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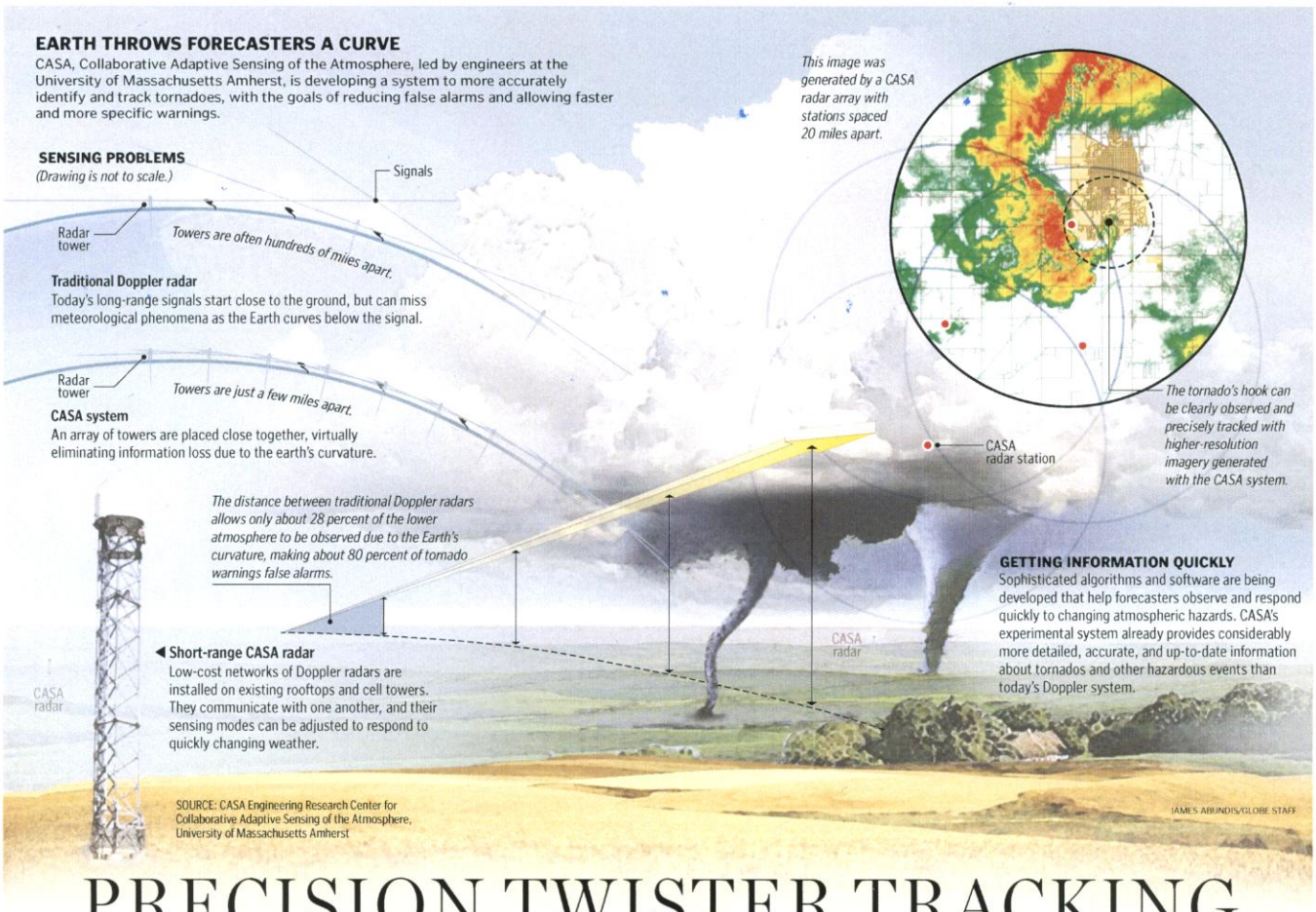

PRECISION TWISTER TRACKING

UMass team leads project to develop a system of far more accurate warnings

By Marion Davis
GLOBE CORRESPONDENT

The storm that hit Oklahoma on May 24 had been brewing for hours. Forecasters saw it on the Doppler radars and issued an early warning.

Shortly before 5 p.m., the radars showed a twister heading into Newcastle. Lee Kuhlman, who leads a team of storm spotters, sent them out to look. The town's emergency manager dispatched rescue teams and sounded an alert siren.

But then, between Doppler scans, the powerful EF4 tornado changed direction. The spotters couldn't see it — it was wrapped in rain — but Kuhlman did on a separate, experimental radar system.

"It completely changed our target area," Kuhlman said. "The emergency manager got on the radio, and with literally minutes to spare, got EMS and fire to move, possibly out of the way of the storm."

The system Kuhlman used is part of a $43 million, 10-year project called CASA, for Collaborative Adaptive Sensing of the Atmosphere, that engineers at the University of Massachusetts Amherst have been leading since 2003.

