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Tornado-Chasing Project Aims to Improve Forecasts

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When a tornado is about to cut a devastating swath through an American town, those in its path get a warning lead time of 13 minutes on average to try to reach shelter.

"If you live in a trailer community, is 13 minutes enough to wake your family and get them bundled up and outside?" asks tornado researcher Joshua Wurman, head of the nonprofit Center for Severe Weather Research. And "if you are elderly or handicapped, you're going to have a hard time getting to a shelter in 13 minutes," he said.

And that's the average; many times people are warned about six or seven minutes earlier. That is because although scientists know that certain kinds of "supercell" thunderclouds can spin off tornadoes, they know very little about the exact conditions that indicate a tornado will occur and whether it will be a mild twister or a violent killer.

In the mid-1990s, a two-year study called Vortex had a phalanx of scientists chasing tornadoes around the Great Plains, inspiring much public fascination, daredevil amateur tornado-chasers and the 1996 movie "Twister."

Vortex (which stands for Verification of the Origins of Rotation in Tornadoes Experiment) resulted in significant advances, including the revelation that tornadoes can occur on smaller time and space scales than previously thought and that sometimes they do not show up on radar. Knowledge gained from the study led to an increase in average warning times, but it did not unlock the secrets of exactly when and why tornadoes form.

As a result, predictions about tornado occurrence are successful only about a quarter of the time.

"Sometimes people will choose not to take shelter even if they're told to," said Yvette P. Richardson, a meteorology professor at Pennsylvania State University. "In general, the more we can reduce the false-alarm rate, the more seriously the public will take warnings."

Now comes Vortex2, a five-week tornado-chasing project beginning next month that scientists hope will finally provide the knowledge to accurately predict when and where a tornado will develop.

"Ultimately we'd like to get to the point where we can put sufficient data into our models so we know when a tornado will happen," said Stephan P. Nelson, a program director in the atmospheric sciences division of the National Science Foundation, which, along with the National Oceanic and Atmospheric Administration, provided the $12 million funding for Vortex2. "Then you can get first responders to be better prepared --

police, fire, medical personnel, even power companies. Now, that's not even remotely possible."

As part of Vortex2, about 80 veteran scientists and graduate students will chase storms across a wide swath from South Dakota to Texas and from eastern Colorado to Iowa and Minnesota, with their nerve center in Norman, Okla.

They will be armed with a host of tools, including lasers that measure raindrops, Doppler radar mounted on trucks, high-tech balloons, unmanned aircraft and instruments on tripods anchored in the tornadoes' path.

"We're throwing everything but the kitchen sink at it," said Wurman, who has chased 141 tornadoes over 14 years. "We'll have a whole potpourri of instruments surrounding the storm, all measuring different things in different ways."

The technology available this time is far superior. The inaugural Vortex used Doppler radar on planes, which would pass over a tornado at about five-minute intervals. Now radar mounted on trucks, which can get within two miles of a tornado, will provide uninterrupted data.

"We will be able to distinguish between rain, hail, dust, debris, flying cows," said Howard Bluestein, a meteorology professor at the University of Oklahoma and member of the Vortex2 steering committee.

Two ingredients are necessary to form the supercell thunderstorms that spawn tornadoes: a source of buoyant energy, namely warm and moist air near the ground, and a rotational force generated by winds at the surface blowing at a different speed or direction than winds high in the atmosphere.

A typical thundercloud develops as warm air rises into colder air masses above, then usually dissipates quickly once rain falls. Supercell thunderstorms, by contrast, can last for hours and can move rapidly, tracking over 100 miles. Supercell thunderstorms may also create "mesocyclones," swirling winds embedded within the larger thunderhead that can be as much as six miles in diameter.

About five to 10 percent of these storms actually spin off tornadoes, which are typically about 500 feet in diameter. Scientists know what forms a mesocyclone, but they are largely lost when it comes to understanding which ones will spawn tornadoes and how violent they will be.

"A number of things have to happen sequentially and at the same time and in the right order," said John Monteverdi, a meteorologist at San Francisco State University who has been chasing tornadoes for 24 years. "You have to start knocking the dominos down to find out what happens in that last stage. I think we're getting close, and this project should help."

Risky though it appears, members of the project note that their crews have never logged a death or severe injury. But they say amateur tornado-chasers who follow scientists around with video cameras are endangering themselves and others. Not only do these adrenalin junkies put themselves in harm's way, the scientists say, they often speed and park their cars in the middle of the road, endangering other motorists and distracting highway patrol officers.

Scientists warn that it is only a matter of time before a major tornado sweeps through a densely populated urban area and causes horrific damage and loss of life.

Chicago, Atlanta, Dallas and Houston, in particular, are in regions prone to violent tornadoes. Wurman said

in a 2007 study that a tornado cutting through Chicago could kill 13,000 to 45,000 people and cause tens of billions of dollars in damage.

"Tornadoes have a great beauty to them sometimes," Wurman said. "There's a great elegance to the vortex itself. But when you see it going toward a town or city, there's a quick change in your impression, and it's like a tiger: Something beautiful becomes deadly."

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