

# WVORTEX



Susan Cobb, NOAA

The NOXP radar moves into position on top of a hill with no trees or buildings to obstruct its scans of a storm in southwest Iowa.

# Armed with the latest technology, an intrepid group of storm chasers spread out across the Central Plains to solve the mystery of tornadoes.

By MEREDITH MORIAK

**G**rowing up in Minnesota, Robin Tanamachi became interested in weather and was intrigued by a massive tornado experiment in the mid-1990s. Nearly 15 years later, she is working beside some of the world's brightest scientists and research meteorologists in the largest tornado experiment ever. Together, they are collecting data on tornadoes that could save lives in severe storms.

Tanamachi, a Ph.D. candidate, is studying under University of Oklahoma meteorology professor Howard Bluestein, using mobile radars to look at storms. This summer, Bluestein and his team spent five weeks roaming more than 900 miles of the Central Plains investigating tornadoes as part of the Verification of the Origins of Rotation in Tornadoes Experiment 2 (VORTEX2). They were joined in the chase by more than 100 veteran scientists, researchers and students from more than 15 organizations, universities and non-profits.

"I grew up hearing about VORTEX, and many of the people involved with that program became heroes to me," Tanamachi says. "It is now a great honor for me to work with them in VORTEX2."

Like Tanamachi, undergraduate meteorology student Sean Waugh was one of about 40 students in the field this summer. As a student technician at the National Weather Center on OU's Research Campus, Waugh worked with experienced NOAA National Severe Storms Laboratory field equipment technicians to provide a fully mobile armada for history's most ambitious attempt to study tornadoes. Waugh outfitted more than 40 vehicles prepared to harvest data from every part of a storm.

Collaborative teams of researchers are seeking to understand how, when and why tornadoes form. To accomplish this, they followed supercell storms that could produce tornadoes.

"Never before have we gotten everyone together at the same time to focus on the same storm," Bluestein says. "You need to observe many different variables in space on a very, very fine scale while the tornado is forming."

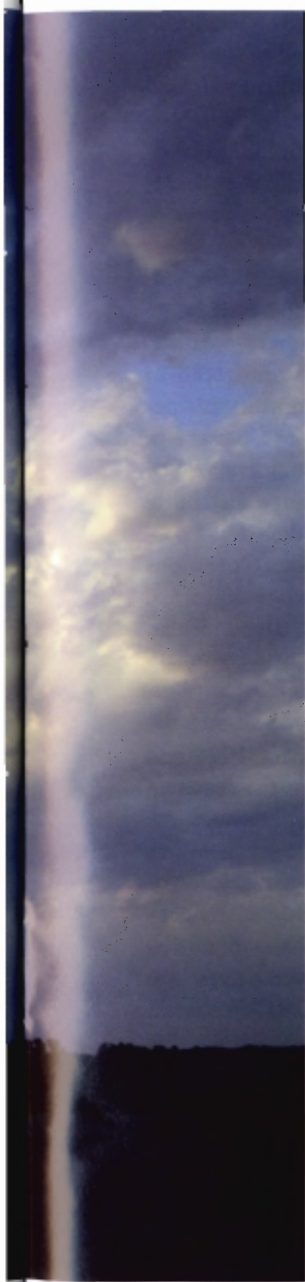
By capturing data on all types of supercells, the scientists will be able to understand why a storm did or did not produce a tornado. Findings from the experiment are expected to increase the advance warning for those in the path of deadly tornadoes.

OU is a lead partner in the two-year \$11.9-million, multi-institutional program funded by the National Science Foundation and the National Oceanic and Atmospheric Administration. Key OU participants include CIMMS researcher Don Burgess, professors Bluestein, Mike Biggerstaff, Jerry Straka and Ming Xue, and staff scientist Kathy Kanak.

## The equipment and technology

Unlike the original VORTEX, VORTEX2 was entirely mobile with no home base. The main operations center was based in Norman to provide backup, but most decisions came from the Field Command vehicle. All VORTEX2 vehicles were equipped with cutting-edge communication and computer technologies, which allowed the fleet to track each other and monitor the data they collected in real-time. The goal was to create an observational network in and around a tornadic supercell thunderstorm while simultaneously communicating between vehicles. The data assembled will allow researchers to analyze a tornado's strength, track and lifetime.

Before the armada launch on May 10, Waugh spent hundreds of hours inside the vehicle bay at the NWC preparing the tools for the project. He constructed mobile mesonets—environmental monitoring stations attached





John Oakland, CIMMS

The NOXP radar, jointly operated by NOAA and OU, scans a wall cloud with a lowering a few miles in the distance.



John Oakland, CIMMS

In Wyoming, softball sized hail from the storm that produced VORTEX2's only tornado shattered the windshield of a mobile mesonet.

to minivans that were positioned in key areas of a storm.

"I have a natural interest in taking things apart and putting them back together," Waugh says. "Working with the vehicles just comes naturally."

With little instruction or guidance from his supervisors, Waugh developed techniques for assembling the VORTEX2 mobile mesonets.

"Basically, they told me, 'Here's the car, here's what I want in it—find a way to make it work,'" he says.

