WESTERN REGION TECHNICAL ATTACHMENT
NO. 87-44
October 27, 1987

STATISTICAL CORRECTION FOR THE NGM COLD BIAS

As described in Technical Procedures Bulletin NO. 363, radiational heating calculations introduced in the NGM in July 1986 produce a progressively colder temperature field at the rate of about 1.5°C in 48 hours at almost all levels. Beginning with the 12Z October 21, 1987 run of the NGM, a major change was made to that model to compensate for this pronounced cold bias.

Because recent experiments have failed to determine the reason for the cold bias, the change to remove it is a statistical correction. Once each hour, the average potential temperature is computed over the entire hemisphere at each level. This average is compared with the initial (time zero) average, and the value at each grid point is adjusted by the amount of the difference. The adjustment has the effect of restoring the average potential temperature back to the value it had at the start of the forecast for each model level, every hour. It does not account for the fact that the cold bias is not geographically uniform. For example, on average, the cold bias is larger over the Rocky Mountains than in the eastern U.S.

Experiments during the past summer show that the above correction is very effective at removing the bias (Figure 1) at least during summer situations over North America as a whole. In order to determine what typical impact the change might have this time of year over western North America, some comparisons are made below for 500mb height fields and 1000-500mb thickness fields between NGM runs made immediately before and after the change was implemented. The comparisons are between NGM runs from 00Z October 21 (old version) and 12Z October 21 (new version). Of course the comparisons must be viewed with some caution since they constitute only one case, and differences may be due in part to initial data and analysis differences.

Figure 2 shows the difference in 500mb heights and 1000-500mb thicknesses between the two model runs at 36 hours after 12Z October 21. Solid lines are from the old version of the model, dashed lines from the new version. At 500mb (Figure 2a), differences are close to 60 meters over the north central and northeastern U.S. and roughly 30-40 meters elsewhere over the U.S. The pattern and magnitude of thickness differences (Figure 2b) are about the same.

In order to get a feel for the time evolution of the differences and to see which model run did best, verifications of 500mb heights at various projections are depicted in Figures 3 and 4 for the new and old versions of the model, respectively. Corresponding thickness verifications are displayed in Figures 5 and 6. Forecast isolines are all depicted in solid, verification isolines in dashed.

At 500mb, the run made from 12Z October 21 (new version) resulted in an excellent height forecast (Figure 3) at 12, 24, and 36 hours. It exhibits no appreciable bias over the U.S. Biggest errors are in the extreme western U.S. and could well be due to initial analysis errors in the data-sparse east Pacific. The run made from 00Z October 21 (old version, Figure 4), on the other hand, shows a significant negative error (10 to 20 meters) over the U.S. at 24 hours that grows to values of about 30-60 meters by 48 hours. Errors in the extreme west may be due as much to initial analysis problems as to any systematic bias.

Similar statements to the above can be made about the thickness verification in Figures 5 and 6. That is, the new NGM makes a rather good thickness forecast except in the extreme West. On the other hand, the old NGM forecasts thicknesses too low by 10-20 meters at 24 hours with errors 60 meters or greater in some areas by 48 hours.

This single example should give forecasters some idea of how the latest version of the NGM will behave compared to the old version. The warmer temperature characteristics of the new NGM will result in lower relative humidity values as well and, thus, somewhat less precipitation. NMC experience so far suggests areal coverage of precipitation will be about 5-10 percent less. Also since statistical guidance from the NGM is based on the perfect prog approach, the guidance will produce systematically warmer forecasts. Both of these changes will be improvements since previous NGM forecasts have, on the average, tended to be too wet and cold. Details about this change in the NGM are covered in Technical Procedures Bulletin NO. 373, which will be distributed very soon.

