Researchers Develop Machine Learning Technique to Predict Severe Weather

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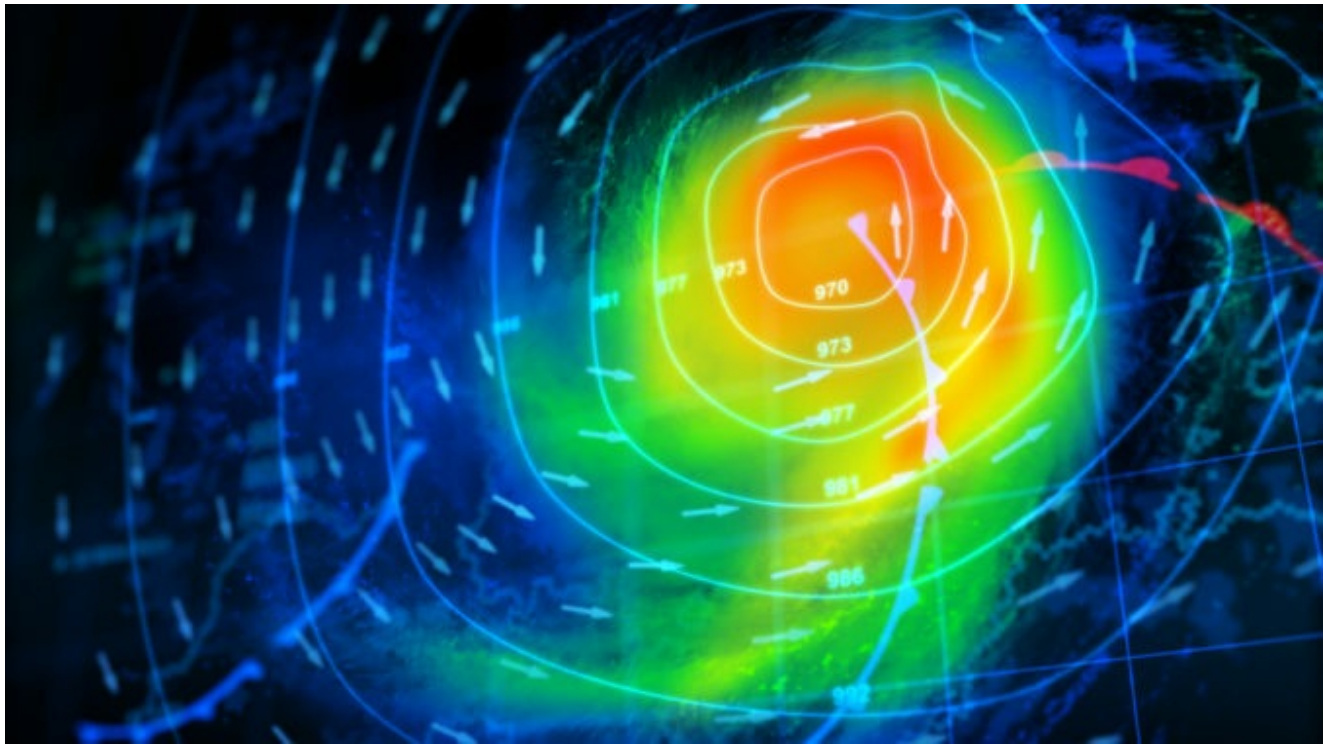


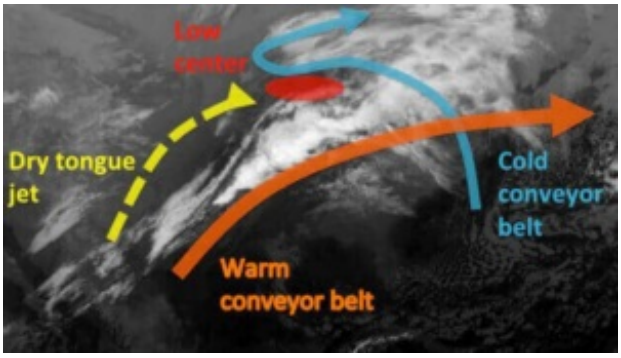
Severe weather causes thousands of deaths and billions of dollars in damage every year – and as climate change looms, the number of severe weather events increases year by year. Now, a team of researchers at Penn State, AccuWeather, Inc., and the University of Almería have revealed a new, AI-powered model that can help forecasts identify these severe storms faster and with greater accuracy.

Specifically, the researchers used a framework based on machine learning linear classifiers to detect rotational movements in clouds pictured in satellite imagery. They hunted for what they call “comma-shaped clouds” – which are strongly associated with cyclone formations, which themselves lead to severe weather events like hail, thunderstorms and blizzards.

The researchers trained their models to recognize these clouds using hand-annotated cloud examples and focusing on both shape and motion. The results? 99% accurate detection at an average of 40 seconds per prediction, leading to 64 percent prediction of severe weather events – and beating other severe weather detection methods.

“Because the comma-shaped cloud is a visual indicator of severe weather events, our scheme can help meteorologists forecast such events,” said Rachel Zheng, the project’s main researcher. “Our method can capture most human-labeled, comma-shaped clouds. Moreover, our method can detect some comma-shaped clouds before they are fully formed, and our detections are sometimes earlier than human eye recognition.”

“This research is an early attempt to show feasibility of artificial intelligence-based interpretation of weather-related visual information to the research community,” said James Wang, Zheng’s dissertation adviser. “More research to integrate this approach with existing numerical weather-prediction models and other simulation models will likely make the weather forecast more accurate and useful to people.”



An example of a satellite image with the comma-shaped cloud in the north hemisphere. Image courtesy of the researchers.

“The more advanced notice to people that would be affected by a storm, the better we’re providing that service,” said Steve Wistar, senior forensic meteorologist at AccuWeather. “We’re trying to get the best information out as early as possible.”

“The benefit,” he concluded, “is calling the attention of a very busy forecaster to something that may have otherwise been overlooked.”

The research team ran their AI framework on the Pittsburgh Supercomputing Center’s Bridges supercomputer – a system rated at 1.35 Linpack petaflops that houses nearly 29,000 Intel CPU cores, 128 Nvidia GPUs and 274 TB of RAM. Bridges recently received $1.8 million in upgrades to its deep learning capabilities thanks to an NSF award in 2018.

About the research

The research paper, “Detecting Comma-Shaped Clouds for Severe Weather Forecasting Using Shape and Motion,” was written by Xinye Zheng, Jianbo Ye, Yukun Chen, Stephen Wistar, Jia Li, Jose A. Piedra-Fernandez, Michael A. Steinberg and James Z. Wang. It is available to access at this link.

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