WEATHER MODEL PREDICTS HURRICANE INTENSITY

Scientists have made significant headway when it comes to predicting the path of a hurricane barreling toward land. But predicting what a deadly storm’s intensity will be when it makes landfall is tougher — intensity often changes during a hurricane’s journey. Now, a next-generation weather model is proving capable of simulating intensity variations, potentially allowing scientists to make better hurricane intensity predictions in the future.

Every hurricane consists of a center, or eye, surrounded by an eye wall, a zone of dense clouds in which wind speeds reach their maximum. But as a hurricane grows, this structure often changes; in more than half of strong hurricanes a secondary eye wall forms outside the first one and eventually displaces the initial eye wall. This formation and replacement process can increase the area over which strong winds prevail — an important factor with respect to the amount of damage that a hurricane can cause. But during this process, the intensity and structure of the hurricane change, and this change is “one of the most challenging forecast problems,” says Bin Wang, a meteorologist at the University of Hawaii at Manoa.

During Hurricane Katrina, for example, at least one secondary eye wall formed and broadened the overall wind field, which was a major reason for the storm’s destructiveness, says Michael Bell of the National Center for Atmospheric Research in Boulder, Colo. Katrina’s most damaging effect was the storm surge, which was affected by how strong the winds were, how long they were sustained, and how large of an area they covered, Wang adds.

But changes in intensity and size due to eye wall formation and replacement like Katrina’s are difficult to predict in real time. And size matters, Bell says. “Katrina was a Category-3 storm at landfall,” which meant its peak wind speed was weaker than, for example, Hurricane Charlie, which struck the Florida coast in 2004, he says. “But because [Katrina] was much bigger, it affected a very broad stretch of the coastline.”

Wang and Hawaii colleague Xiaqiong Zhou found that the high-resolution Weather Research and Forecasting (WRF) model — a model that has been around for a few years but has never been used for this aspect of hurricanes — could simulate the process well. WRF modeled the formation of a secondary eye wall, the replacement of the first one and the transformation into an annular hurricane — a type of hurricane characterized by a large eye and eye walls thicker than those of regular hurricanes — better than any previous weather model, they reported in Geophysical Research Letters. Annular hurricanes — 2005’s Category-3 Hurricane Rita may have been one — sometimes form after secondary eye wall formation and replacement. The WRF model showed the formation of an annular hurricane within 24 hours of secondary eye wall formation and replacement, which is consistent with observations and indicates that the model appears to match reality, Wang says. By comparison, previously used models produced the formation of annular hurricanes only after several days and without eye wall replacement.

The findings are promising, Bell says. “We have made a lot of progress in track forecasting over the past 20 years, but the intensity problem has not made as much progress as we would have liked,” he says. “These findings give us some hope that if a storm was threatening the United States’ East Coast or the Gulf of Mexico, we could [use the model] to potentially simulate these types of structural changes in a real-time forecast.”

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