HIGH-RES MODEL CAPTURES EXPLOSIVE INCREASE IN HURRICANE STRENGTH

WRF-ARW simulates Hurricane Patricia's rapid intensification

Nov. 1, 2016 | Last fall, Hurricane Patricia exploded from a Category 1 to a record-breaking Category 5 storm in just 24 hours.

Patricia's rapid intensification off the coast of Mexico blindsided forecasters, whose models vastly underestimated how strong the hurricane would become. Patricia — and more recently Hurricane Matthew, which also jumped from Category 1 to Category 5 in less than a day — highlight a weakness in predictive capabilities. While we've made great strides in forecasting a hurricane's track, forecasting its intensity remains a challenge.

New research using a sophisticated weather model based at the National Center for Atmospheric Research (NCAR) offers some clues about how these forecasts can be improved.

The scientists — Ryder Fox, an undergraduate researcher at the New Mexico Institute for Mining and Technology, and Falko Judt, an NCAR postdoctoral researcher — found that an advanced version of the Weather Research and Forecasting model (WRF-ARW) could accurately forecast Hurricane Patricia's rapid intensification when run at a high enough resolution.

"Because Patricia was so out of bounds — the hurricane broke records for high wind speed and low pressure — we didn't think our model would actually be able to capture its peak intensity," Judt said. "The fact that the model nailed it took us by surprise."

FOR JOURNALISTS

Media Office

NCAR & UCAR at a Glance

Visuals & Multimedia

Backgrounders on Climate, Weather

News Release Archive by Year

Hurricane Patricia approaches the west coast of Mexico on Oct. 23, 2015. (Image courtesy NASA.)

Judt and Fox think that the model's resolution was one important key to its success. The scientists ran WRF-ARW with a 1-kilometer (0.6-mile) resolution on the Yellowstone system at the NCAR-Wyoming Supercomputing Center. The models being used to actually forecast Patricia at the time had resolutions between 3 and 15 kilometers.

"Going to 1-kilometer resolution may be especially important for very strong storms, because they tend to have an eyewall that's really small," Judt said. "Patricia's eye was just 13 kilometers across at its most intense."

Still, the researchers caution that more simulations are needed to be sure that the model's ability to capture Hurricane Patricia's intensity wasn't a fluke.

"We're not sure yet that, if we ran the same model for Hurricane Matthew, we would forecast that storm correctly," Judt said. "There are so many things that can go wrong with hurricane forecasting."

To address this uncertainty, Judt and Fox have begun running the model additional times, each with slightly tweaked starting conditions. The preliminary results show that while each model run is distinct, each one also captures the rapid intensification of the storm. This relative harmony among the ensemble of model runs suggests that WRF-ARW does a good job of reproducing the storm-friendly environmental conditions that Patricia formed in.

"The set-up that nature created may have allowed for a storm to intensify no matter what," Judt said. "The sea surface was downright hot, the air was really moist, and the wind shear, at times, was virtually zero. It was a very ripe environment."

Fox began working with Judt through SOARS, the Significant Opportunities in Atmospheric Research program, which pairs young researchers with NCAR mentors. An undergraduate-to-graduate bridge program, SOARS is designed to broaden participation in the atmospheric and related sciences.

"The SOARS program means everything — not just to my ability to do this type of research, but also to grow as a scientist and to find my place within the scientific community," said Fox, who published the research results as an article in Physics Today.

Fox hopes the research on accurate modeling of Hurricane Patricia may lead to improved early warning systems that could help prevent loss of life.

"My personal passion regarding severe weather research lies in improved early warning systems," Fox said, "which optimally lead to lower death counts."

Peggy Stevens, Administrative Support
NCAR|UCAR Communications
+1 303.497.8601
Communications Office