The Big Idea

Q. How do you unlock the mysteries hidden inside storm clouds?

A. Send in the drones.

By Chip Minty

Imagine it's a warm afternoon in early May, and you are a meteorologist approaching a severe thunderstorm in southwest Oklahoma. You've seen these types of storms a hundred times. Most fizzle into vapor with little explanation, but this one is different. It has the potential of growing into a monster of devastating violence—the kind that seasons Oklahoma springtime with a unique flavor of dread.

But this time you have a new tool that gets into the heart of the beast, revealing its temperature, pressure, wind speeds, humidity and other critical information that has been beyond reach until now.

It weighs only a few pounds, is packed with sophisticated sensing and communications gear and flies with the agility of a fighter jet. Scientists call it a UAV, short for Unmanned Aerial Vehicle. Most people call it a drone.

Photo provided

OU Professor Phillip Chilson prepares to send a weather drone on its mission to improve forecasting.

The vision of launching drones to learn more about storms is not new. Researchers and engineering students from the University of Oklahoma have been exploring the possibility for nearly three decades.

OU's Associate Vice President for Research James Grimsley remembers his undergraduate days on the Norman campus in the late 1980s, wandering down to the engineering labs to see friends working on the "Tornado Chaser." The unmanned aircraft was one of the first designed to fly into storm clouds, but the limited technology of the time hindered Chaser's success.

Today, fueled by advances in computational capacity, artificial intelligence and remote sensing, the technology is there, but obstacles still stand in the way of using drones, Grimsley says. Public concerns, safety issues and regulatory hurdles must be addressed, but he sees progress.

"The FAA (Federal Aviation Administration) has been responsive to our vision so far," Grimsley says. "We have a good relationship. We have a shared vision of how we want to get there, and a lot of aviation stakeholders are engaged in conversations about how to make this happen."

Meanwhile, OU researchers and technicians are continuing to develop the technology.

Phillip Chilson, an OU professor of meteorology, is at the forefront of that effort. He and fellow researchers from three other universities were recently awarded a $6 million National Science Foundation grant to continue developing drones to improve weather forecasting through the study of atmospheric physics.

Chilson is director of the Center for Autonomous Sensing and Sampling and is affiliated with OU's Advanced Radar Research Center. As a physicist, he has spent his career study-

