

Reply

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Professor Newman's comments provide an opportunity to clarify the philosophy followed by the National Meteorological Center with respect to central guidance products, as well as certain procedures used in the generation of those products.

Early in the operational numerical weather-prediction era, it was recognized that computer-generated forecast products could be improved in accuracy and enhanced in usefulness by skilled forecasters, trained as specialists in the interpretation and evaluation of NWP products. Out of this evolved the "man-machine mix" (Fawcett 1963) philosophy that has guided NMC operations for more than three decades. Central guidance products, generated at NMC by the combination of numerical analyses and forecasts evaluated, interpreted, and perhaps modified by these specialists, are indeed intended to "steer" other meteorologists to the most likely sequence of events. That is, of course, precisely the purpose of central guidance.

The "machine" part of the philosophy has certainly changed a very great deal in the past 35 years; so has the human part. In the late 1950s, the numerical projections typically consisted of forecasts of heights of a few standard pressure surfaces. The forecaster was then obliged to interpret those in terms of sensible weather elements. Forecasters also learned to adjust the model output for systematic errors.

In present practice, NMC forecasters typically have several different numerical forecasts to evaluate. For the 3- to 5-day problem, forecasts from the European Centre for Medium-Range Weather Forecasts (ECMWF), the United Kingdom Meteorological Office (UKMO), and the NMC operational medium-range forecast (MRF) model are available to the fore-

casters. In addition, NMC always has an experimental version of the MRF, for testing and evaluation of improvements, running in parallel with operations. Output from this source is also available. Based on experience with systematic errors and other characteristics of the models in the synoptic situation, the forecasters make a judgement on which is the most probable solution.

Professor Newman rightly notes that the numerical guidance is least accurate in the shorter waves. This is precisely where the forecasters have the most room to improve the model guidance. Our verification scores of, for example, the human-adjusted sea level pressure field show that they are very successful on the average. Thus, the central guidance for the 3- to 5-day problem, in the form of AFOS graphics 9JH, 9KH, 9LH, and the accompanying discussions (AFOS headers PMDHMD, PMDEFD), reflects an excellent combination of multiple numerical models and the wisdom of skilled, experienced forecasters. National Weather Service field forecasters and private-sector forecasters alike should find this guidance useful, and should use it in their local forecast products.

Finally, we disagree with Professor Newman's statement that "It would not be in the best interests of the NWS to announce that a particular forecast had little or no skill." One can think of many examples in which intelligent users of forecasts would make one set of decisions if the forecast is attended by a statement of high confidence, and a completely different set if the situation is such that confidence in the forecast is low. We believe that if such confidence measures can be applied with skill, the NWS is obligated to do so.

REFERENCE

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Fawcett, E. B., 1962: Six years of operational numerical weather prediction. *J. Appl. Meteor.*, 1, 318-332.