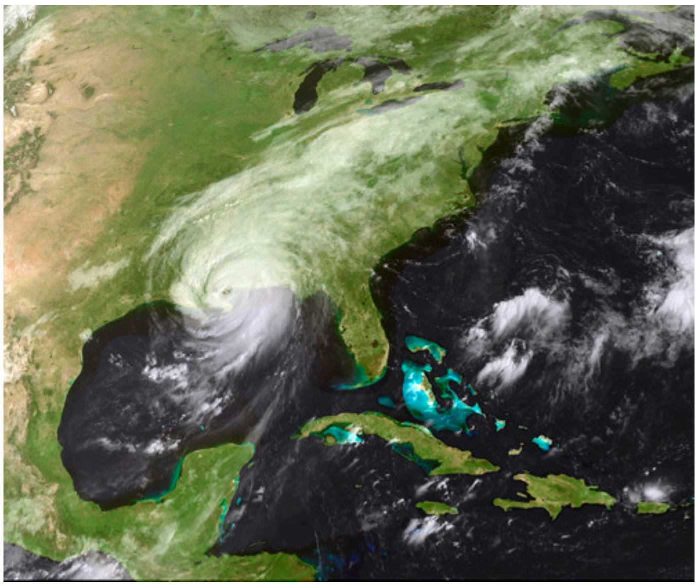

Researchers at Penn State and AccuWeather, a weather forecasting company, are developing a system that utilizes satellite imagery and historical weather data to more accurately predict severe storms.

*Image: NASA Goddard Space Flight Center*

# Penn State, AccuWeather researchers collaborate on storm prediction system

**Stephanie Koons**
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UNIVERSITY PARK, Pa. -- Extreme weather events, such as hurricanes, tornadoes and ice storms, cause billions of dollars of damage every year worldwide. While meteorologists use advanced technologies and the power of big data to make weather forecasts, advanced graphical techniques can be used to improve the accuracy of the current systems. Researchers at Penn State's College of Information Sciences and Technology (IST), in partnership with the weather forecasting company AccuWeather, are developing a system that leverages satellite images and historical storm reports to more accurately predict severe storms.

"If we can effectively make use of that archived information to find patterns with predictive value, we can potentially make the (storm) predictions more accurate," said James Wang, a professor at the College of IST who is working on the project.

Wang and his fellow researchers describe their proposed weather forecasting system in their paper “Locating Visual Storm Signatures from Satellite Images,” which was written by Wang; Yu Zhang, a doctoral student at the College of IST; Jia Li, a professor of statistics at Penn State; and Stephen Wistar and Michael Steinberg, meteorologists at AccuWeather, which provides daily weather forecasts and information to more than a billion people worldwide through new and traditional media as well as customized weather products and services to more than 175,000 clients worldwide in business and government.

In their paper, the researchers propose an algorithm that analyzes satellite images from the vast historical archives to predict severe storms. Conventional weather forecasting involves utilizing numerical models that predict the future state of the atmosphere based upon how physical processes change the initial data. In the system proposed by Wang and the other authors, they extract and summarize important visual storm evidence from satellite image sequences in a way similar to how meteorologists interpret those images. Particularly, the algorithm extracts and fits local cloud motions from image sequences to model the storm-related cloud patches. Historical storm reports since 2000 were used as the statistical knowledge base.

“We use satellite data to add another channel to the storm prediction system,” Zhang said.

According to Steinberg, most severe weather forecasts are made by combining real-time radar, satellite and lightning strike information with computers that are applied to solve numerical models about weather systems, “which basically take the physics of the atmosphere and fluid dynamics equations with initial data conditions” to calculate the future conditions of a weather system. While the numerical methods can efficiently process large amounts of meteorological measurements, according to the researchers, a “major drawback of such methods is that they do not interpret the data from a global point of view at a high cognitive level of resolution.” For instance, meteorologists can make sound judgments of future weather conditions by looking at the general cloud layout and developing trend from a sequence of satellite cloud images using domain knowledge and experience. Numerical methods, according to Wang and his team, do not capture such high-level cues. Additionally, historical weather records provide valuable references for making forecasts, but numerical methods do not make good use of them. To address the weakness of numerical models, the researchers are developing a computational weather forecasting method that takes advantage of both the global visual cues of satellite data and the historical records.

“Instead of using the physics of the atmosphere as the starting point, we’re looking at something entirely different,” Steinberg said. “We’re looking at the same data and finding graphical patterns in the data that are signatures for severe weather.”

AccuWeather's forecasts and services are based on weather information derived from numerous sources, including weather observations and data gathered by the U.S. National Weather Service and meteorological organizations outside the United States, and from information provided by non-meteorological organizations such as the Environmental Protection Agency and the armed forces. Founded in 1962 by Joel N.

Myers, AccuWeather has its Global Headquarters and Operations Center in State College with its global sales office in Rockefeller Center in New York City and its Enterprise Solutions operational center in Wichita, Kansas.

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