

## How global warming will affect strength and frequency of tornadoes is a complex question

by Robert Krier

On May 4, a massive tornado, estimated at 1 3/4 miles wide, roared through Greensburg, Kan. It obliterated the town and killed a dozen people.

Unfortunately, that twister was not an isolated incident this year. Tornadoes have already killed 73 people in the United States, well above the annual average of 55 fatalities. The 2007 toll is the highest since 1999.

The spike in death and destruction, as with many extreme weather events recently, inevitably plants a question in the minds of many: Can the U.S. expect more destructive twisters in the future when global warming could play a more dominant role?

Tornado experts at the Storm Prediction Center and the National Severe Storms Laboratory in Norman, Okla., won't venture a guess.

"My best answer right now would be, I don't know," said Dan McCarthy, the warning coordination meteorologist at the Storm Prediction Center, which issues watches and warnings for severe thunderstorms and tornadoes in the contiguous United States. "It's really hard to gauge."

**WINDS OF CHANGE** - Can the U.S. expect more destructive twisters in the future, when global warming could play a more dominant role? CNS Graphic by Aaron Steckelberg.

Experts are wary about predicting what tornadoes will be like in the future for two main reasons:

1. They don't know if the U.S. is already getting more tornadoes than in past decades. It's nearly impossible to find trends because tornado detection and reporting have changed drastically.

2. Models designed to forecast future conditions indicate global warming should cause two major atmospheric shifts that will affect tornado formation. One envisioned change, increased energy in the atmosphere, could potentially lead to more tornadoes. The other, decreased wind shear, could make it harder for them to form.

"It turns out we don't have a good handle on how the variables will change," said Harold Brooks, a research meteorologist at the National Severe Storms Laboratory.

McCarthy, who has been at the Storm Prediction Center for 20 years, said 1,200 tornadoes are recorded in the U.S. in the average year. That number is higher than it was 20 years ago, but it doesn't necessarily mean there have been more tornadoes. The increase is due largely to more eyes on the ground and better equipment in weather offices.

Since the Weather Service installed its nationwide Doppler radar network in the 1990s, tornadoes that might otherwise have gone undetected are now recorded. Doppler can see a storm's "signature," which can indicate if a tornado has formed or might form. Before 1990, eyewitnesses were often needed to confirm a tornado.

It's difficult to know how many tornadoes hit the vast stretches of the Great Plains in the early decades of the 20th century because there was no radar and there were seldom eyewitnesses. Now population growth has put many more people near the paths of tornadoes, and there is an extensive road network to bring the curious closer.

Since the movie "Twister" in 1996, scores of storm chasers, some doing scientific research but many just out for a thrill, hit the roads each spring in hopes of seeing a tornado. They'll drive hundreds of miles to remote areas, and they'll sometimes spot and report twisters that are outside Doppler's range. Their videos are verification.

And the National Weather Service's own expanded network of trained spotters, plus an influx of TV-station helicopters in Tornado Alley, has made it increasingly difficult for a tornado to escape detection.

Brooks said the revolution in tornado reporting has made the records "insufficient to show anything."

"It's possible there really have been changes, but we can't see it," he said. "We can't see any long-term trends."

## NOT UNPRECEDENTED

The tornado that wiped out Greensburg, Kan., was unusual in its size and intensity, but it was not unprecedented. There have been wider tornadoes, higher wind speeds and far more death and destruction.

Winds in Greensburg reached an estimated 205 mph. The May 3, 1999, tornado that hit Oklahoma City and its suburbs had wind speeds estimated in excess of 300 mph. And some tornadoes have been wider than two

miles. The widest ever is believed to have been the May 22, 2004, tornado that hit the town of Hallam, Neb. That twister was estimated at 2.5 miles wide.

The deadliest tornado in U.S. history was the Tri-State Tornado in 1925. That storm killed 695 people in a rapid, 219-mile march across Missouri, Illinois and Indiana.

Whether such deadly tornadoes will occur more frequently because of global warming could depend on which of two key tornado ingredients is altered the most.

Tornadoes need energy in the environment to form, and a world warmed by climate change will have more energy, Brooks said. Increased temperatures also will allow the atmosphere to hold more moisture - another key ingredient in tornado formation. The more energy and moisture present, the greater the potential for atmospheric instability, which tornadoes need.

But another important element in a tornado is wind shear, or changes of wind speed or direction with height. Wind shear helps create the swirl or spin of a tornado.

Brooks said wind shear is often created by large-scale temperature gradients between air masses. Those temperature differences are not expected to be as great or as frequent in a world altered by global warming.

"At the moment, we can't tell which one (atmospheric change) will win," Brooks said. "If we had to bet, we'd say the changes will be pretty small."

Tornado forecasters can't predict before the start of the season, which begins in spring, if the year will be severe. McCarthy said researchers are not even clear on the impact of the El Nino/La Nina cycle on twister formation and frequency.

Tornadoes are not something you can watch develop for several days like a hurricane, McCarthy said. Forecasters can't say with certainty, days in advance, that tornadoes will form in a specific area. About the best they can do, McCarthy said, is say that conditions will be favorable for tornadoes four or five days out. Anything beyond that becomes problematic.

Trying to work climate change into the equation creates an even bigger quandary.

"It's hard to apply something as big as global warming to a much smaller-scale phenomenon like a tornado," McCarthy said. "Tornadoes are random events. Conditions have to be just right for a tornado to form."

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