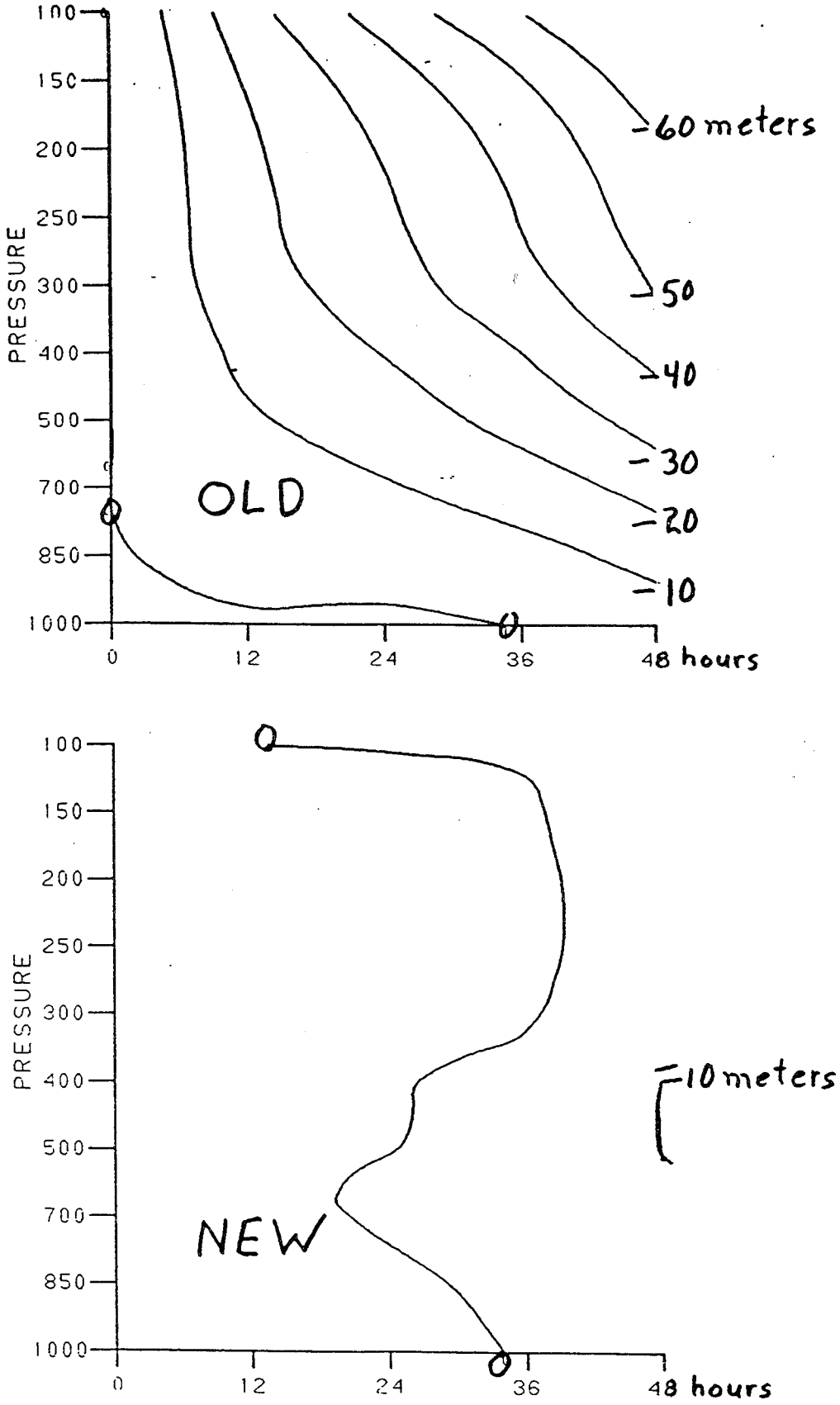
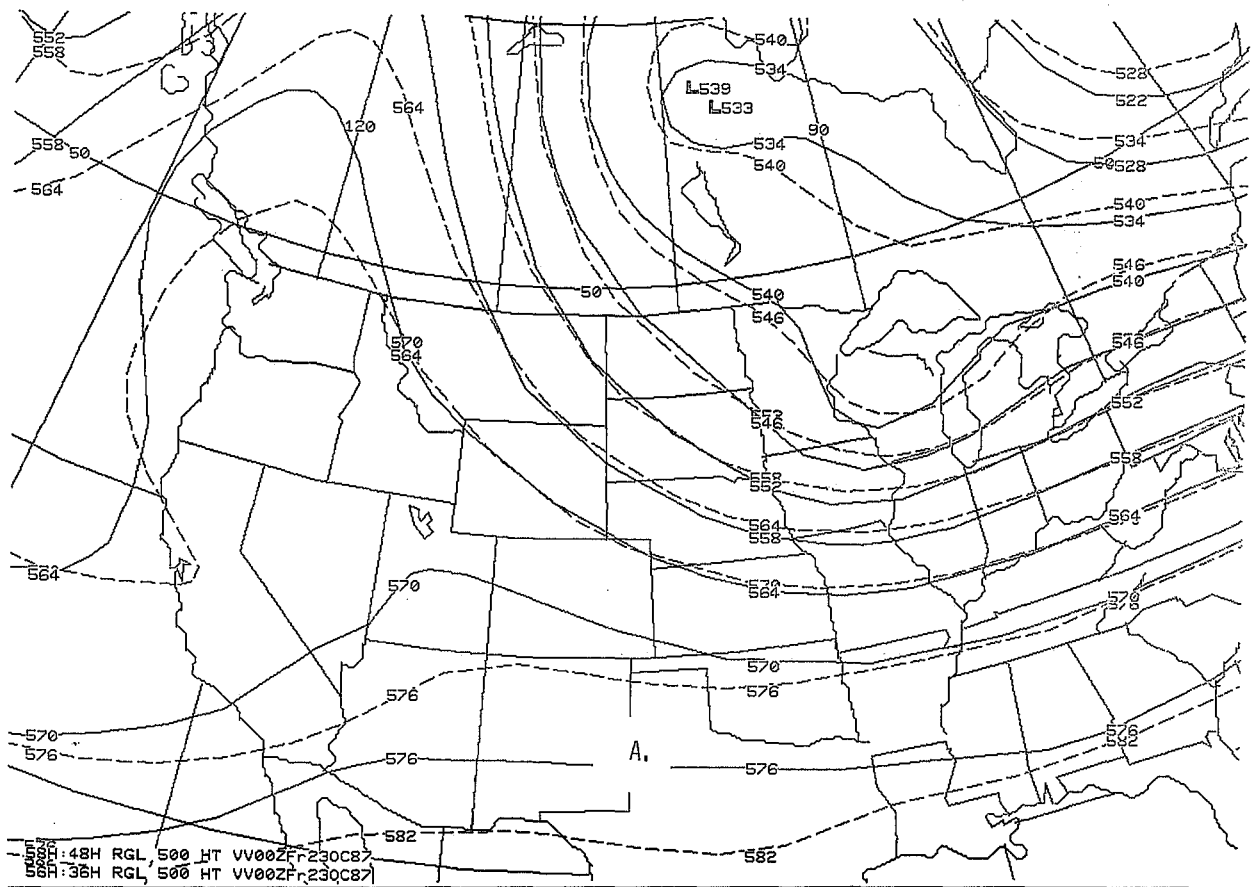


