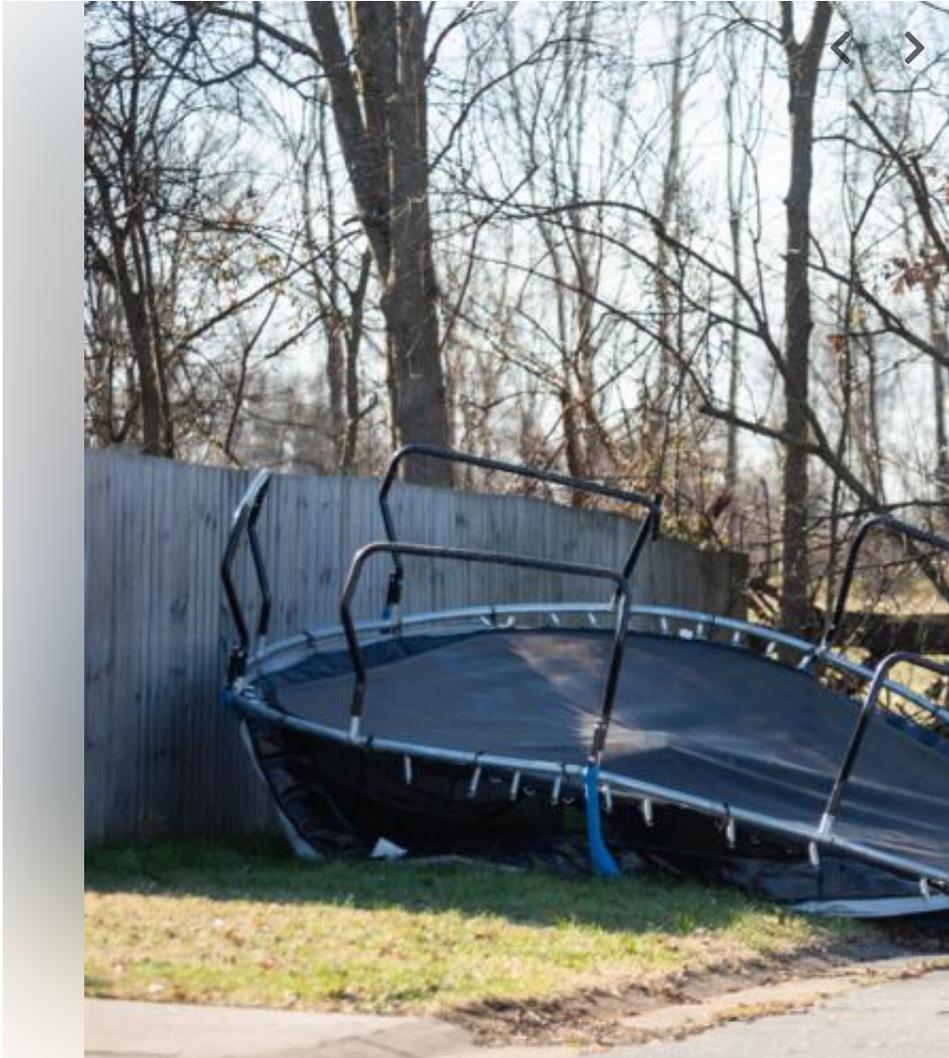


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# Experts discuss December tornado trend

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A storm-thrown trampoline lays upside down near a line of trees on Wood Springs Road on Tuesday, Dec. 12, 2023, as clean-up and recovery efforts continue. The National Weather Service's Louisville office rated the area as an EF-1 with winds up to 100 mph. (Photo by Grace Ramey/[grace.ramey@bgdailynews.com](mailto:grace.ramey@bgdailynews.com))

Grace Ramey

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Climatologists and meteorologists across the region are trying to make sense of an increase in December tornadoes across southcentral Kentucky in recent years.

Two such tornadoes touched down along the Tennessee-Kentucky border and in southern Bowling Green last week, almost two years after more touched down in December 2021.

John Gordon, chief meteorologist of Louisville's National Weather Service Forecast Office, said the increased rate of tornadoes is real, but the cause and future remain unclear.

"We've always had them in January and February and November, but December has definitely increased in the last couple of years," Gordon said. "There's no question, (but) it's only two years of trend."

Gordon explained that tornadoes are complex and require subtle factors to form. Meteorologists studying potential outbreaks typically focus on moisture in the air, rapid changes in

the wind's speed or direction called wind shear and the presence of heat near the ground with cold air above causing instability.

“When you get the right amount of wind shear and the right amount of instability in a certain area and you have something to lift it, whether it's a jet stream or a cold front, that's when you've got problems,” Gordon said. “That's when you start to see the outlooks from the storm prediction center and the watches that come out of them.”

Gordon said a tornado is never guaranteed, even in ideal conditions, making them difficult to study and track. While technological advancements in weather monitoring have made predictions much more accurate, tornadoes are almost exclusively studied in-depth after they've occurred.

He added that December typically has the lowest likelihood for tornadoes in Kentucky due to colder temperatures and dryer air. This year, however, was an El Niño year,

meaning increased precipitation and temperatures which can contribute to tornado development.

El Niño is a recurring phenomenon caused by above-average sea surface temperatures in the tropical Pacific Ocean, causing a shift in the behavior of oceanic winds that can push warm air east of the Rocky Mountains that creates a jet stream along colder air, Gordon said.

