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A COMPARISON OF THE OBSERVED AND FORECAST FREQUENCIES OF
VARIOUS PRECIPITATION AMOUNTS IN THE 1986, 1987, AND 1988 VERSIONS
OF THE NESTED GRID MODEL

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changed (October 22, 1987 - December 9, 1987), and after both changes were implemented (October 22, 1988 - December 9, 1988). For comparison, we also tested the Limited-area Fine-mesh Model (LFM) (National Weather Service, 1978; Newell and Deaven, 1981) for the same periods and with matched samples. The model forecasts were interpolated to about 230 stations throughout the contiguous United States where precipitation observations were available. Only forecasts from 0000 UTC were evaluated. For each of the 6-h periods between 12 and 48 hours, we determined the observed and forecast relative frequencies of ≥ 0.01, ≥ 0.10, ≥ 0.25, ≥ 0.50, and ≥ 1.00 inches of precipitation. Note that the two 6-h periods between 0 and 12 hours were not used because of "spin up" problems in the NGM and because of the method used to calculate precipitation in the LFM during the first 12 hours of the forecast.

3. RESULTS

For each of the three 7-week verification periods, we combined the data for all stations and days and for the six 6-h forecast periods. This gave us a sample size of approximately 60,000 cases in each verification period. Fig. 1 shows the relationship between the observed and forecast relative frequencies of the various precipitation amounts for the three verification periods for the NGM. In this graph, we've plotted the forecast versus observed relative frequencies of ≥ 0.01, ≥ 0.10, ≥ 0.25, ≥ 0.50, and ≥ 1.00 inches of precipitation for each of the verification periods. Ideally, all points would fall on the dotted line where the forecast frequency matches the observed frequency. If a point is above and to the left of the dotted line, the model is underforecasting the event. Points plotted below and to the right of the dotted line indicate that the event is being overforecast. Of course, the highest observed or forecast frequency corresponds to the lowest precipitation amount category (≥ 0.01 inches) and vice versa. Clearly, there is a distinct change in the relationship between the observed and forecast relative frequency between 1986 and 1987 for the frequencies of ≥ 0.01, ≥ 0.10, and ≥ 0.25 inches of precipitation. The hemispheric temperature adjustment definitely appears to have "dried out" the NGM. Fig. 1 also indicates that there was little change in the relationship between observed and forecast relative frequency between the 1987 and 1988 verification periods for the same three amounts. Note that the NGM overforecast the frequency of ≥ 0.01 during all three verification periods.

To better understand the effects of the model changes on the relative frequencies of the larger amounts of precipitation, we plotted the same data on a log-log plot (Fig. 2). For the categories of ≥ 0.50 and ≥ 1.00 inches, Fig. 2 indicates that the relationship between the observed and forecast relative frequencies changed most between the 1987 and 1988 verification periods. Between 1987 and 1988, the time step change appears to have significantly reduced the forecast relative frequencies of the larger amounts of precipitation in the NGM. Note that the model underforecast the frequencies of ≥ 0.50 and ≥ 1.00 inches during all three of the verification periods.

For comparison, the LFM was evaluated on a matched sample of data. Note that the LFM was not changed during the 1986 - 1988 period. Fig. 3 is a linear plot of the observed and forecast relative frequencies for the LFM for the three verification periods. Although the observed relative frequency of ≥ 0.01 inches changed significantly between 1986 and 1987, the relationship between the observed and forecast frequencies changed only a little. Clearly, however, the LFM overforecasts the frequencies of ≥ 0.01, ≥ 0.10, and

≥ 0.25 inches of precipitation. Fig. 4 is a log-log plot of the same data. As anticipated, the results for the three verification periods are very similar.

4. SUMMARY

For the October 22 - December 9 period, the inclusion of the hemispheric temperature correction scheme appears to have reduced the NGM's forecast frequencies of ≥ 0.01, ≥ 0.10, and ≥ 0.25 inches of precipitation, but had a relatively small effect on the forecast frequencies of ≥ 0.50 and ≥ 1.00 inches of precipitation. In contrast, the change to the longer time step reduced the NGM's forecast frequencies of ≥ 0.50 and ≥ 1.00 inches of precipitation, but had little effect on the forecast frequencies of the smaller amounts.