Figure 1. Development with forecast time of isobaric height error averaged over North America and averaged over 25 forecasts for the period 7/30/12Z - 8/12/00Z 1987. The top diagram is for operational forecasts, the bottom diagram for experimental forecasts using the temperature adjustment described in the text.



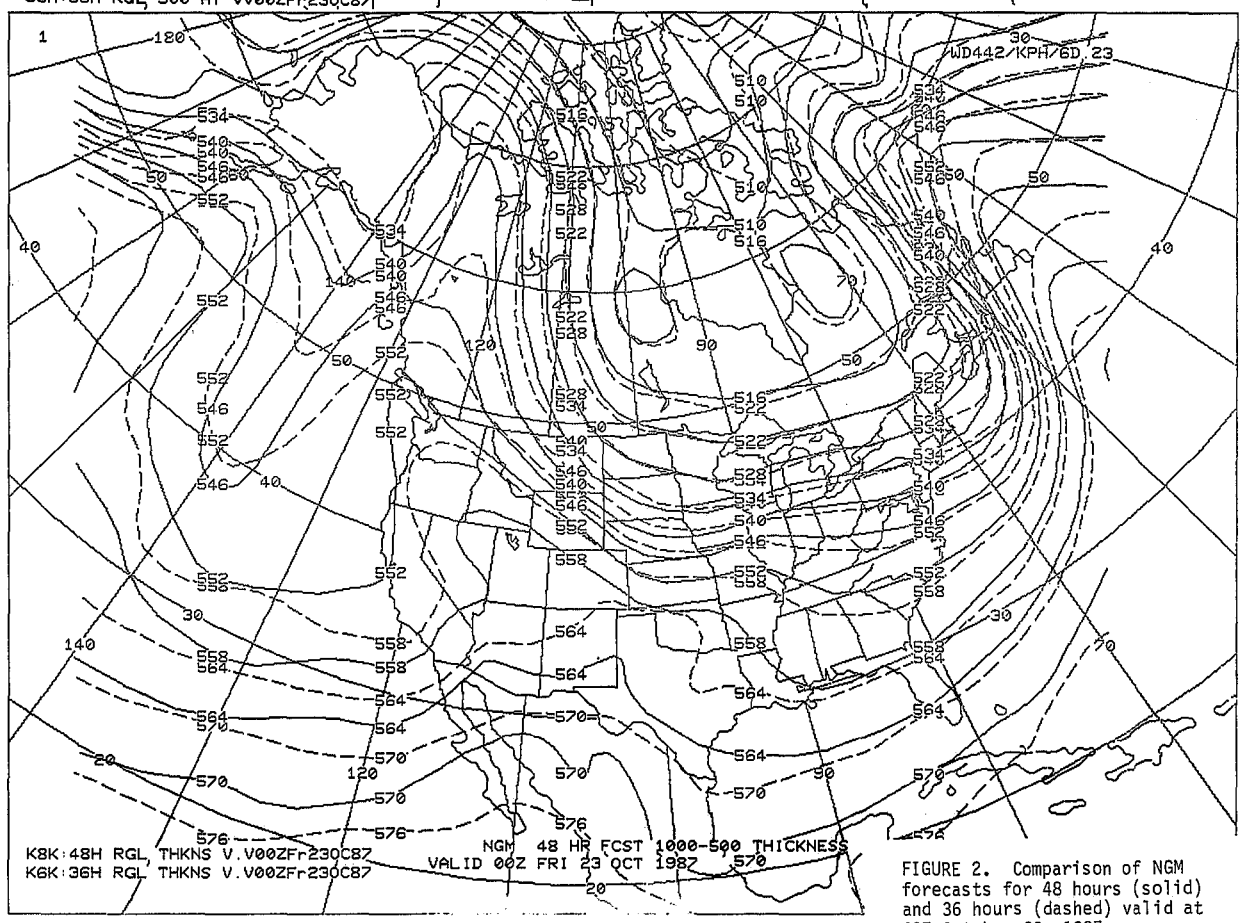


FIGURE 2. Comparison of NGM forecasts for 48 hours (solid) and 36 hours (dashed) valid at 00Z October 23, 1987.
(a) depicts 500mb height.
(b) depicts 1000-500mb thickness.

