Research News

Whom to Blame for the Great Storm?

An inquiry following the surprising October storm that battered both sides of the English Channel urges that forecasters know their computer models better

Baltimore

FIFTEEN million trees in the south of England perished on 16 October at the hands of a mighty storm. Nothing could have saved the trees, but the local residents would have appreciated a bit more warning than the 3 to 4 hours that British forecasters gave them before once-in-a-century winds of 60 to 90 kilometers per hour with gusts over 160 kilometers per hour struck. In the aftermath there were charges that British forecasters had ignored sound advice from computer forecasting models, that the French had done far better than the British. The interaction of man and machine was a bit more complicated than that; the lesson—know your own machine. In this case, the French did seem to know theirs better.

Representatives of the two weather services presented considered analyses of their storm forecasts in back-to-back talks at the Conference on Numerical Weather Prediction* late last month. Alan Gadd and Andrew Lorenc of the British Meteorological Office in Bracknell led off followed by Michel Jarraud of the French Meteorological Service.

Everyone agreed that they "didn't need much [understanding of] meteorology to see that something was going to happen," as Lorenc noted. A trough of low pressure at higher altitudes out in the Atlantic was catching up with a strong frontal zone, their merger being a cinch to produce a storm. The computer models predicting the weather around the globe 3 to 10 days in advance agreed with human forecasters. Medium-range models at the Meteorological Office, the U.S. National Meteorological Center, and the European Center for Medium-Range Forecasting, which happens to be located in Reading, England, all predicted a storm. Everyone knew of this agreement by the models because the European Center exists to serve its European member countries and many forecasts are exchanged electronically among the major forecasting centers of the world.

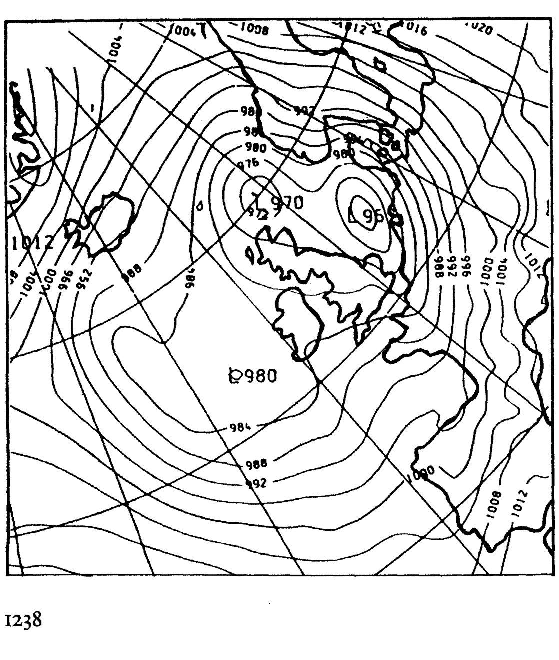
The forecasters also knew that it remained uncertain just how strong the storm would be and where and when it would strike. Three days before it struck, the models' 3-day forecasts placed the storm in the North Sea, 1200 kilometers away from there in the Atlantic southwest of Ireland, and 300 kilometers outside the mouth of the Channel. The storm's forecast intensity ranged from moderate to severe, but no forecast called for anything as intense as eventually occurred.

Uncertainties would persist, but more than 24 hours before the storm struck, French forecasters decided to issue a severe storm warning for northern France. Jarraud explained that on general principles French forecasters assumed that a large storm system such as this can have smaller, more intense systems embedded in it. Their own forecast model was not calling for much intensification, but the European Center's was. But then the European Center's storm was swinging through Ireland, not the north of France.

The French resolved this disagreement between models by noting that their model was run later and thus used more recent observations to plot the future track of the storm. However, from experience they knew that their model usually fails to intensify storms as much as it should, whereas the European Center's model does a better job at that part of forecasting. The resulting warning: a storm striking northern France with the strength forecast by the European Center's model, including gusts exceeding 100 kilometers per hour inland of the coast.

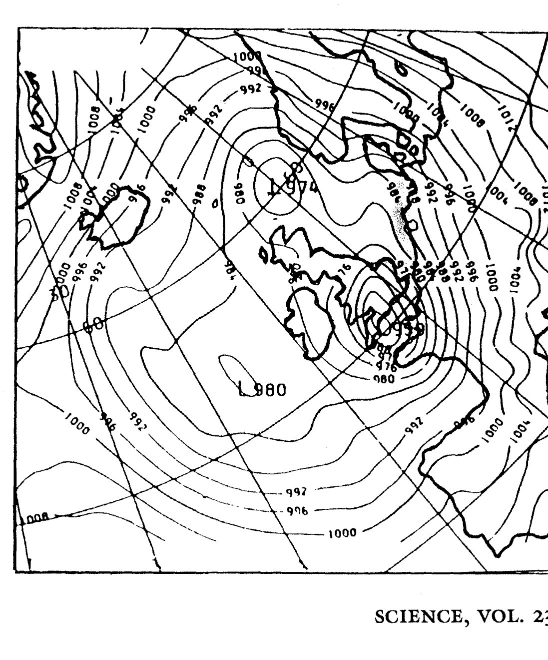
The French warning was out, but the British had a problem. Their global model's 24-hour forecast placed the storm's center in the Channel, just 50 kilometers from where it would actually be on the French coast, and it called for moderately strong winds. But

*Eighth Conference on Numerical Weather Prediction held 22 to 26 February 1988 in Baltimore, Maryland, by the American Meteorological Society.



