Hurricane Forecasting Shows Promise

With Hugo bearing down on the U.S. coast last September, forecasters at the National Hurricane Center in Miami had to be on edge. For a long time, things have been pretty bleak in the hurricane prediction business. After 30 years of advances in weather satellites, computer forecasting models, and basic research, forecasters had reduced errors in predicting the paths of hurricanes by just 14%. Not very encouraging when facing the strongest U.S. hurricane in decades.

But out of the public eye, a new weather forecasting tool was being tested that offers a glimmer of hope. Almost serendipitously, a computer forecast model being run at the National Meteorological Center (NMC) in Camp Springs, Maryland, showed uncommon hurricane prediction skill during the past season. The ETA model (from the Greek letter eta used to describe the model's design) was designed in Yugoslavia by Fedor Mesinger and Zanis Janjic of the University of Belgrade and was later refined at NMC by Janjic and NMC meteorologist Thomas Black.

The researchers did not give much thought to hurricanes in particular when they designed ETA. It was intended to improve forecasts over North America or to focus on regional trouble spots such as East Coast snowstorms or tornado-spawning weather systems in the Midwest. But during its 9-month experimental run last year, five hurricanes, including Hugo, happened to enter the model's North American forecasting domain. And says John Ward of NMC, ETA "did quite well compared to the other, operational models. We've been snakebit before, but it is very promising."

In the case of superstorm Hugo, ETA did especially well. In forecasts of the storm's eventual landfall that were made 24 and 48 hours before Hugo actually struck the South Carolina coast, ETA's errors were smaller than, or at worst equal to, those in some relatively good predictions made by a raft of other models consulted by forecasters. But after Hugo hit the coast, ETA pulled off its piece de resistance. While the official forecast called for the dissipating but still dangerous storm to track just inland, ETA was calling for it to pass over West Virginia 200 kilometers to the west, which it did.

Just why one model does better than another in forecasting the track of hurricanes is not always obvious. The goal is to forecast where a hurricane's steering winds—the ever changing background of air flows that carry the hurricane along like a twirling leaf in a stream—are going to take it. This alone can be fraught with uncertainty. But if the steering winds should weaken, the hurricane can begin to steer itself. Forecasters, human and computer-driven, then have a particularly hard time of it.

So what could make ETA so adept at predicting the steering of hurricanes? Ward says it may be that this model uses a more accurate simulation of the way hurricanes make rain. Computer simulation of atmospheric precipitation is critical to good forecasts, because the heat released by precipitating clouds drives hurricanes, but it's a particularly nasty proposition. The process spans spatial scales ranging from micrometer particles all the way to masses of towering cloud. And computer models have to represent all of this on widely separated points of a three-dimensional grid. ETA does this with a new computational scheme that shows more rain condensing in a storm than other models do. This gives a more realistic picture of the storm and its surroundings and apparently simulates steering more faithfully.

The ETA model differs from its closest relative at NMC in several other ways. All its computational power goes into forecasting weather over North America or a smaller region; a separate global model feeds it information about what the atmosphere beyond North America is doing. Perhaps most important, ETA's gridpoint separation is only 80 kilometers, which increases the sharpness of its picture of the weather compared to those produced by most other models. That picture may be improved even more, as the NMC group plans to reduce the separation as soon as more computer time becomes available.

Although things may be looking up in the hurricane forecasting business, the outlook is not entirely rosy. "The big limitation is probably not in the models but in the initial conditions," says meteorologist Kerry Emanuel of the Massachusetts Institute of Technology, who specializes in hurricanes. The larger the errors in the model's starting picture of the weather, as drawn from weather observations, the faster the errors will grow in the model and the sooner its forecast will become useless. "They [forecasters] are not going to make substantial progress until they sample the hurricane a lot better," Emanuel says. "The conditions over the ocean are so undersampled, even with weather satellites." Perhaps, he says, the next generation of weather satellites due up this decade will perform better than the last generation. Forecasters sincerely hope so.

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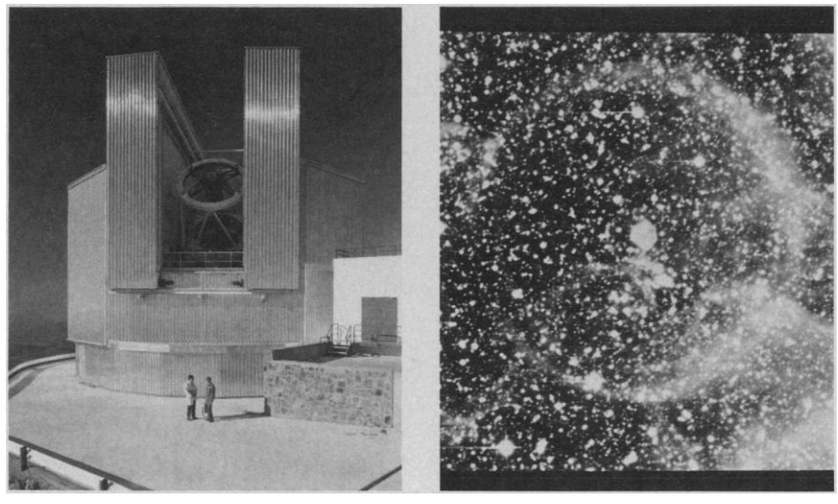

European Southern Observatory

New telescope opens for business. The 3.5-meter New Technology Telescope of the European Southern Observatory (ESO) may not be the largest in the world, but it is the most advanced. Dedicated on 5 February at ESO's mountaintop site in La Silla, Chile, the telescope incorporates a suite of advanced technologies that are likely to become standard on future telescopes. Its main mirror is remarkably light and thin for its size. Yet it produces some of the sharpest images anywhere, courtesy of a computer-controlled "active optics" system that pushes and tugs on the mirror about once every second to keep it from sagging under its own weight and distorting the images. A specially designed building also helps by minimizing local air turbulence over the mirror. And a satellite link enables astronomers to control all this from ESO headquarters in Garching, West Germany, thereby minimizing time and travel expenses.

The excellent quality of pictures made by the New Technology Telescope can be seen in the image on the right. It shows Supernova 1987A encircled by a ghostly "light echo," in which interstellar gas clouds lit up by the steadily expanding flash of light from the initial explosion are reflecting the light back toward Earth.

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