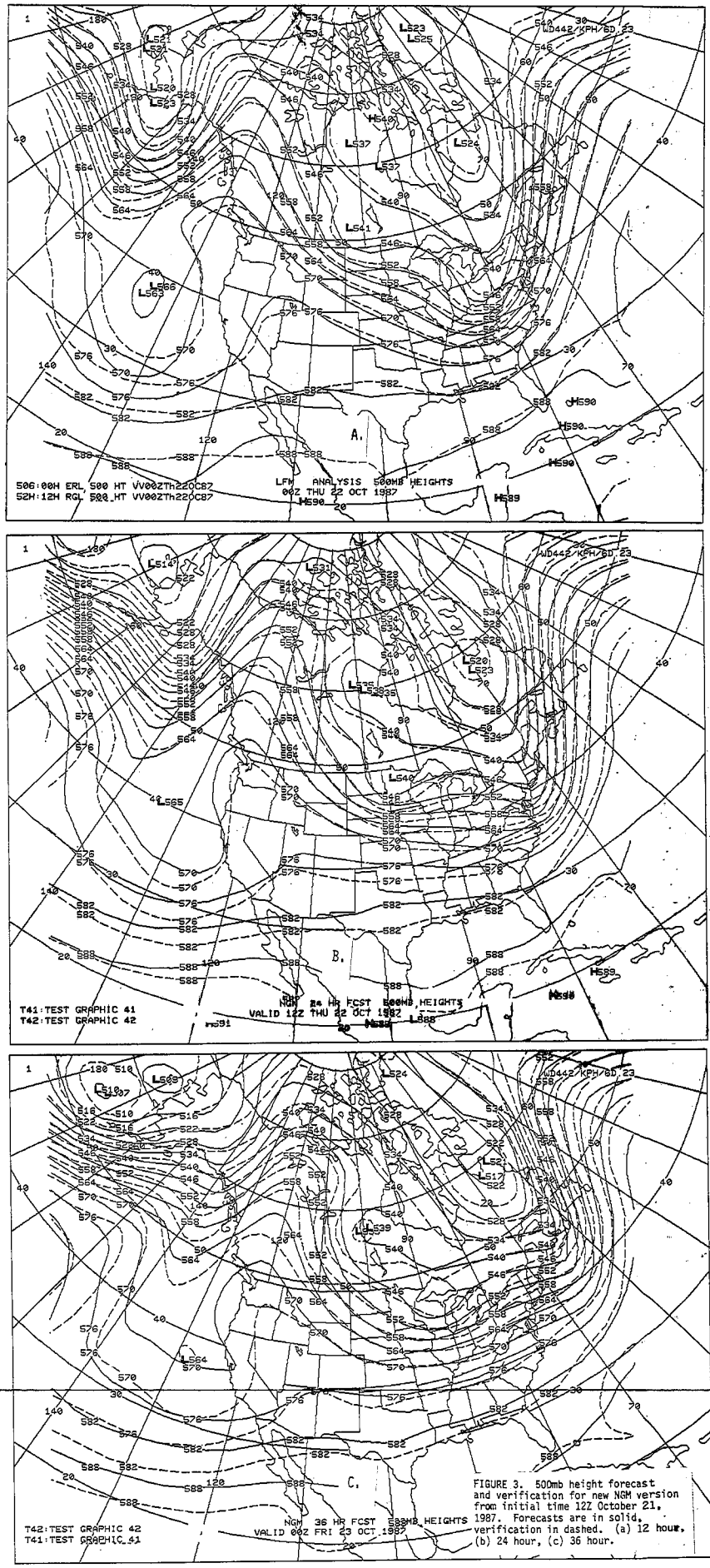


FIGURE 3. 500mb height forecast and verification for new NGM version from initial time 12Z October 21, 1987. Forecasts are in solid, verification in dashed. (a) 12 hour, (b) 24 hour, (c) 36 hour.

