Who Can Forecast the Worst Weather?

As the National Weather Service becomes only one of a myriad of forecast sources, it is attempting to keep the competition out of the hazard warning business; it won't be easy

THE GULF COAST OF TEXAS WAS HOLDING its breath in September of 1988. Hurricane Gilbert, a potential killer if there ever was one, was churning across the Gulf of Mexico. Where would Gilbert and its 260-kilometer-per-hour winds strike the coast? Galveston? Corpus Christi? Brownsville? Or would it ravage the coast of Mexico to the south? Hundreds of thousands of people waited to learn whether they should board up their homes and businesses and run before the storm.

Run for it was Accu-Weather, Inc.'s, advice. A private weather forecasting service in State College, Pennsylvania, Accu-Weather was, by some accounts, predicting that Gilbert would veer from its northwesterly course toward the north and "go onshore between Galveston and Corpus Christi." Winds would reach average speeds of 60 to 110 kilometers per hour in the Galveston area.

Sit tight, said the U.S. Weather Service. In a prediction issued 36 hours before Gilbert's landfall, the Weather Service's National Hurricane Center in Coral Gables, Florida, put Galveston well out of harm's way. The storm would continue on its northwesterly course and hit the Mexican coast 640 kilometers southwest of Galveston, the forecast said.

What should Galveston do in the face of these conflicting forecasts? The city could not take Gilbert lightly. Galveston sits on a low-lying island where 6000 people died in 1900 when a hurricane caught the residents by surprise. This time around, city officials decided the prudent course was evacuation, even though surrounding jurisdictions were following the Hurricane Center's guidance and staying put.

The result was mass confusion as some of the Galveston area's 200,000 residents followed the "official" Weather Service forecast and remained at home while others heeded the local directive to flee, only to find that inland cities were ill-prepared to receive them. In the end, Gilbert never turned further northward. It slammed into Mexico pretty much at the spot predicted by the Hurricane Center.

The confusion wrought by the conflicting forecasts for Gilbert points up a territorial dispute now embroiling the nation's weather forecasters. Is the issuance of warnings for hurricanes, tornadoes, and other severe weather solely the responsibility of the U.S. Weather Service, or can private forecasters join in too? "I feel very strongly that warning is the responsibility of government," says Robert Sheets, director of the National Hurricane Center. "For the public forecast of safety, the private sector should not get into it." Indeed, the National Weather Service is trying to carve out a monopoly on severe weather warnings. A soon-to-be-released policy statement, being redrafted with the White House Office of Privatization, will attempt to keep private forecasters out of this area.

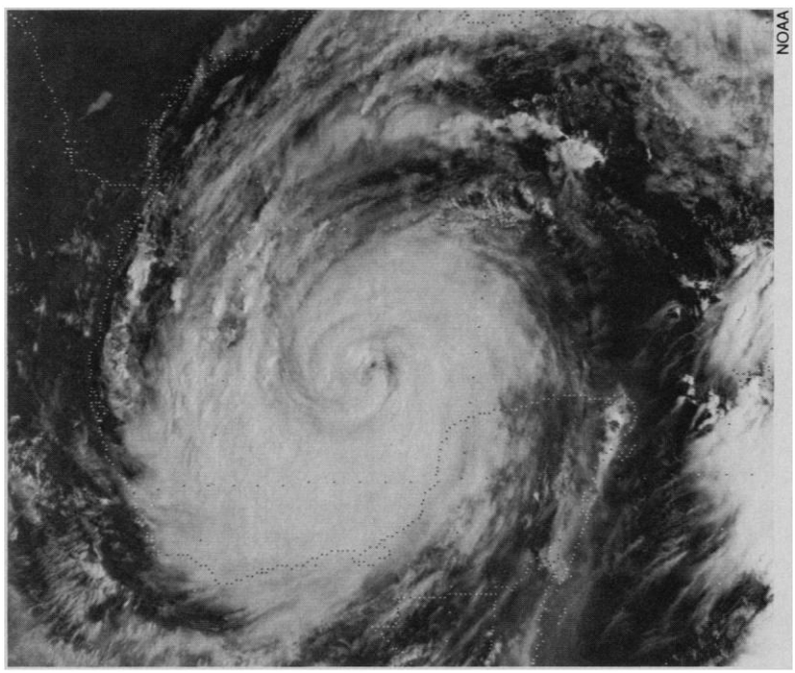
Not surprisingly, Accu-Weather founder and president Joel Myers disagrees with this policy. As head of "the largest and fastest growing private service in the world," Myers believes that "if the National Hurricane Center were always right, we'd need only parrot their forecasts. Since they're not, we reserve the right to comment" on their forecasts.