Tanamachi uses the University of Massachusetts-Amherst's W-Band Mobile Doppler radar to collect high resolution data in the field. "With W-Band resolution, we can see very small scales and detailed structures inside of the tornadoes," Tanamachi says.

The experiment focused on the Central Plains because the relatively flat landscape allows the mobile radars to acquire data close to the ground. Researchers chose mid- to late spring, statistically the most active time of year for severe weather. Additionally, storms tend to move slower during this period and present a better opportunity for observation.

One setback the field scientists faced was the unpredictability of weather, although they knew before launching there was a possibility of clear skies during the five-week program. Operations slowed during the second and third week due to a lack of storms, then picked up dramatically after encountering a spectacular, classic twister on the plains of Wyoming.

### The background

During the original VORTEX field program of 1994 and 1995, scientists set out to answer questions about the causes of tornado formation. "VORTEX successfully documented the near-ground weather conditions close to tornadoes," says Erik Rasmussen, VORTEX and VORTEX2 principal investigator.

Targeting a single storm each day, a team of investigators operated a dozen instrumented vehicles, two mobile laboratories, a mobile Doppler radar and two Doppler-equipped aircrafts. In contrast to VORTEX2, however, the original VORTEX worked out of Norman with scientists driving to meet storms, limiting their area of deployment to Texas, Oklahoma and Kansas.

An important finding from the first VORTEX experiment was that tornadoes happen on smaller time and space scales than scientists had thought, says Stephan Nelson, former NSF program director for physical and dynamic meteorology and OU alumnus.

The largest contribution VORTEX findings made to the public was the notable improvement in the average lead time of the National Weather Service's tornado warnings during the late 1990s.

### The mission and the benefits

The findings from VORTEX serve as the basis for VORTEX2, allowing scientists to ask tougher, more precise questions, such as: How do tornadoes form? What exactly causes the wind to spin into a concentrated funnel? How can we tell exactly when a tornado will form and when it will die, or how long it will last? Why do some thunderstorms produce tornadoes and others do not? What is the structure of tornadoes? What is the relationship of tornadic winds to damage?

“The VORTEX2 experiment is designed to obtain a large number of measurements near the surface in and around the storm to better understand the relationship between storm rotation and temperature, humidity and wind fields in this layer,” says Lou Wicker, steering committee member and NOAA National Severe Storms Laboratory scientist.

“The goal is to use the best observations we have now and all of the information we gathered in VORTEX and take that to make models,” says Kevin Kelleher, NSSL deputy director. “The end game is to help forecasters predict what is going on more accurately.”

Scientists, students and professional forecasters participating in VORTEX2 hope to use their newly gained knowledge to continue improving tornado forecasts and warnings in the next decade. They hope their conclusions will once again increase the tornado warning lead time.

### The collaboration

Although they are distributed across the country, all eight steering committee members have ties to Norman through OU and the federal NSSL. This group was responsible for the planning of the experiment and has been working on the project since the end of the original VORTEX. Pennsylvania State University professors Paul Markowski and Yvette Richardson earned their Ph.D.s from OU as well as David Dowell, a researcher at the National Center for Atmospheric Research in Boulder, Colorado. NSSL ties include Burgess, Wicker and Rasmussen. Former OU faculty member Joshua Wurman is president of the Center for Severe Weather Research, and Bluestein has been on the OU meteorology faculty since 1976. Working together on this project allows them to reconnect with past professors and colleagues.

Additionally, VORTEX2 has drawn national media attention to the project and Norman. Prior to project launch, The Weather Channel spent an entire week at the National Weather Center, profiling key researchers and equipment. During the project, they were embedded with the team and brought unprecedented coverage to television audiences, broadcasting live from the field multiple times a day. During Media Day, journalists from across the country inspected field equipment and talked with scientists about to embark. Throughout the experiment, a media vehicle guided by the NSSL took more than 25 reporters, photographers and videographers along for close and personal contact with scientists.



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Weather instruments mounted on minivans called mobile mesonets were used to penetrate the storms and measure temperature, pressure, humidity, wind speed and direction during VORTEX2.

### The future

The collaboration between students and mentors in the field is beneficial to the future of science. Tanamachi says students will have the ability to process VORTEX2 data for senior capstone projects, master's thesis work and Ph.D. dissertations.

“The data collected during this experiment will have a large impact on the future,” says OU meteorology professor Mike Biggerstaff. “In addition to the students in the field, you figure at least another 100 will look at the data during the next few years.”

Many former Ph.D. students have developed their dissertations around the findings from the original VORTEX, including Markowski. It is expected that findings from VORTEX2 will provide valuable data for many scientists and new doctoral candidates. Those who missed this year's chase will have another chance when VORTEX2 hits the road again May 1-June 15, 2010.

“We have talented, young scientists learning the craft from veterans in the field,” Biggerstaff says. “It is a transfer of knowledge from one generation to another. We take bright young minds and give them the opportunity to work in real time experiments with real consequences.”

*Meredith Moriak, a journalism junior from Bedford, Texas, was a public relations intern with OU CIMMS and NOAA at the National Weather Center in spring 2009 and will be managing editor of The Oklahoma Daily for fall semester.*