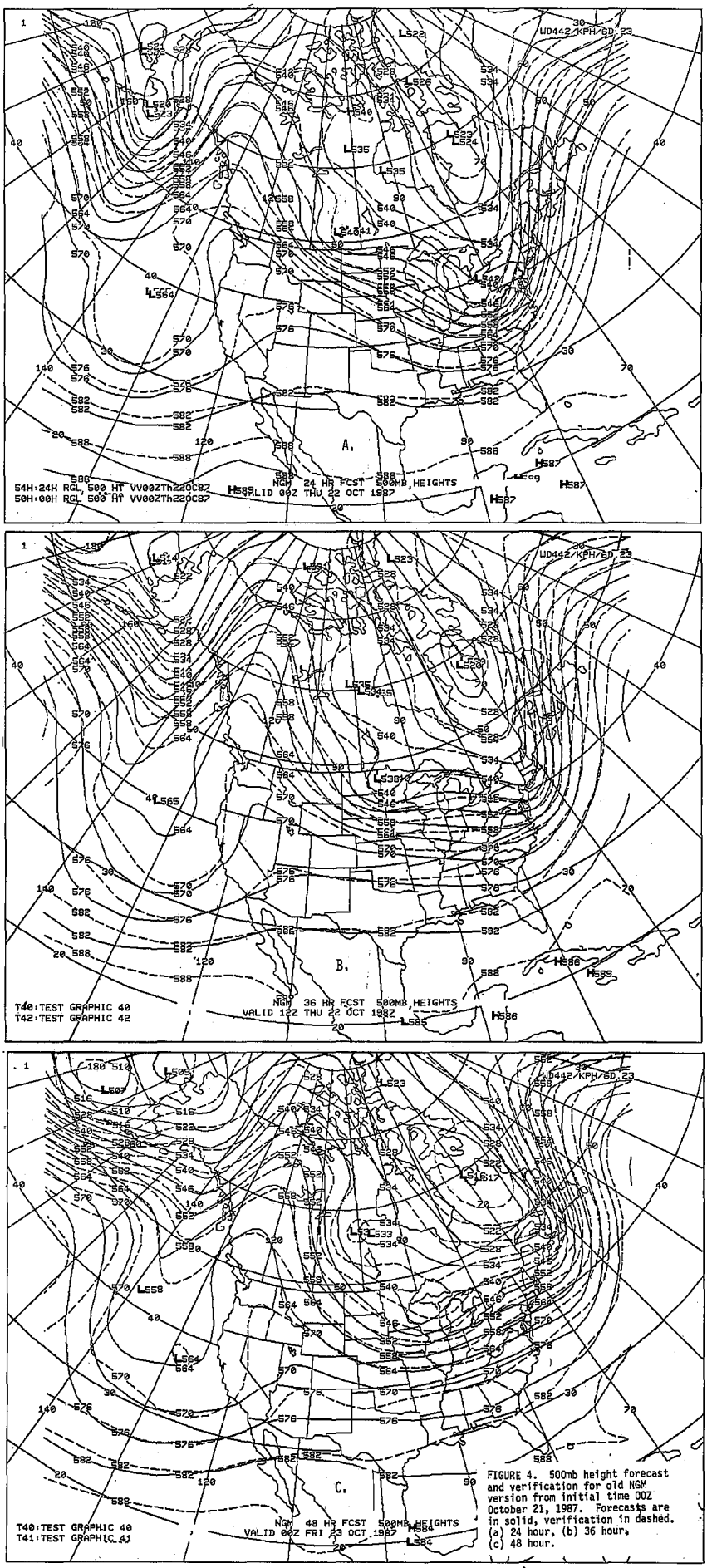


FIGURE 4. 500mb height forecast and verification for old NGM version from initial time 00Z October 21, 1987. Forecasts are in