TORNADOES:

WHEN THE AIR NEAR THE GROUND IS WARM AND HUMID AND THE JET-STREAM IS STILL PRESENT OVERHEAD, THE WEATHER IS RIPE FOR TORNADIC THUNDERSTORM FORMATION.

PHOTOS BY DR. JOHN MONTEVERDI
NOT JUST IN KANSAS ANYMORE

BY REBECCA WAN
Until fairly recently, Monteverdi says, both the scientific community and the public were unaware of California’s tornadoes. As recently as the mid 1980s, he says, even meteorologists disagreed over whether California has true tornadoes. At that time, Monteverdi began working with colleagues, including SF State student Scott Braun—now a NASA meteorologist—to convince others in the field that tornadoes do occur in the Golden State. Before the 1980s, Monteverdi explains, severe storms “were often reported as wind damage as opposed to tornado damage.”

He cites one notable tornado that struck the Los Angeles Convention Center on Mar. 1, 1983. The National Weather Service was slow to respond, surveying the site days after the weather event. By then, Los Angeles city workers had cleaned up most of the debris. Meteorologists at that time measured tornado intensity after-the-fact by applying the Fujita scale, developed by University of Chicago meteorologist Ted Fujita in 1971. This scale ranges from F0-F5, based on the damage caused to man-made structures. Because the debris in Long Beach was largely gone, NWS surveyors assessed the tornado as an F2. Based on his own observations, however, Monteverdi theorizes that possibly an F4-level tornado with wind speeds of many ,

The mention of tornadoes elicits images of Tornado Alley in the American Midwest, or conjures scenes from *The Wizard of Oz* or *Twister*. A unit of the National Weather Service (NWS) called the Storm Prediction Center has amassed statistics that confirm a strong association between tornadoes and the Central time zone. Within that zone, Texas, Oklahoma, and Kansas had the most recorded tornadoes between 1950 and 1994, with 5,400, 2,300, and 2,110 respectively. These same three states are also among the 10 highest recorders of property damage, injuries, and fatalities due to tornadoes. Far less familiar to most people, however, is California’s own miniature “Tornado Alley.” The kinds of storm conditions that give birth to tornadoes occur frequently in parts of Los Angeles, Orange County, and the Central Valley. A meteorologist at San Francisco State University, Dr. John Monteverdi, has set out to change the public’s preconceptions about tornadoes in California and elsewhere. Accordingly, he has embarked on annual storm-chasing trips every spring for the past two decades to further his tornado research.
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Monteverdi also surveyed the damage associated with one of the most severe Bay Area thunderstorms in recent memory: the supercell thunderstorm that hit Sunnyvale and Los Altos on May 4, 1998. Based on radar analysis and amateur video taken by Sunnyvale residents, Monteverdi and his colleagues hypothesized that the weather event produced two rare anticyclonic tornadoes. The storm uprooted trees, lifted cars, and tore the roofs from buildings. The National Weather Service classified it as an F2, with winds speeds up to 157mph. “If I showed you the pictures,” he says, “you would say, ‘Oh, that looks like Oklahoma.’ Every house had its roof taken off. It was just lucky that no one was killed.”

After the tornado hit, Sunnyvale resident Jane Rendon told the town’s local newspaper that she’d never seen such a storm in her 30 years as an area resident. Although the Bay Area produces an average of one to two tornadoes per year, most are much weaker than F2s or F4s. The last Bay Area F2 tornado, for example, touched down in 1951.

Tornadoes form only under very specific circumstances and typically occur in spring. That’s why Monteverdi schedules his annual storm-chasing trips in mid- to late-May. When the air near the ground is warm and humid and the jet-stream is still present overhead, the weather is ripe for tornadic thunderstorm formation. A tornadic thunderstorm starts when a buoyant bubble of warm air lofts into the higher atmosphere and a thunderstorm forms within it. Under the right conditions, when the jet stream is overhead, circulating air within that thunderstorm creates a mesocyclone—a vortex of air that rotates around a vertical axis. Meteorologists call a storm that contains a persistent mesocyclone a supercell thunderstorm, and such storms are the most violent type. While supercell thunderstorms do not always produce tornadoes, most strong and violent tornadoes are associated with this type of turbulent storm.
As a mesocyclone intensifies, it circulates rain and hail to the back side of the storm, forming what observers call a “hook echo” on weather radar. This plume of precipitation interacts with surrounding warm dry air to form a “rear flank downdraft.” In a poorly understood process, the collision of this warm sinking air with humid inflow air appears to be associated with tornado formation. Initially, a nascent tornado will appear as an airborne funnel cloud. Technically, though, the storm becomes an official tornado only when that funnel touches the ground.