Later is better

One of the British computer models does much better if late-arriving data from trans-Atlantic planes are added. The forecast that was made 24 hours before the storm struck (left) misplaced and weakened it. With aircraft data added (right), the storm's position and strength are nearly correct.



U.K. Meteorological Office

another of their forecast models, the fine-mesh model that focuses on the European region, was producing a different view. "This is where the trouble started," said Lorenc. The fine-mesh model "has a good reputation. Our forecasters have come to rely on it." It called for the storm to strengthen a day later, as it did, but the model had it moving so fast that by then it would be over the North Sea.

Both 24-hour forecasts from the British models called for strong winds over France, noted Lorenc, but only the global forecast had them over southern England. British forecasters examined the other information routinely available to them—satellite cloud pictures, late-arriving surface observations, and the behavior of low-pressure centers in the trough that had arrived earlier, for example—and chose to strike a compromise between the two model forecasts: gales along the coast but not much to worry about inland.

Unbeknownst to the forecasters, their fine-mesh model was leading them astray. Study since the storm has shown that forecasts by the fine-mesh model can depend quite sensitively on a few of the observations fed into it. The night before the storm hit, it sorely missed reports from commercial airliners approaching Britain from the United States. They recorded their observations at 2:00 a.m.; the fine-mesh model run is held up only 2 hours after midnight for the inclusion of last minute data. The aircraft data missed that cutoff but made the deadline for inclusion in the global model.

When the aircraft observations were later included in a rerun of the 24-hour forecast, the fine-mesh model produced a "very much better forecast," said Lorenc. In fact, the location is on the south coast of England, not the North Sea, and the intensity is greater than any the global model ever made of this storm. The Meteorological Office now runs the fine-mesh model a second time at 6:00 a.m. to take advantage of the reports from the red-eye flights that land at dawn, Lorenc reported.

The French were having similar problems the day before the storm struck. Their model was still failing to strengthen the storm while the European Center's model was placing its forecast location even farther away. They again consulted the latest supplementary information and decided to stick with their warning.

Just 12 hours from some of the strongest winds in southern England in memory, the British fine-mesh model played a dirty trick on its human handler—its forecast "almost exactly agreed with him," according to Lorenc. The compromise forecast of 12 hours earlier looked good, so the forecaster stuck with it.

Aftermath

Nothing could have saved these trees in Parliament Square from the storm that struck the night before, which downed 15 million trees and killed at least 13 persons. The wind gusted up to 151 kilometers per hour in the center of London, a development unforeseen by either human or computer forecasters.

AP/Wide World Photos

Actually, when the model produced its 12-hour forecast, too few new observations were available to form a usable picture of the storm as it entered its early development stages, much less forecast its behavior 12 hours into the future. The model would have been better off sticking with its 12-hour forecast from 12 hours earlier as a starting point for its next forecast. A new system for producing the starting point for the model forecast, a system still under development last October, leaves the old forecast in place largely unchanged if the new set of observations cannot improve the starting picture of the present weather. With this system in place, the model produces "an excellent 12-hour forecast" of the October storm. The system is soon to be in routine use.

After summing up the Meteorological Office's conclusions, Lorenc had some of his own. "The synergy [between human forecasters and their computer models] often works, it doesn't always, and it didn't in this case. My main conclusion is that I was glad I wasn't on duty that night."

An independent investigative panel reported to Parliament on 27 February that "no individual should be seriously blamed" for the bad forecast. The nature of the storm, the dearth of observations in the Atlantic, the pressing demands on forecasters, and the inevitable shortcomings of models all contributed to the failure, the panel said. The predictable recommendations included the need for changes in training and organization and for evermore powerful computers. As it happens, the Meteorological Office has just taken delivery of an ETA 10, one of the newest supercomputers. Improved forecasts lie ahead; perfection remains out of reach.

For his part, Jarraud noted that neither forecaster nor model could have done as well as the combination of the two. Ignoring the suggestion that French forecasters had an easier forecast to make, he gave credit for their more timely warning to judicious use of supplementary information and knowledge of their model's biases. "It's very important for forecasters to know the limits of the model," he noted.

The independent British investigators tended to agree with the French. Although the two forecasting problems are not strictly comparable, they noted, " . . . the French forecasters showed the better appreciation of the nature of the phenomenon they were dealing with. This enabled them to interpret the forecasts of the computer model with deeper insight, making much more allowance than did our own forecasters for model limitations." ■ RICHARD A. KERR