

# EXPLAINER: Was tornado outbreak related to climate change?

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In this photo taken by a drone, buildings are demolished in downtown Mayfield, Ky., on Saturday, Dec. 11, 2021, after a tornado traveled through the region Friday night. A monstrous tornado killed dozens of people in Kentucky and the toll was climbing Saturday after severe weather ripped through at least five states, leaving widespread devastation. Credit: Ryan C. Hermens/Lexington Herald-Leader via AP

The calendar said December but the warm moist air screamed of springtime. Add an eastbound storm front guided by a La Nina weather pattern into that mismatch and it spawned tornadoes that killed dozens over five U.S. states.

Tornadoes in December are unusual, but not unheard of. But the ferocity and path length of Friday night's [tornadoes](#) likely put them in a category of their own, meteorologists say. One of the twisters—if it is confirmed to have been just one—likely broke a nearly 100-year-old record for how long a tornado stayed on the ground in a path of destruction, experts said.

"One word: remarkable; unbelievable would be another," said Northern Illinois University meteorology professor Victor Gensini. "It was really a late spring type of setup in in the middle of December."

Warm weather was a crucial ingredient in this tornado outbreak, but whether [climate change](#) is a factor is not quite as clear, meteorologists say.

Scientists say figuring out how climate change is affecting the frequency of tornadoes is complicated and their understanding is still evolving. But they do say the [atmospheric conditions](#) that give rise to such outbreaks are intensifying in the winter as the planet warms. And [tornado alley](#) is shifting farther east away from the Kansas-Oklahoma area and into states where Friday's killers hit.

Here's a look at what's known about Friday's [tornado outbreak](#) and the role of climate change in such weather events.

## WHAT CAUSES A TORNADO?

Tornadoes are whirling, vertical air columns that form from



thunderstorms and stretch to the ground. They travel with ferocious speed and lay waste to everything in their path.

Thunderstorms occur when denser, drier cold air is pushed over warmer, humid air, conditions scientists call atmospheric instability. As that happens, an updraft is created when the warm air rises. When winds vary in speed or direction at different altitudes—a condition known as [wind shear](#)—the updraft will start to spin.



Kenny Sanford exits his mother-in-law's apartment through a collapsed wall Saturday, Dec. 11, 2021, in Mayfield, Ky. Tornadoes and severe weather caused catastrophic damage across several states Friday, killing multiple people overnight. Credit: AP Photo/Mark Humphrey

These changes in winds produce the spin necessary for a tornado. For especially strong tornadoes, changes are needed in both the wind's speed and direction.

"When considerable variation in wind is found over the lowest few thousand feet of the atmosphere, tornado-producing 'supercell thunderstorms' are possible," said Paul Markowski, professor of meteorology at Pennsylvania State University. "That's what we had yesterday."

There's usually a lot of wind shear in the winter because of the big difference in temperature and air pressure between the equator and the Arctic, Gensini said.

But usually, there's not a lot of instability in the winter that's needed for tornadoes because the air isn't as warm and humid, Gensini said. This time there was.

## WHAT CONDITIONS LED TO STORMS OF THIS SCALE?

A few factors, which meteorologists will continue to study.

Spring-like temperatures across much of the Midwest and South in December helped bring the warm, moist air that helped form thunderstorms. Some of this is due to La Nina, which generally brings warmer than normal winter temperatures to the Southern U.S. But scientists also expect atypical, warm weather in the winter to become more common as the planet warms.

"The worst-case scenario happened. Warm air in the cold season, middle of the night," said John Gordon, a National Weather Service meteorologist in Louisville, Kentucky.



Once the storm formed, exceptionally strong wind shear appears to have prevented the tornadoes from dissipating, experts say. Tornadoes are thought to die off when thunderstorm updrafts lose energy.



Tony Parrott looks through his daughter's damaged apartment unit after a tornado in Mayfield, Ky., on Saturday, Dec. 11, 2021. Tornadoes and severe weather caused catastrophic damage across several states late Friday, killing multiple people overnight. Credit: AP Photo/Mark Humphrey

Tornadoes typically lose energy in a matter of minutes, but in this case it was hours, Gensini said. That's partly the reason for the exceptionally long path of Friday's storm, going more than 200 miles (322 kilometers) or so, he said. The record was 219 miles (352 kilometers) and was set by

a tornado that struck four states in 1925. Gensini thinks this one will surpass it once meteorologists finish analyzing it.

"In order to get a really long path length, you have to have a really fast moving storm. This storm was moving well over 50 miles (80 kilometers) per hour for a majority of its life," Gensini said. That's not the speed of the winds, but of the overall storm movement.

"You're talking about highway-speed storm motions," Gensini said.

## HOW RELATED IS CLIMATE CHANGE TO TORNADO OUTBREAKS?

It's complicated. Scientists are still trying to sort out the many conflicting factors about whether human-caused climate change is making tornadoes more common—or even more intense. About 1,200 twisters hit the U.S. each year—though that figure can vary—according to the NOAA National Severe Storms Laboratory. No other country sees as many.

Attributing a specific [storm](#) like Friday's to the effects of climate change remains very challenging. Less than 10% of severe thunderstorms produce tornadoes, which makes drawing conclusions about climate change and the processes leading up to them tricky, said Harold Brooks, a tornado scientist at the National Severe Storms Laboratory.

Scientists have observed changes taking place to the basic ingredients of a thunderstorm, however, as the planet warms. Gensini says in the aggregate, extreme storms are "becoming more common because we have a lot warmer air masses in the cool season that can support these types of severe weather outbreaks."

The U.S. is likely to see more tornadoes occur in the winter, Brooks said, as national temperatures rise above the long-term average. Fewer events

will take place in the summer, he said.

Furtado of the University of Oklahoma said tornado alley, a term used to describe where many twisters hit the U.S., has shifted eastward into the Mississippi River Valley. That shift is because of increases in temperature, moisture and shear.

"Bottom line: The people in the Mississippi River Valley and Ohio River Valley are becoming increasingly vulnerable to more tornadic activity with time," he said.

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