solid, verification in dashed. (a) 24 hour, (b) 36 hour, (c) 48 hour.

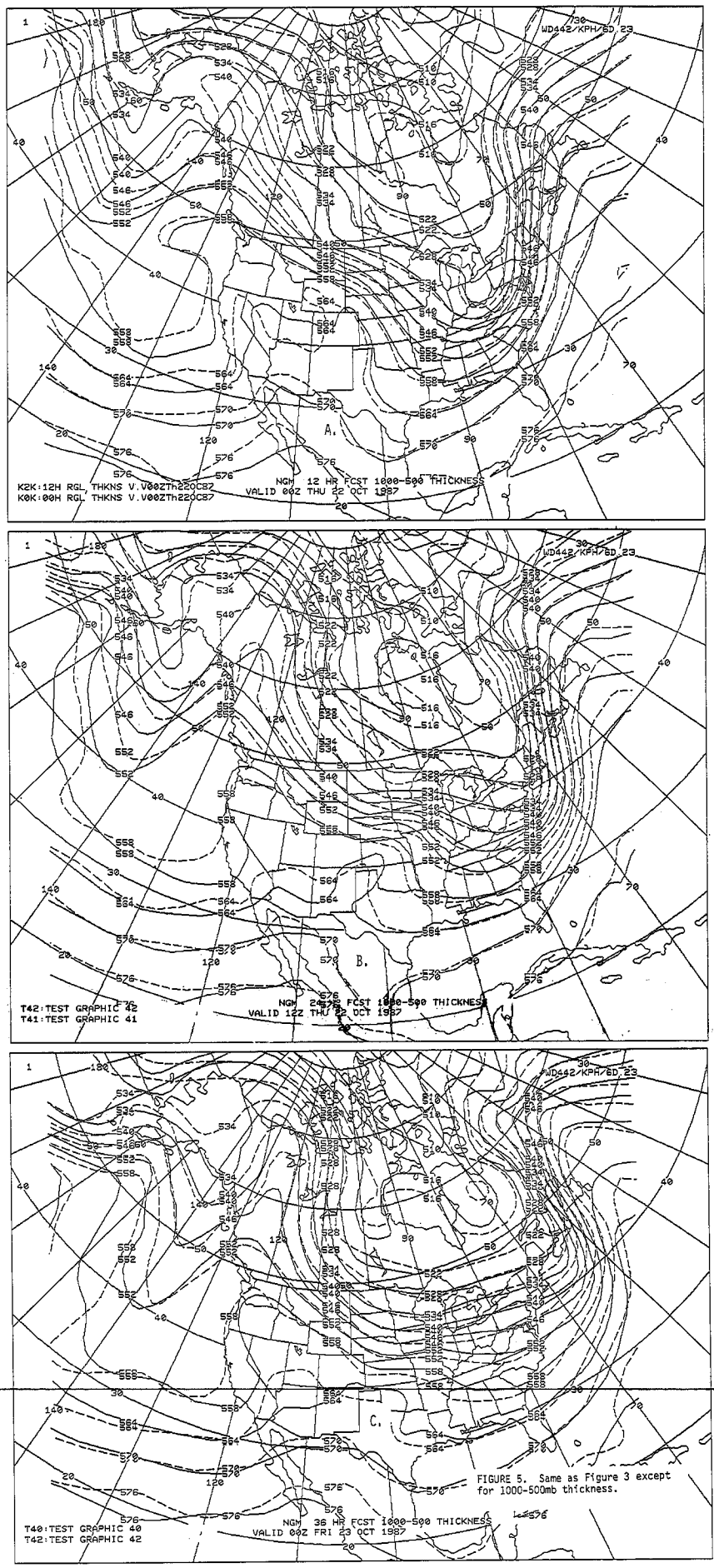


FIGURE 5. Same as Figure 3 except for 1000-500mb thickness.