Gordon said this winter has been projected to be unseasonably warm through mid-January in part due to an exceptionally strong El Niño.

“When you get warm weather east of the Rockies in the cool season, there’s always going to be a tornado event in the South,” Gordon said. “It might be Louisiana, Alabama, Mississippi – they’re more prolific than we are, but right now, there’s definitely been an uptick, there’s no question.”

Gordon said the tornadoes that struck Bowling Green in December 2021 did not occur during an El Niño year but added that there was an

active jet stream during that time. That year did have a La Niña event, the inverse of El Niño with cooler surface temperatures.

Gordon said the Dec. 11 tornado day was “just so anomalous” compared to other tornadoes. He recalled numerous tornado events before 2013, but very few between 2013 and 2021.

Gordon said NWS Louisville is embarking on a multi-year historical study of tornadoes dating back to 1860 to determine more patterns. While Gordon said it may be two years before findings can be conclusive, he said tornadoes have always occurred cyclically, with a major outbreak before a gap in activity.

Jerald Brotzge, a Western Kentucky University professor of meteorology and state climatologist, said Kentucky averages roughly 21 tornadoes a year across the state – roughly nine days out of the year – making them “extremely rare” compared to other places.

Brotzge said he couldn't find any December tornado days in the record between 2000 and 2013. In contrast, he found eight tornado days between 2013 and 2021, with four occurring in 2021 alone.

“In some ways, it's kind of luck of the draw maybe that we didn't see December tornadoes before 2013,” Brotzge said. “Typically, climatologists like to have 30 years of records before they can say anything definitively, and we just don't have that yet with a tornado record.”

Brotzge said while records exist going back to the mid-1800s, many are incomplete until the 1950s. Even further, Brotzge said the most accurate records don't begin until the late 1990s thanks to advances in monitoring and testing technology.

The result is a lack of definitive answers, he said.

“When you look back at Kentucky's tornado record, and this goes for the country as a whole, you see the number of tornadoes increasing in the record simply because we're able

to identify the weak tornadoes that previously we'd usually miss," Brotzge said.

He said that the number of tornadoes in January and April, for example, have decreased over time as December tornadoes increased, though tornado formation is in many ways random chance.

Brotzge said the percentage of tornadoes that occur in the winter has remained roughly the same with concentrations in December – though he again leans toward chance rather than trend.

Brotzge also said he doesn't "see much relationship" between tornadoes and weather phenomena like El Niño due to how localized tornadoes tend to be in their formation.

La Niña brings stormier weather to Kentucky and did occur during December 2021, but Brotzge said in both cases they have a "very weak relationship at best" to tornado formation.

Brotzge echoed Gordon's sentiments that tornadoes occur cyclically, adding that those cycles themselves make predictions difficult.

"We've had an unusual number of events in Kentucky in the last several years, but we could very well go another 20 years without another big event, and that's somewhat typical of Kentucky," Brotzge said.

Joshua Durkee, a WKU professor of meteorology and university meteorologist, said it's important to view tornado analysis from a "30,000-foot view" as well as locally.

Durkee said tornado season in the southern U.S. tends to run from early spring and late winter and slowly moves northeast over time. Around fall, tornado weather "reconstitutes" back in the South, repeating the cycle in winter, Durkee said.

He said severe storms in November and December are "not wildly uncommon" across the South, but many times just don't reach Bowling Green.

Durkee said the field of meteorology has changed drastically since 2000 thanks to technological advancements as well as growing public interest in the field, both resulting in more instances of observed tornadoes.

This again can skew data, giving the appearance that tornadoes are more frequent when they are actually more easily observed.

“When you look at the records, that’s what you’re dealing with,” Durkee said. “You’re looking at how many tornadoes have been missed, how many tornadoes get counted that were not actually tornadoes. It’s a real challenge.”

He said to answer the question of how tornadoes are changing, it’s more important to look at the factors leading up to them.

Durkee said the temperature across southcentral Kentucky is continuing to warm on average – “so there’s one ingredient being satisfied.” He added

that the humidity across the region has also been “very above average,” satisfying another ingredient.

“And not just by a little. We’re seeing some pretty marked jumps in temperature and humidity in the lower part of the atmosphere,” Durkee said.

He said it’s better to say the climate of the region has been more conducive to tornado formation than in the past, rather than focusing first on tornadoes themselves.

Durkee added that research shows this tornado-conducive climate is becoming more common across the southern U.S. during the winter, though he said tornadoes may not always form even when the weather is right.

He added that climate change may not directly relate to tornado formation, but it can impact events like El Niño and change weather to better suit tornadoes.

“Unfortunately, we have to let more data pour in before we can make more concrete statements,” Durkee said. “But for now, the takeaway is tornadoes form under specific environments, (and) research shows that those environments are expected to spread east of the Mississippi River into the southern U.S. and set up these conditions more often in the near future.”

Durkee said when it comes to weather, “there’s no rules.”

“I always teach my students meteorology is a lot like a personality or a mood,” Durkee said. “Think about the scale at which our personalities and moods can change, say over a year. ... My takeaway for people is to have an open mind. We are all, as scientists, working to solve these puzzles, and it’s a hard puzzle and why we’re here,” Durkee said. “When you have an idea about the way something works, it’s possible that we discover later on that things aren’t what we originally thought.

“Our ideas change, our findings change, but every time we learn and discover those things, we get a little bit closer to the answers we’re all seeking.”

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## Michael Collins

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