There was a time when such conflicts were unheard of. A few decades ago, you could assume that any forecast you saw was from the U.S. Weather Service, whether it was a weather map in the newspaper or a forecast read on the radio or television. No more.

Private forecasting has been a growth industry since World War II, but as tight federal budgets squeezed the resources of the Weather Service, the Reagan and Bush administrations pushed to get it out of any aspect of forecasting that the burgeoning private sector could do just as well. Why squander precious funds in areas that the private sector could cover better, the thinking went.

The theory paid off, from the industry's point of view. Some 100 firms are now in the $200-million-per-year business of providing data and forecasts to clients, including radio and television stations and newspapers. And in addition, many television stations have taken to hiring professional meteorologists who make their own forecasts.

Private weather forecast services have also proliferated because they could fill a niche the Weather Service could not afford to occupy. Consumers can now subscribe to private forecasts that are tailor-made and packaged with their particular needs in mind. For example, say a crop-damaging freeze threatens Florida. With its limited resources and responsibility for the entire country, the Weather Service could at best name whole counties that might be hit. But, starting with the computer forecasts



Whither Hurricane Gilbert? *The Weather Service said Gilbert would hit Mexico. A private forecasting firm said Texas.*

and weather observations provided at minimal cost by the Weather Service, a private forecaster may be able to do better. He might be able to tell an orange grower he doesn't have to worry about trying to fend off a frost in his particular 40 acres of a threatened county.

Both sides see this privatization trend in weather services as a positive development, but incidents like Gilbert are reminders of the potential snags in the public-private relationship. That particular "snag" has yet to be fully explained. Sheets and Myers still cannot agree on how it happened. In a paper published in the June issue of *Weather and Forecasting*, Sheets quotes extensively from documents obtained from the client of an unnamed private forecasting firm. Although Sheets declines to identify the firm, Myers confirms that it was his. According to the documents, the forecast calling for a

Squeezing Out Better Weather Forecasts

Although the U.S. Weather Service and private forecasting companies do not always see eye to eye about who should have the responsibility for predicting severe weather such as hurricanes (see p. 29), they can agree on one point at least: slowly, but surely, weather forecasting is getting better. Twenty years ago, forecasters were doing well to predict what the weather would be like 3 or 4 days down the road; now, with the help of computers, they have extended their forecasts of general weather patterns to 6 days and, under favorable conditions, to a week and beyond. In fact, computers have gotten so good that they usually outdo human forecasters in medium-range forecasts extending 3 to 10 days ahead. Only in preparing short-range forecasts, for under 36 hours, do humans still have a clear edge.

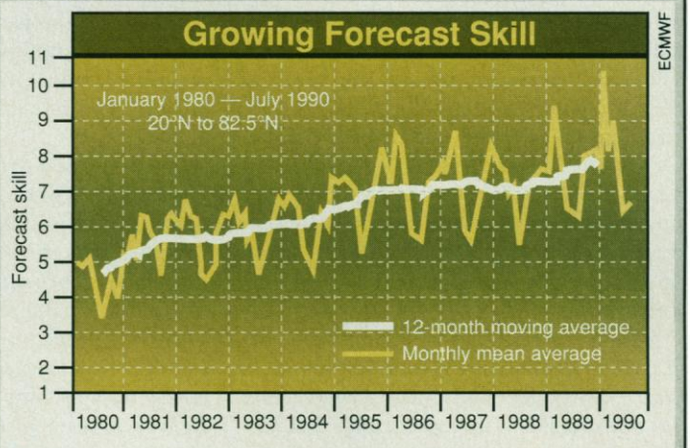
These improvements in medium-range forecasting have been powered by the steadily increasing speed of supercomputers. More speed allows more detailed and thus more accurate computer models of the atmosphere to be constructed, thereby producing better forecasts.

The best medium-range forecasts come from the European Center for Medium-Range Forecasts in Reading, England. During the winter, for example, the European Center recently produced useful forecasts out to 7.5 days. That's up from 5.5 days in 1979 when the center began operational forecasting.