Funded by a highly competitive National Research Foundation grant, CASA is a partnership with state universities in Colorado, Oklahoma, Puerto Rico, Virginia, and Delaware, the National Weather Service, technology giants Raytheon Co. and ITT Corp., and specialty manufacturers including EWR Weather Radar and Vaisala, and Weathernews Inc.

The project's goal, director David J. McLaughlin said, is to create a better hazardous-weather warning system that gives geographically specific, actionable information to all who need it.

The United States has the best Doppler network in the world, McLaughlin said, and it does "a pretty good job" with tornadoes, issuing warnings for 80 percent. But roughly 80 percent of warnings turn out to be false alarms, and none are very specific.

Take the June 1 tornadoes that hit Western Massachusetts.

In the Springfield area, there were three deaths, hundreds of injuries, and at least $90 million in damages. Yet 20 miles north, Amherst, where sirens were also sounded, had just a rainstorm. The problem, McLaughlin explained, is that the current system, called NEXRAD and deployed in the 1990s at a cost of $2 billion, has significant coverage gaps and provides coarse-grain data.

NEXRAD uses 159 high-powered radars, positioned atop towers about 200 miles apart, to cover the country. It offers a good big-picture perspective, McLaughlin said, but because of the radars' elevation and the Earth's curvature, it can't see storms close to the ground.

The Dopplers also take a relatively long time to do their 360-degree scans, updating weather data only every five minutes. For fast-moving storms, that's too long, Kuhlman said.

"I could be looking at a location on radar that's 10 miles away, and if it's going at 60 miles per hour in five minutes it's five miles away from me, and five minutes later it could be on top of us."

The CASA system uses lower-power, X-band radars placed as low as 20 feet off the ground (in Oklahoma, where it's flat), about 20 miles apart, each with a 25-mile range, so there is overlap. The radars feed data into a closed-loop system with software that uses algorithms to detect trouble spots and can put the radars into "sector scan" mode to focus on specific areas.

As a result, said Michael Zink, deputy director of CASA and lead developer of the software, updates can be much quicker, down to 15 seconds. The images are also finer-grained: What gets a few pixels in NEXRAD is shown as a distinct image in CASA.

"We've shown that we can follow the vortex of a tornado down to the ground and follow it down individual streets, because of the resolution of the system," McLaughlin said.

The CASA team's long-term goal, McLaughlin said, is to build a nationwide network of 1,000 to 10,000 small radars linked to a common, publicly accessible system.

"But I think we're still five years away from having a technology that can be deployed at low cost, coast to coast," he said.

The basic concept has been proven, McLaughlin said. CASA has published hundreds of papers and gotten validation from a National Research Council review. Yet the cost of the technology is still high. And even if CASA can get the price down to $1 billion for the full network (the target price), it still has to persuade potential users to make the investment.

Unlike NEXRAD, McLaughlin said, this system won't be built by the federal government, but by municipalities, regional groups, and private companies.

In the lab, engineers and computer scientists are refining the technology, with a focus on flat-panel radars that shift their beams electronically, called phased arrays, that could increase reliability by eliminating moving parts.

Such arrays now cost the military $1 million per square meter, McLaughlin said, but CASA has gotten the cost down to $100,000. Since multiple panels will be needed for each installation, however, as well as hardware and software, the cost has to drop far more.

In the field, Brenda Philips, a resource economist at CASA, is working to find out how people use radar data and how to make it more useful.

Philips is also preparing a major test of CASA, in the Dallas-Fort Worth area: a five-year, $10 million project with the North Central Texas Council of Governments set to start in February with eight radars.

Apoorva Bajaj, meanwhile, CASA's industry liaison, is looking for new markets: electrical utilities, transportation companies, and especially weather data resellers who can create "value-added" packages for the media, consumers, and specialized sectors.

And Theodore Djaferis, the UMass Amherst engineering dean, is setting up CASA 2.0, a set of specialized projects to test further applications of the technology, such as one to detect low-flying aircraft or to help wind-power generators find the strongest gusts.

Already, Bajaj said, CASA has made an impact on the market, and some radar manufacturers are making X-band weather radars to sell to municipalities. Dense radar networks are also being built abroad, McLaughlin said, in Australia, France, Britain, and Japan.

Mark Russell, a vice president at Raytheon — a CASA partner from the start — said he thinks the system is "a fascinating and viable approach" to an important problem.

The key now, he said, is to implement it on the proper scale at an affordable price.

Raytheon could be interested in commercializing some of CASA's work, he said — though he expects smaller companies to step in.

In Oklahoma, Kuhlman said, municipalities are trying to persuade a philanthropist to buy new radars to replace the ones they have been using, which will be sent to Texas to be used in the Dallas-Fort Worth project.

"I think we saved lives on May 24," he said.