



OU's AI Weather Pioneer

**An innovative computer
programmer is using
artificial intelligence
to identify deadly storms
before they strike.**

BY CHIP MINTY



Kelvin Droegemeier has been peering into the future of storm prediction for years. For much of his career, he has pursued secrets inside the clouds that produce ferocious hailstorms and deadly tornadoes.

To that end, the University of Oklahoma Regents' Professor of Meteorology co-founded OU's Center for the Prediction and Analysis of Storms in 1989.

"If only we could identify an approaching hailstorm or tornado an hour before it strikes, that could make all the difference," he has said many times. That was Droegemeier's vision 30 years ago, but he admits those dreams may not have been attainable with the technology available at the time.

But Droegemeier never lost his vision and, in 2004, he found a path leading toward a transformational change in technology. It began at the door of Amy McGovern, then a postdoctoral research associate working in computer science at the University of Massachusetts, Amherst.

Droegemeier believed that machine learning and artificial intelligence (AI) were needed to move his vision forward. He just had to convince McGovern. ▶

ABOVE - Amy McGovern, a professor with dual appointments in the School of Computer Science and the School of Meteorology, is using artificial intelligence to look for common patterns in destructive storms while they are still forming, giving the public longer times to prepare.

She didn't have a meteorology background, but what she did have was passion—passion for computer science and using it to solve real-world problems, and passion for the planet.

"I wanted to be an astronaut when I was little," McGovern says. "Observing Earth in a scientific way has always been interesting to me."

So, when Drogemeier approached McGovern about using AI to improve weather forecasting, she didn't hesitate to relocate to Norman, Okla., where she offices in the National Weather Center on the University Research Campus. A *Wall Street Journal* story on McGovern's research noted that she was one of those rare people "who moved to Oklahoma for the weather."

"When Kelvin started talking about how we could use AI for information gathering and weather forecasting, I said, 'That sounds really cool, let's do it.'"

With that conversation, McGovern embarked on a 17-year journey, programming high-powered computers to simulate human intelligence and sniff out storms like hounds after prey.

Early in McGovern's career, only a handful of weather researchers were interested in AI. Her first session at the American Meteorological Society's AI Conference attracted just 30 participants, she says.

"I was pretty much the only one who had a computer science background. The others were meteorologists trying to learn AI, and I was trying to learn meteorology."

As a committee chair, McGovern has watched the AI



Oklahomans are no strangers to the loss of lives and property inflicted by catastrophic weather. A new OU institute is harnessing AI to increase the warning time for storms.

"We're not going to be able to stop tornadoes and hail, but if we can improve the prediction of them, we can save lives and property."

says. "We've also been working on hail forecasting, to improve it from zero to three hours.

"If you have even an hour, you have time to move cars, RVs and other vehicles," she says. "You're still going to lose your roof because you can't move your house. But you would have time to take a lot of other protective actions."

According to the National Oceanic and Atmospheric

conference attendance double each year and says, if not for the pandemic, that attendance could have reached 300 participants in 2020. She says AI is making inroads into the fundamental science of severe weather as meteorologists witness the potential for computers to gather enormous amounts of data and to analyze the markers of severe storms before they strike.

"Humans themselves can only analyze one or two events at a time because there's just so much data," McGovern says. "An AI system can analyze thousands of tornado modals and find patterns in them that humans might not."

Over time, those patterns could lead forecasters to spot developing storms earlier and allow for longer warning times.

"The average warning for a tornado is 15 minutes," McGovern says. "We're trying to get it up to 30 minutes."

The experimental computer programs McGovern is developing are being tested in real-world applications at the National Weather Service's Storm Prediction Center in Norman.

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Administration, 22 weather and climate disasters in 2020 caused more than \$95 billion in damages—more than double the 41-year average of \$45.7 billion. Some modelers estimate that the February 2021 freeze in Texas alone destroyed infrastructure and disrupted supply chains worth \$90 billion.

If AI can help forecasters save lives and property, McGovern is all in.

Right now, she says, meteorologists are bogged down in a huge data overload. Weather forecast offices have several screens displaying information that is constantly updating 24 hours a day. Using AI, computers can monitor massive amounts of data simultaneously and alert forecasters to areas of concern where tornadoes, hail, and other storms are likely. AI will not replace meteorologists, she says, but it can supply tools that will help them provide faster and more reliable forecasts.

Through the years, McGovern's contributions have expanded far beyond her research and faculty positions at OU. She also serves as director of the National Science Foundation's AI Institute for Research on Trustworthy AI in Weather, Climate and Coastal Oceanography.

In 2020, McGovern led an application effort that resulted in a \$20 million NSF grant to fund the new institute.

The award was one of seven AI Institute grants the NSF gave last year, and McGovern says the OU-based institute is the only one focused on weather. The term "Trustworthy AI" is relatively new in the AI vernacular, representing the importance of accuracy, reliability and consistency, and the institute is doing groundbreaking work to quantify what it means for AI to be trustworthy.

"We don't want to predict something that doesn't happen," explains McGovern. "Let's say AI told you that there was an 80% chance of hail tomorrow at a particular time, but it doesn't happen.

"Say you're a car manufacturer, and you put all your cars



Millions of dollars in property could be saved with increased warning times for hailstorms, which are growing in frequency and intensity.

under cover. You've now wasted so much money because the hail didn't come. If that happens once, maybe that's not the end of the world, but if AI is constantly crying wolf, then it's not trusted. We want it to be accurate and reliable. We also want to know what other indicators there are for trust. There aren't a lot of studies on what it means for humans to trust automation."

In addition to her leadership role within OU's AI institute, McGovern recently became editor-in-chief of *Artificial Intelligence for the Earth Systems*, a new scholarly journal established by the American Meteorological Society (AMS). The publication features research associated with AI and machine learning in meteorology, atmospheric science, climate science, oceanic science and other areas of environmental science.

"AI is starting to revolutionize a whole bunch of different sciences, but articles about AI for meteorology, oceans and climate have been scattered all over the place, so I proposed that we put them all together in one journal," McGovern says. "I've been told the AMS has never jumped on a journal that fast. It was approved unanimously."

Droegemeier says McGovern has made an enormous impact on weather research, establishing OU as a world leader in the ever-expanding field of artificial intelligence.

"AI is a rapidly growing field. There are some huge, heavy hitters around the world, and it is important for OU to have a leadership role in the United States," says Droegemeier, former director of the White House Office of Science and Technology Policy and science adviser to the president during the Trump administration.

"I'm just really proud of Amy. The word 'pioneer' is absolutely an appropriate term for her."



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