atmosphere, there are all these feedbacks and interactions that we don't even know about. This experiment we're doing on planet Earth is altering clouds and the hydrologic cycle, at least regionally," Ann Marie Carlton, an atmospheric chemist at the University of California-Irvine who was not involved in the new study, said in a statement. "I think this paper is scratching the surface of what we don't know. ... To have cloud-related findings so robust is sort of unusual, in my experience."

Clouds are notoriously difficult to study. Part of the problem is that scientists don't have historical data on how they used to behave during the preindustrial era, unlike they do for greenhouse gasses preserved in ice core bubbles, trees and fossils. The rest lies in how complex it is to simulate clouds in scientific models that help us better understand their composition and activity.

So, Cynthia Twohy, an atmospheric scientist at NorthWest Research Associates and the Scripps Institution of Oceanography, with a team spent the summer of 2018 sampling mid-altitude altocumulus clouds while soaring above the western U.S. in a research plane as wildfires raged.

Special instruments on board measured gasses, wildfire particles and cloud droplets; the team then analyzed their chemistry in a lab.

They found that clouds hovering above wildfires contained about five times the number of droplets than clouds free of smoky particles, yet the droplets were half the size of those in their "clean" counterparts.

This unexpected size difference, researchers say, is what could determine if we will experience a downpour or a meaningless drizzle.

Smaller droplets are less likely to grow into heavier ones that will eventually fall as rain, meaning wildfire seasons could be exacerbated by drier conditions on land that ultimately fuel more and larger blazes.

It's a concerning finding given the area wildfires burn in the Western U.S. has increased in recent years and is predicted to grow as temperatures rise. New data released Friday shows July was the hottest month ever recorded in Earth's history.

But it's not all that bad, Twohy said, noting that the study can help future research in the field.

She hopes these findings will "spur detailed regional modeling studies that will help us understand the net impact of smoke on clouds and climate in the region."

More information: Cynthia H. Twohy et al, Biomass Burning Smoke and Its Influence on Clouds Over the Western U. S., *Geophysical Research Letters* (2021). DOI: 10.1029/2021GL094224