Chasing twister. (research on tornadoes)

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Scientists are unraveling the mystery of nature's scariest storm--the tornado--to give you enough time to escape.

Joshua Wurman won't soon forget the first time he chased a twister. In June 1995, he and a team of meteorologists (weather scientists) barreled down Texas roads in a gear-laden truck through blinding rain, savage winds, and hailstorms. They raced to catch up with a tornado about to rip off a stretch of highway asphalt. The twister had already hurled cars, trucks, and a house like a child's toys into the furious sky.

"It was really scary," says Wurman, assistant professor of meteorology at the University of Oklahoma. "We couldn't see the tornado and didn't know if, at any second, it would suddenly appear and mow us down."

Sound like twister, the '96 blockbuster flick?

When the truck got mired in a ditch. Wurman and his crew braved the storm to heave the vehicle out. But he fell into a pool of mud and manure--and ended up driving after the twister in only a towel and boots. What a scientist does for research! Finally the team spotted its "prey," whirling like an elongated ice cream cone that licked up the ground and spat out debris.

The truck closed in on the tornado. Then, in 12 minutes, armed with a system called Doppler radar, they collected the most extensive data ever recorded on the epicenter of a tornado's funnel, or whirling wind cloud. They were able to create a three-dimensional "map" of the funnel's wind structure and pinpoint where some winds blew fast and other winds blew slow. "We felt like Columbus, or Lewis and Clark," says Wurman. "It's what every scientist dreams of--observing the results of a great experiment."

Despite Wurman's personal risk, safety is the key reason he and other scientists are probing tornado mysteries--to figure out why they lash and destroy with no warning, and how to forecast them with plenty of lead time.

About 800 twisters strike the U.S. every year. Most cause little damage, but a few "killer" storms pack winds of up to 300 miles per hour, and strew mass destruction--and death--in their path. "Tornado Alley," the swath of great plains from North Dakota to Texas, is the country's hardest-hit, zone in spring and summer. But given the right conditions, a tornado can whip up anywhere.

STORM SYSTEM

What, makes for a twister? Start with warm, moist air rolling north from the Gulf of Mexico and cold air moving east from the Rocky Mountains. The warm air rises, cools, and water vapor condenses, or changes from vapor to liquid--first into droplets that form huge storm clouds, and then into rain. Condensation releases energy, called latent heat, that causes air to rise. Result: The makings of tantrum storms called supercells.

Still, a unique condition called wind shear has to occur to spout a twister, explains Stephen Goss, a meteorologist at the National Weather Service Storm Prediction Center in Norman, Oklahoma. Fast winds above and slow winds below drive and tilt the air layer between them until that layer spins on its end like a top. The spin can turn into a wild mesocyclone, a whirling column six miles wide. The condition is now ripe for sizzling lightning, hailstones--and coiled, deadly twisters.

Scientists don't know why some thunderstorms spawn twisters and others don't. Somehow the rotating mesocyclone spawns a tighter, much more intense whirlwind called a tornado.

To understand the exact workings of a twister, Wurman and other scientists turned to Doppler radar, a system devised more than 30 years ago, but used only in the last decade across the country by the National Weather Service to track storms. Regular radar transmits a beam of microwaves (short electromagnetic waves) to "see" if rain (or snow) is in the air. The waves rebound off raindrops back to an antenna and are used to form a radar-screen image.

Doppler radar, on the other hand, shows how raindrops are moving, because it measures what's known as the Doppler effect (see diagram). Rain that, moves toward the antenna causes the microwaves to bounce back with higher frequency Rain moving away from the antenna causes the waves to bounce back with lower frequency "So Doppler radar can detect if a storm is rotating and how fast the air is turning," says meteorologist Goss.

THE DOPPLER EFFECT

If a fire truck screeches toward you, its siren's pitch (frequency) seems to increase. That's because sound wavelenghts shorten as they move toward you and lengthen as they recede from you--the Doppler effect.

TWISTER TRUCKIN'

Once the scientists locate a tornado, they advance to within two miles of the twister and park in triangle formation--with the tornado at one angle and two trucks at the other two angles (see diagram). The radars act like two intersecting flashlight beams.

TORNADO TRACKING

Two trucks get as close to a twister as safety allows--two miles. They park in a triangle three miles apart. This configuration helps the truck antennas receive much clearer Doppler radar images than if they were any farther away from the twister or one another. The triangle formation also lets them see both wind speed and wind direction inside the tornado.

Another reason for the triangle formation: Doppler radar measures only objects moving forward or away from the radar source, not those moving sideways. A policeman on a highway pointing a radar gun across the road wouldn't be able to record the speed of an oncoming car, Wurman explains. He'd only be able to record the speed of a car changing lanes. Similarly, it takes the measurements of two radar sources to detect the wind speed and direction inside the tornado.

Unlike the weather geeks in Twister, Wurman has never been caught in a tornado's vortex during his research. "It takes 50 seconds to start collecting data, and we can stop and run away in about 25 seconds," he says. Using a computerized road map and signals downloaded from a satellite navigation system called GPS, or Global Positioning System (see SW 3/9/98, p. 16), the research team always knows which roads to head for if they need a fast getaway.

Wurman plans to keep studying twisters--from a safe distance. "In Twister, the scientists got hit by the tornado repeatedly," he says. "That's a pretty stupid plan."