Mesocyclone formation tends to occur in certain parts of California when particular weather patterns favor thunderstorms. Chiefly, the ingredients come together in California’s Central Valley, in coastal valleys, and in the western Los Angeles basin, producing about six to seven tornadoes a year, on average. Although it surprised many in his field, says Monteverdi, “It turns out there are thunderstorms that produce ‘Wizard of Oz-type tornadoes in the Central Valley.’ Weather forecasters have caught on to this fact, in part, due to his research. The general public, however, still seems unaware that tornadoes do happen outside the Midwest, he says.

Monteverdi’s fascination with weather began with a child’s Lionel weather station kit, assembled in his parents’ backyard. That sparked a drive to learn about weather patterns that became a lifelong passion. He still runs a weather station today—but a much more sophisticated one. And starting 25 years ago, Monteverdi began his annual storm-chasing trips. The walls of his Oakland home are now lined with breathtaking storm photos that he took himself while on those largely self-funded excursions.

Has he ever felt himself to be in serious danger while storm chasing? “A couple of times, maybe,” he says. On a 2008 trip, he and a longtime friend and chase partner, Thom Trimble, were in Quinter, Kansas. “The visibility was awful...you couldn’t see a quarter mile. On radar, we could see that there was a rotating thunderstorm, then out of the darkness, you could make out a shape. It was like a science fiction movie...the sirens came out of the town because the National Weather Service had issued a tornado warning, and then all of a sudden there was a multiple-vortex tornado...and we had to get out of the way.” Monteverdi only managed to capture a blurry photo as they hastily retreated to a safer spot.

Despite this seemingly exciting escapade, Monteverdi emphasizes that he would never intentionally get so close to a tornado. In Quinter, low visibility inadvertently led to the near miss. “Even though we had radar, it takes radar four minutes to do a sweep, so the image is always up to four minutes old.” During a period that long, he adds, “something moving 50 miles an hour can travel quite far.”

The tornadoes on Monteverdi’s wall fill each photo frame, but are actually miles away from the camera lens. He captured the image of one particularly impressive funnel from 10 miles away. He has never been injured in his quarter-century of storm chasing and stresses the importance of “not doing anything stupid.” That includes never “punching the core,” or heading directly into the path of a tornado, as the characters in “Twister” did repeatedly. Tornado winds—which can become strong enough to pick up a storm chaser’s car and deposit it miles away—are a major threat. Lightning and baseball-sized hail could severely injure or kill a careless storm chaser. Even worse, Monteverdi warns, reckless amateur storm chasers threaten the safety of others, sometimes blocking exit routes with their erratic driving and creating road hazards for evacuees and emergency vehicles.

Contrary to storm-chasing scenes in movies like “Twister,” Monteverdi reports that his annual chase trips are mostly boring. While weather forecasters can predict tornado-producing weather patterns several days in advance, they can only hypothesize about where and when a funnel cloud will actually form. Monteverdi spends most of his time waiting for the right conditions to occur with no guarantee of a tornado-spotting on any given trip. Regardless, he takes illustrative photos of lightning and storm structure for his students.

Monteverdi’s activities, both dull and exciting, reveal a drive to educate others about weather patterns. When not studying severe storms, he works as an educator, administrator, and webmaster for the SF State geosciences department. He also operates a business called Mayacamas Weather Consultants that provides forecasts, expert trial testimony, environmental impact reports, and climate trends. His clients have included vineyards, construction companies, law offices, and city governments.

Looking toward the future, Monteverdi is concerned about global climate change and the potential for generating more tornado-producing storms. He leaves the study of changing climate patterns to other researchers, however, preferring to study weather on a local scale and to focus on the comparatively smaller details. “No matter what global warming does,” he says, “we’re going to have to react to the kinds of patterns that can produce tornadoes.”