Since the NGM overforecast the relative frequency of ≥ 0.01 inches of precipitation, the inclusion of the hemispheric temperature correction scheme has helped to reduce this overforecasting bias. Since the NGM tended to underforecast the relative frequencies of ≥ 0.50 and ≥ 1.00 inches of precipitation, the change to the longer time step made this underforecasting bias worse. Note, however, that synoptic-scale models should be expected to overforecast the frequencies of small amounts of precipitation and underforecast the frequencies of large amounts of precipitation when being verified with station data.

The results presented here are for all stations combined for the October 22 - December 9 period. Note that the precipitation that occurs during this period is generally non-convective. Because the ratio of convective to non-convective precipitation varies depending on the time of the year and location within the country, and because the changes made to the NGM (especially the change in the time step) are related to the type of precipitation (convective versus non-convective), the results should not be interpreted as being valid for all stations and seasons. However, the results do support the conclusions of Phillips et al. (1988).

5. ACKNOWLEDGMENTS

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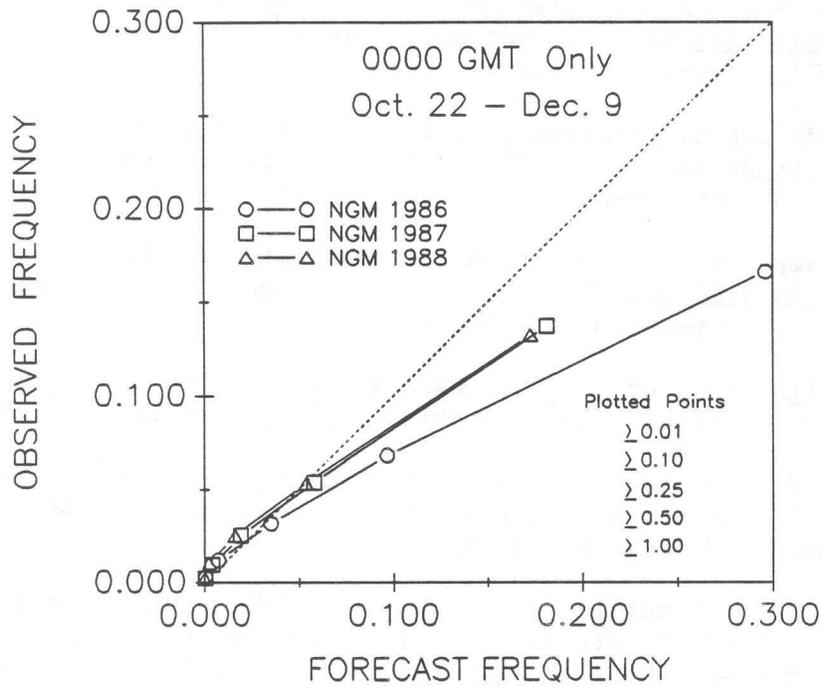
Figure 1. Observed versus NGM forecast relative
frequencies of ≥ 0.01, ≥ 0.10, ≥ 0.25, ≥ 0.50,
and ≥ 1.00 inches of precipitation for the 1986,
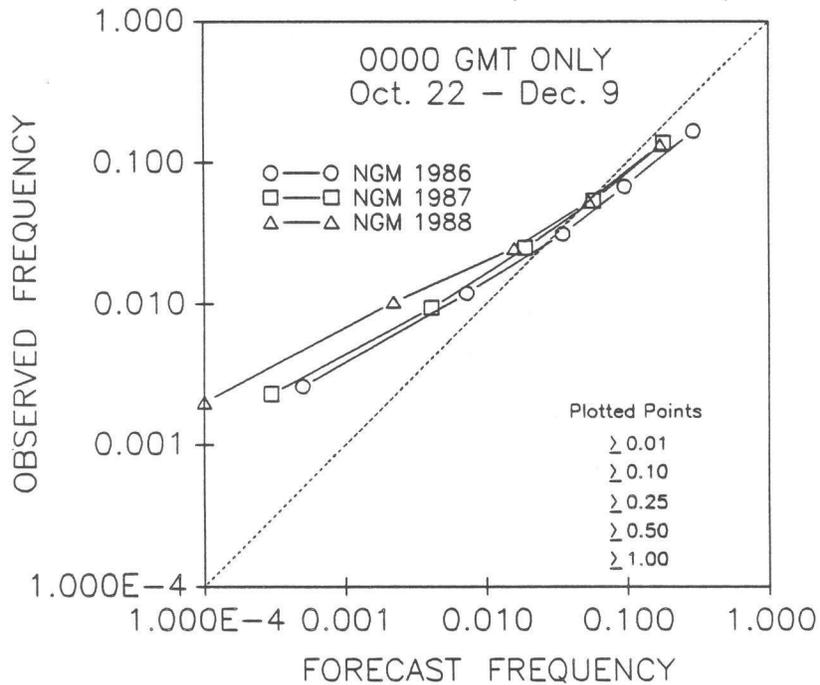1987, and 1988 test periods.

