Rooting out the errors in climate models to better predict hurricanes

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By enhancing climate models, a project will help to improve forecasts of intense hurricanes like Hurricane Florence. Credit: NASA

On the eve of every hurricane season, climatologists around the world offer their studied prognostications: Will we see high activity? Low

activity? How will ocean temperature affect storm development? What are the chances of a powerful storm making landfall?

Scientists use climate models to simulate tropical cyclone behavior with an ever-increasing degree of accuracy, but basic modeling errors continue to limit the reliability of their forecasts.

Now, researchers from Columbia University, Florida State University, and the University of Washington are working with the National Oceanic and Atmospheric Administration to root out those nagging errors. With the support of a $500,000 grant from the NOAA Research, Modeling, Analysis, Predictions and Projections Program, the team will develop diagnostic tools to identify the hidden biases that compromise high-powered climate models.

"Simulating the most intense hurricanes seems to be harder for some models than others, and we are trying to understand the cause of that," explained Lamont-Doherty Earth Observatory climatologist Suzana Camargo.

Even the most sophisticated and optimized tropical cyclone modeling strategies can be vulnerable to process-level errors. One common bias among low-resolution models is their tendency to underestimate the amount of tropical cyclones that occur around the world. Even many high-resolution models have trouble simulating intense storms that develop into category four or five hurricanes.

"Going to higher resolution models improves some of these biases but doesn't solve everything," said Allison Wing, an assistant professor at Florida State University. "Without an accurate simulation of tropical cyclones in the present day, there is uncertainty in relying on climate models for future projections of tropical cyclone activity."

What's particularly exciting about this project, Camargo says, is "if we succeed and improve the models, we would be able to have more reliable tropical cyclone projections."

The team has already begun developing diagnostics to identify errors in the ways climate models simulate moisture, clouds and the circulation of warm air. This latest grant will help the researchers take those tools to the next level.

Using existing long-term satellite observations and detailed analyses of tropical cyclones, the team will compare observed tropical cyclone behavior to model simulations to reveal discrepancies.

The researchers will also use their tools to examine biases in the most recent Coupled Model Intercomparison Project, a large aggregation of leading climate models from around the world. While the team has worked with individual model simulations in the past, they have never used their techniques in a collection of models.

Ultimately, the group is aiming to develop a diagnostic framework for remedying the complicated errors that undermine climate model reliability—a challenge Camargo welcomes.

"I'm very excited to be working in this team along with very promising young scientists," she says. "As we can see by the expected impacts of Hurricane Florence, improving the projections of tropical cyclone activity in the next decades would be very important."

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