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Wind patterns in lowest layers of supercell storms key to predicting tornadoes

October 13 2016, by Tracey Peake

Credit: Lyndon State College from VORTEX2

New research from North Carolina State University has found that wind patterns in the lowest 500 meters of the atmosphere near supercell thunderstorms can help predict whether that storm will generate a tornado. The work may help better predict tornado formation and reduce the number of false alarms during tornado season.

Supercells are a special type of thunderstorm. They last much longer than normal thunderstorms and produce the vast majority of tornadoes and other severe weather. Seventy-five percent of supercell thunderstorms are nontornadic, or don't cause tornadoes. Difficulty in predicting which storms may produce tornadoes has resulted in a false alarm ratio for tornado warnings that also hovers around 75 percent. When using traditional weather sampling methods, there are no clearly observable differences between tornadic and nontornadic supercells in terms of precipitation echoes, rotating updrafts or surface air circulations.

To address this knowledge gap, researchers involved in the second Verification of the Origins of Rotation in Tornadoes Experiment (VORTEX2) collected data in close proximity to supercell storms. Using data from the 12 best-sampled storms - seven of which produced tornadoes - Brice Coffer, a graduate student in marine, earth, and atmospheric sciences at NC State and lead author of a paper describing the work, ran simulations of supercell storms to determine which factors made tornadogenesis more likely.

"We noticed that the biggest difference between tornadic and nontornadic storms was the wind in the lowest 500 meters near the storm," Coffer says. "Specifically, it was the difference in the way the air rotated into the storm in the updraft."

All storms have an updraft, in which air is drawn upward into the storm, feeding it. In supercells, the rising air also rotates due to wind shear, which is how much the wind changes in speed and direction as you go higher in the atmosphere. Coffer's simulations demonstrated that if wind shear conditions are right in the lowest 500 meters, then the air entering the updraft spirals like a perfectly thrown football. This leads to a supercell that is configured to be particularly favorable for producing a tornado, as broad rotation at the ground is stretched by the updraft's lift, increasing the speed of the spin and resulting in a tornado.

On the other hand, if the wind shear conditions in the lowest part of the atmosphere are wrong, then the air tumbles into the storm like a football rotating end over end after a kickoff. This results in a disorganized storm that doesn't produce tornadoes due to a lack of stretching near the ground. Coffer hopes that his results may lead to fewer tornado false alarms.

"This work points to the need for better observational techniques of the low-level winds being drawn into the storms' updraft," Coffer says. "Improving this aspect of storm monitoring will improve our predictive abilities when it comes to tornadoes."

The research appears in *Monthly Weather Review*.

More information: Brice E. Coffer et al, Simulated supercells in nontornadic and tornadic VORTEX2 environments, *Monthly Weather Review* (2016). DOI: 10.1175/MWR-D-16-0226.1

Provided by North Carolina State University

Citation: Wind patterns in lowest layers of supercell storms key to predicting tornadoes (2016, October 13) retrieved 23 April 2024 from https://phys.org/news/2016-10-patterns-lowest-layers-supercell-storms.html