

Researchers rise to challenge of predicting hail, tornadoes three weeks in advance

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People living in Kansas, Nebraska and other states in the Plains are no strangers to tornadoes and hail storms—among the most costly and dangerous severe weather threats in the United States.

Meteorologists and computer models do a good job forecasting severe thunderstorm activity up to a week in advance. Scientists can also read long-term, seasonal signals of severe [weather](#) months in advance. But there's a middle ground—a prediction lead time of about 2 to 5 weeks—that's sorely lacking in current forecasting capabilities.

In a new paper in *Journal of Geophysical Research: Atmospheres*, Colorado State University [atmospheric scientists](#) demonstrate the ability to make skillful predictions of severe weather across the Plains and southeastern United States, including hail and tornadoes, in that coveted 2-to-5-weeks-in-advance period. To do it, they use a reliable tropical weather pattern called the Madden-Julian Oscillation, which can influence weather in distant parts of the Earth, including the U.S., by sending out powerful atmospheric waves.

"When the Madden-Julian Oscillation is active, it is capable of setting up atmospheric patterns that are favorable for severe weather across the United States over the next several weeks," explained Cory Baggett, research scientist in atmospheric science and the paper's lead author. "We have found that an active Madden-Julian Oscillation, which periodically goes around the equator in 30 to 60 days, is a really good source of predictability on these subseasonal time scales." Atmospheric scientists typically consider "subseasonal" to mean about three weeks to three months in advance.

Weather forecasting weeks in advance cannot pinpoint where individual tornadoes or hail storms will occur, Baggett explained, but the researchers have shown they can forecast expected environmental conditions that are favorable for the formation of severe thunderstorms. That includes atmospheric instability and rotational vertical wind shear.

Using available datasets, researchers looked at what the Madden-Julian Oscillation was doing about three weeks ahead of severe weather in the

Plains and southeastern United States, during the typical severe-weather months of March through June. They used 37 years of data to cross-validate their predictions.

They found "forecasts of opportunity" where they were able to make skillful predictions of severe weather activity about 60 percent to 70 percent of the time. Meteorologists would consider this rate of success "great," according to Sam Childs, a Ph.D. student in atmospheric science who co-authored the work.

"We're judging ourselves against climatology," Childs said. "If we predicted normal thunderstorm activity, we would be right about 50 percent of the time. Three weeks out, we're getting it right about 2-1." They also found consistently stronger ability to forecast hail and tornado activity during certain phases of the Madden-Julian Oscillation.

To understand whether this new method of predicting severe weather would be useful to forecasters, the researchers hope they can transition the work to operational experts who could test it out. "In essence, these forecasts of opportunity would allow a forecaster to better alert the public of a period in which [severe weather](#) may be more likely a few weeks in advance," Childs said.

"I think we were all surprised at how good some of our forecasts were," he added. "That's motivation enough to carry forward, so that we might be able to have more useful forecasting products in that coveted 2-to-5-week lead time."

More information: Cory F. Baggett et al, Skillful Subseasonal Forecasts of Weekly Tornado and Hail Activity Using the Madden-Julian Oscillation, *Journal of Geophysical Research: Atmospheres* (2018). [DOI: 10.1029/2018JD029059](https://doi.org/10.1029/2018JD029059)

Provided by Colorado State University

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