Figure 2. Same as Fig. 1 except that the data are
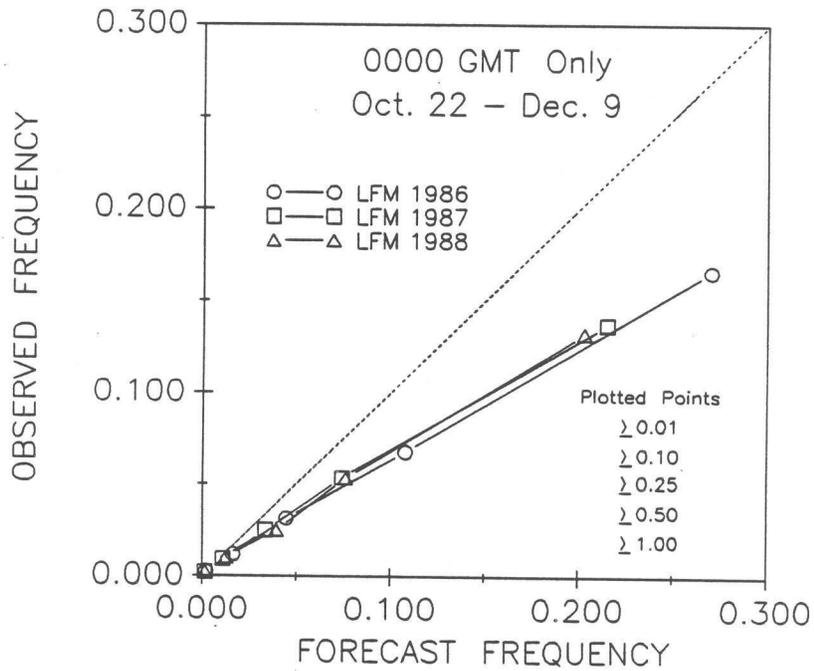plotted on a log-log scale.

Figure 3. Observed versus LFM forecast relative
frequencies of ≥ 0.01, ≥ 0.10, ≥ 0.25, ≥ 0.50,
and ≥ 1.00 inches of precipitation for the 1986,
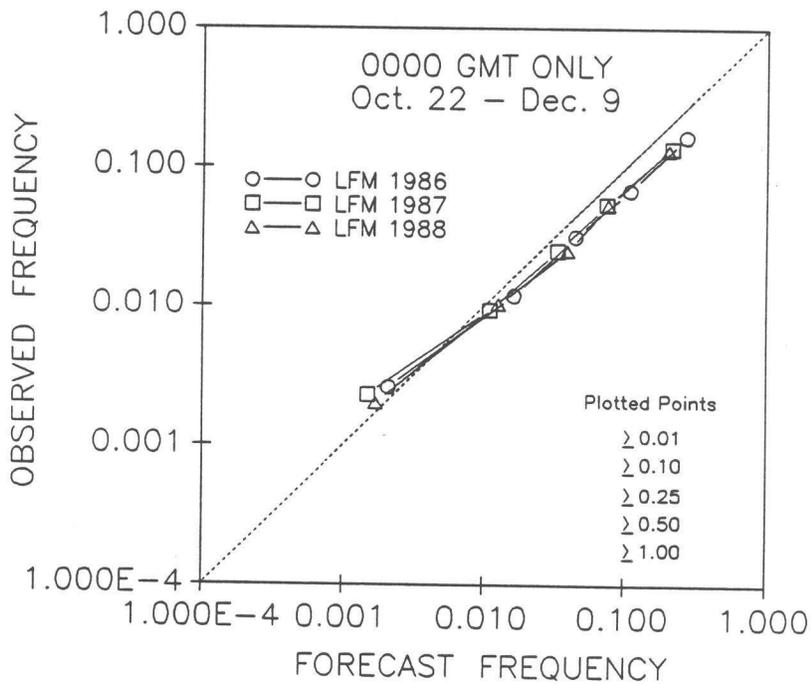1987, and 1988 test periods.

Figure 4. Same as Fig. 3 except that the data are
plotted on a log-log scale.