The competition is staying hard on the heels of the European Center, however. The National Meteorological Center (NMC) in Camp Springs, Maryland, the perennial runner-up in the medium-range forecasting race, is about half a day behind the Europeans in winter forecasting, as it has been for most of the past decade. The NMC lags by about the same amount in forecasts made in the nonwinter months. Averaged around the year, useful forecasts now extend to about 6 days.

The European Center's lead is a reflection of its penchant for being the first to acquire the biggest supercomputers. Most recently they have taken delivery on Cray's top-of-the-line Y-MP8/8-64 model, with half a billion bytes of memory. That will enable the center to improve the resolution of its forecast model at the equator from 120 kilometers to 60 kilometers. Presumably, the increased detail will, as it has in the past, increase the length of useful forecasts. The NMC is also taking delivery of a new Cray, but it is not acquiring such a powerful computer. Its new Cray, the YMP-832, is as fast as the European Center's number cruncher but has only half the memory. NMC's model will produce forecasts that are half as detailed as those of the European Center and, most likely, still half a day behind the competition's forecasts.

As forecasting computers become faster and the models more realistic, researchers are finding that an increasingly important limitation on forecasting accuracy is the quality of the weather observations fed to the models, says Lennart Bengtsson, director of the European Center. Inaccurate weather data from around the world can be caused by anything from typographical errors to observations from miscalibrated instruments. However they originate, erroneous data produce a less accurate starting point for the models and thus less accurate forecasts.



Medium-range weather forecasting continues to improve as increasing power allows more detailed forecasting models. As applied here to the record of the European Center for Medium-Range Forecasts, forecast skill is roughly equivalent to the length of a useful forecast. U.S. forecasters lag by about 12 hours.

Both centers are tightening up procedures that screen out bad data before they enter the models. Chronic problems with data from particular observing sites are also being identified and corrected at the source. Another objective is the better use of satellite weather observations.

While the modelers are striving to make their predictions still better, the human forecasters have been all too aware of the progress computer forecasting has already made. A decade ago, humans could routinely improve on computer forecasts for periods of up to several days by using their knowledge of the models' shortcomings, combined with the latest meteorological observations and their own experience and insight. Now local forecasters are hitting a "36-hour wall" beyond which it is not usually worth their while to try to best the computer forecasts. For example, in 1966, the U.S. computer model erred by an average of 3.0°C in its prediction of temperatures 36 hours ahead in the cool half of the year. The U.S. Weather Service forecasters, who took the model's predictions as a starting point for their own forecasts, were off by an average of 2.6°C. Both have gotten better during the intervening years; the local forecasters made a fairly steady improvement of 0.2°C per decade. But the models improved faster, closing the gap from 0.45°C to only 0.15°C.

Given the vanishing gap between human and computer, the U.S. Weather Service is now leaving the medium range to a small group at NMC that distills the best computer forecast from those of NMC, the European Center, and the U.K. Meteorological Office. Local forecasters are concentrating instead on the short-range. That's where humans' advantages can still produce distinctly better weather forecasts—at least for the time being. ■ **R.A.K.**

hit on the central coast of Texas was both faxed to the client and read by the firm's meteorologist over a local radio station.

After the client called the firm, in Sheets' account, a "correction" from the firm arrived stating that the predicted landfall was a typographical error. The forecast should have read between Brownsville and Corpus Christi, it said. That's more than 370 kilometers to the southwest of Galveston but still 370 kilometers from the official forecast landfall.

In a letter subsequently sent to AccuWeather, the client claimed the faxed forecast might have had a typographical error, but "the intent of the radio spot was clear. It appeared someone was too anxious to be the first to call the long predicted turn to the north."

Myers maintains, however, that AccuWeather's forecast called for a Mexican landfall all along, but also contained some incorrect information that misled the client. The firm quickly caught the typographical error and sent a correction to the private client, Myers says. Firm employees also tried to contact Galveston emergency officials when they heard that the city was evacuating, but officials "wouldn't talk to us," he says.

But whatever happened, the result was that the Texas coast heard conflicting forecasts. Myers sees no particular problems with the public getting diverse advice. Many others disagree. Neil Frank, a Houston TV forecaster and past director of the National Hurricane Center, has a firm response: "I say hogwash! The last thing you want to do is create confusion. You can't go into a crowded theater and holler fire. So I don't have a lot of sympathy with people crying First Amendment."