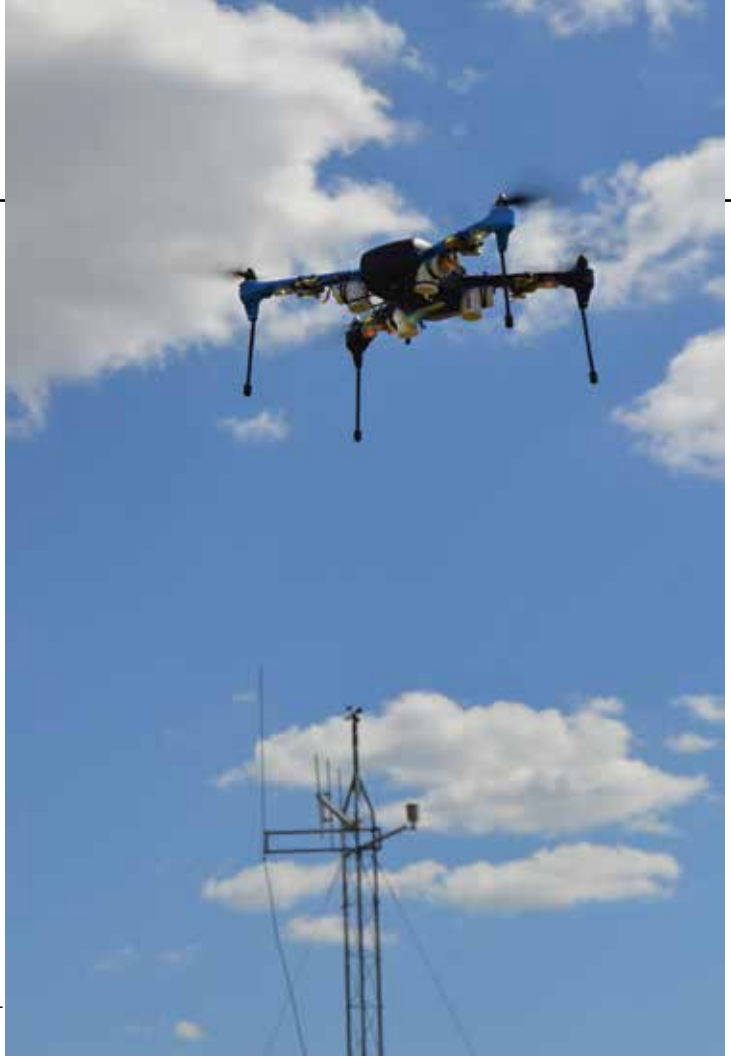

Photo provided

Drones such as this one soon could gather weather "vital signs" from the lower atmosphere and increase tornado warning times.

ing the atmosphere through advanced radar technology. He sees drones as the next step in atmospheric research because they offer a relatively inexpensive way to gather data that is hard to collect.

"They are good at dull, dirty and dangerous," Chilson says.

While collecting data from a raging thunderstorm seems heroic, the day-to-day mission of drones would bore most people to tears. Someday in the not-too-distant future, quadcopters small enough to land on a doormat could fly repetitive missions every hour, 24 hours a day, 365 days a year.

Working from stations across the country, these robo-copters could measure atmospheric vital signs from the surface up to 5,000 feet. With continuous updates and expanded data collection, the drones could be the most revolutionary forecasting tool since weather balloons were put into service more than a century ago. Chilson believes that within a decade, researchers and meteorologists could forecast the weather with far greater acuity through drones like the ones he is developing in the Radar Innovations Laboratory on the university's Research Campus.

For years, Oklahoma's unique system of 120 Mesonet weather monitoring stations has been the envy of meteorological communities around the world. But, the Mesonet provides no information about conditions even 30 feet above the ground, Chilson says.

"We need better data from the lower atmosphere," he says. "It's a guessing game at what exists at less than 1,000 feet. If we can get better at tracking vertical conditions, we can be far more sophisticated in our perception of high-impact weather."

Advanced radar and other technology have improved the weather service's ability to issue tornado warnings. In the 1970s, the average warning time was about four minutes. Today, the average is 13 minutes. Government scientists are now working on computer models that could increase warning times to 40 or even 50 minutes.

Feed those models the supplementary information that only drones can gather and warnings will become even more accurate, Chilson says. But that day may still be a number of years away because technology has advanced faster than regulations.

"It's like having a high-end Maserati, but the speed limit is only 55," Chilson says.

Grimsley accepts the challenge, calling drones a new frontier in the field of aviation.

The test flights outside of Norman resemble scenes from the Wright Brothers at Kitty Hawk, says Grimsley. Cars, trucks and a couple dozen people gather over an area the size of a small farm. Licensed drone pilots, a ground crew, observers, scientists, graduate researchers and communications people are there, many of them required by FAA mandates.

OU researchers are not allowed to lose sight of their aircraft and they must operate in very specific areas. In one application they must confine flights to a specified 400-acre space. They also must stay below 3,000 feet. Grimsley expects the rules to ease as both sides address concerns with technological solutions.

"Right now, we're caught in the middle. We have to save lives by predicting weather better, but we don't want to create a new, unmitigated risk," Grimsley says. "Those are the conversations we're having with the FAA."

Chilson shares Grimsley's outlook.

"We can see the regulations are starting to change. At OU, we have a lot of planets aligning, and Oklahoma has a long history in aviation and a good rapport with the FAA."

"We have a strong weather tradition, wonderful radar assets and great collaboration across different academic disciplines," adds Chilson. "I cannot imagine a better place for this type of activity to be accomplished."

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