Lon Slepicka, Prince Georges Journal

A big, heavy snow.

Ten inches of wet snow fell on Washington on 22 and 23 February, damaging trees, and the houses, cars, and power lines that they fell on.

keep it from melting into rain? If not, would evaporating snow or rain cool the lower atmosphere enough to prevent melting?

On the night before the storm hit, Olson's heavy precipitation group saw all indicators pointing toward heavy snow. The models had been consistently calling for it—consistency over several model runs being a crucial indicator—and their own subjective analysis concurred. At 9:39 p.m. they predicted 20 centimeters or more of snow—no rain—in the Washington area.

Bob Ryan, a local weatherman with WRC-TV, was reaching the same conclusion for much the same reasons. Both models had been moving the rain/snow line toward the east from run to run, and this latest run continued that trend. Ryan predicted heavy snow starting by 6 a.m. and accumulating up to 25 centimeters before it ended.

There was another school of thought. At the Washington Weather Service Forecast Office forecasters were not giving the models much weight in their consideration of the rain/snow question. The evening before the storm their subjective evaluation leaned toward 5 to 10 centimeters of snow before changing to rain in the afternoon. By early morning, when federal and school go/no-go decisions were being made, the amount was up to 10 centimeters, but sleet and freezing rain were still included. Accu-Weather, a private weather service based in State College, Pennsylvania, likewise was calling for 10 centimeters before the rain would set in. By early morning its predicted snowfall was up to 15 centimeters, but Accu-Weather did not drop the turn toward rain until 9 a.m. A forecast of 10 centimeters of snow alerts most Washingtonians to likely trouble, but not the way one of 20 centimeters or more would have. The result was havoc.

The impressive performance of the Nested Grid Model in forecasting the 22 January storm must have had some element of luck in it, everyone agrees, but the model has done reasonably well with subsequent storms too. A day in advance it correctly forecast the beginning of the next storm on 25 January, although that run predicted twice as much snow as actually fell. The next run, the night before the storm, brought the total snow near the actual amount. The 26 centimeters of wet, dense snow that brought down limbs, whole trees, and power lines on 22 and 23 February appeared on time in the model with temperatures only slightly on the snow side of the freezing point, but the forecast amount never reached half the actual amount. Still, that is rather good. "I've been looking at these East Coast storms since 1946," says Saylor, "and to have the Nested Grid Model do that well with three 1-foot snow storms was really something."

"I've been impressed," says Ryan. "The NGM's [Nested Grid Model] had a good track record. But it was fortunate that we still had the LFM [Limited-area Fine-mesh Model] with its long track record. Of course, next winter it could all fall apart."

This winter at least, the combination of computer forecasts and subjective evaluation as practiced in Weather Service forecast offices along the East Coast has yielded an encouraging overall improvement. During the winter of 1985–86, the probability that the Weather Service would issue a timely winter storm warning when it was warranted was 77%. This winter that probability rose to 86%. The false alarm rate dropped from 34 to 17% since last year. The track record of the models in forecasting heavy precipitation has improved dramatically over previous years.

Perhaps the forecasters and their models in particular owe their recent success to chance. Some storms are easier to predict than others, and some winters have more of those well-behaved storms. Such variability in the atmosphere contributes to the considerable variability of forecasting skill scores. Time will tell whether this winter's improvement was luck or an early sign that computer models are improving in another aspect of forecasting. ■ RICHARD A. KERR

Supernova Neutrinos at IMB

Members of the 14-institution IMB collaboration, which operates a giant proton-decay detector in a salt mine near Cleveland, announced on 10 March that their apparatus experienced a burst of neutrinos at the time of the explosion of Supernova 1987A. Moreover, their events come at precisely the same time as the neutrino burst seen in Japan's Kamiokande II detector. Taken together, these two results thus represent the first clear-cut detection of neutrinos from beyond the earth.

Says IMB principal investigator Lawrence R. Sulak of Boston University, "The age of neutrino astronomy is upon us."

The first of IMB's eight events came on 23 February at 7:35:41.37 universal time, says Sulak, or about 18 hours before the supernova was discovered optically. (The detector, a water Čerenkov counter with an effective mass of 5000 metric tons, has a time resolution of 50 milliseconds.) The next three neutrino interactions followed within the first 1.5 seconds of the burst, while the remainder were scattered over the next 4 seconds. This is just what one would expect, says Sulak, since supernova models predict a very strong initial pulse of neutrinos followed by a more gradual trailing off.

Because of the detector's threshold, he adds, IMB neutrinos represent only the high-energy tail of the supernova's full neutrino output. However, a model recently developed by theorist John Bahcall of the Institute for Advanced Studies in Princeton suggests that the IMB distribution could be explained if the supernova had a thermal energy of 5 million electron volts at the center; thus, the observation can be seen as the first direct measurement of a supernova's core temperature.

Further analysis of the events may well shed light on such matters as neutrino mass, neutrino oscillations, and the interactions of neutrinos with matter, says Sulak. Moreover, if supernova shock waves are responsible for accelerating particles to cosmic ray energies, as many theorists now believe, then fresh bursts of cosmic rays from Supernova 1987A will begin arriving at the earth within the next few months. Underground detectors such as IMB and Kamiokande II will then begin to see neutrinos at energies of 100s of billions of electron volts, while air shower arrays on the surface will begin to see similarly energetic gamma-ray events in the atmosphere. Indeed, says Sulak, "the full implications of this discovery are yet to come." ■ M. MITCHELL WALDROP