Robert Ryan of WRC-TV in Washington, D.C., who is chairman of the American Meteorological Society's Commission on Professional Affairs, agrees that private services should stay out of the hurricane warning business. "I wouldn't try to outforecast the Hurricane Center," he says. But he might step in on warnings of less life-threatening forms of severe weather. If the Weather Service were predicting that a storm was going to drop 30 centimeters of snow on Washington and Ryan thought it would swerve away out to sea, he would pass both the warning and his interpretation along to viewers.

And as things currently stand, AccuWeather and the other private forecasting services are well within their rights if they issue warning-like forecasts of hurricanes or other severe weather. The Weather Service lacks a legal mandate to be the nation's sole lookout for severe weather. Instead, it has relied on an unwritten understanding with private forecasters that they refrain from issuing warnings or forecasts that conflict with "official" warnings. And that hasn't always worked, as the case of Hurricane Gilbert illustrates.

Now the Weather Service is formally staking an exclusive claim to its traditional role of enhancing public safety. In its draft policy statement, soon to be published in the *Federal Register* in final form, the National Weather Service concedes that it will continue to compete with private forecasters in some areas. It will not provide customized forecasts as they do, but it will still be making geographically broad predictions for the general public, aviation, marine, and agricultural interests. The law requires it, and Weather Service forecasters believe they can do that job as well as anybody.

But the policy statement goes on to claim that the Weather Service provides "the single 'official' voice when issuing warnings for life-threatening situations." Private forecasters should only pass warnings along and keep their own opinions to themselves, the statement says, unless they can provide advice in cases in which they have "significant understanding of [a client's] operational needs."

But the Weather Service's policy is not legally enforceable and staking a claim can be easier than holding it. Ken Crawford knows that from firsthand experience when he was meteorologist-in-charge at the Weather Service Forecast Office in Norman, Oklahoma. That's just outside Oklahoma City and in the midst of tornado alley. As Larry Mooney, who recently left the forecast office there to be meteorologist-in-charge in Denver, puts it, two things loom large among Oklahoma City area residents—football and severe weather. Such public interest alone can make for keen competition among forecasters at local television stations.

Should private forecasters compete with the Weather Service in forecasting hurricanes? "The last thing you want to do is create confusion. You can't go into a crowded theater and holler fire."

—Neil Frank

Then in the early 1980s, Oklahoma City's television stations jumped ahead of the U.S. Weather Service by buying their own Doppler radars. A new technology at the time, Doppler radar, like conventional weather radar, can reveal where rain, snow, and hail are falling and provide some measure of how heavy the precipitation is. But Doppler radar does more; it can map out wind speeds and directions from the frequency shifts imparted to the radar reflections by precipitation or dust. That opened up whole new ways of foreseeing the development of severe weather, including tornadoes.

Meanwhile, Crawford and his staff at the forecast office had no Doppler radar and were often on the sidelines, he says, and everybody knew it. The public and even civil defense directors were turning to one broadcaster or another for word on imminent severe weather, while the Weather Service was left out in the cold. The only solution, Crawford decided, was to get better at forecasting. To help do that, starting in 1983, the Norman Forecast Office tied into the Doppler radar that was being used for research a few miles away at the National Severe Storms Laboratory. Now, the Weather Service is back in the game in Oklahoma City. All the area TV stations follow Weather Service warnings and "rarely go out on their own," says Mooney.

How successful the Weather Service will be in holding its ground on severe weather warnings remains to be seen, however. In hurricane forecasting, it will have the advantage of offering a direct feed to TV stations from Hurricane Center, as it did during Hurricane Hugo's approach to the Carolina coast last year. Having the center's director addressing the public on almost every TV channel seemed to minimize confusion.

Nevertheless, the spread of Weather Service Doppler radar that is beginning with Oklahoma City will put one of the most powerful tools in the severe weather warning business in the hands of anyone willing to pay for a connection to Weather Service data lines. The temptation to cross the fuzzy line between giving advice on warnings and issuing one of their own could be too great for some private forecasters to resist. Stay tuned to your favorite TV forecaster to see how it turns out. ■ **RICHARD A. KERR**

ADDITIONAL READING

R. C. Sheets, "The National Hurricane Center—past, present, and future," *Weather Forecasting* **5**, 185 (1990).

National Oceanic and Atmospheric Administration, "Draft policy statement on the Weather Service/private sector roles," *Fed. Reg.* **54**, 52839 (1989).