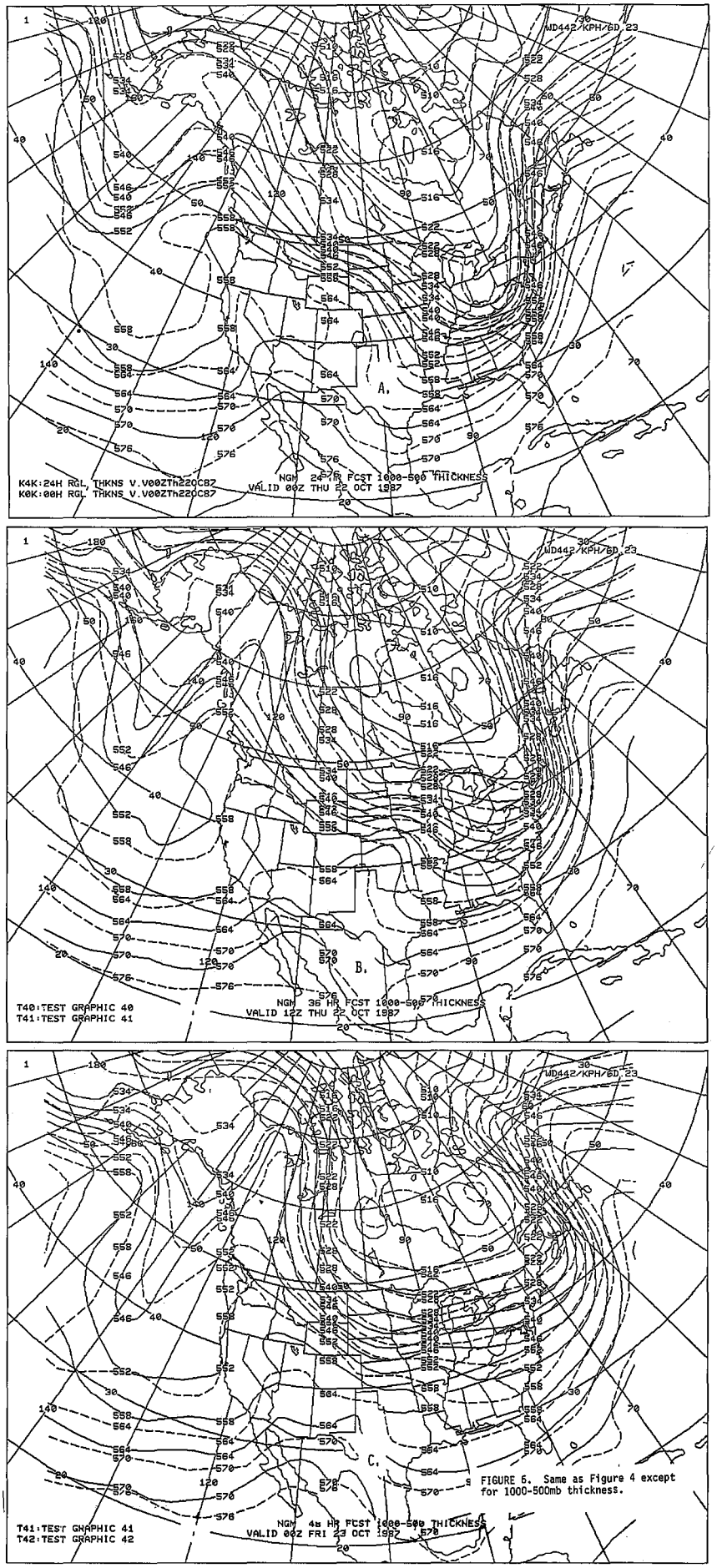


FIGURE 6. Same as Figure 4 except for 1000-500mb thickness.