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LARGE PRECIPITATION "BULLS-EYES" AND THEIR EFFECT ON THE NGM 48 HOUR FORECAST

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Since SELS began producing a second day outlook earlier this year, the 48 hour forecast set from the models has become a more important tool in preparing this forecast. This has led to closer examination of model biases over the longer term. Precipitation "blow-ups" are a concern to the forecaster because when they occur, the model atmosphere (especially the LFM) can become very unlike the real atmosphere as the model steps further through time.

Most forecasters are familiar with the "convective feedback" problem in the LFM as the vertical motion maximum and latent heat accompanying precipitation release is transported through out the entire atmospheric column. However, this is not the case with the current NGM.

On July 23, 1986, a number of changes were made in the physics package of the NGM. These changes are documented in Technical Procedures Bulletin number 363 dated June 30, 1986. The most dramatic change was the increase in precipitation forecast by the NGM. This was due to a revised convective precipitation procedure which was introduced into the NGM. Moisture accumulated in the model atmosphere is allowed to fall to the ground once a column became convectively unstable and the relative humidity of the column reaches 50 per cent or more.

While this change produced a marked improvement in the summer NGM precipitation forecasts, the increase in precipitation appears to have had a detrimental effect on the model forecast at 48 hours. This is illustrated by the three attached cases.

Fig. 1a presents the 48 hour NGM quantitative precipitation forecast (QPF) for 12Z 2 September 1986 and Fig. 1b shows observed verifying 24 hour accumulated precipitation chart for 12Z 2 September 1986. Heavier precipitation generally fell in the area forecast by the model. What is more interesting is the effect on the model atmosphere of the forecast 3.22 inch precipitation maximum over western North Carolina and the 2.54 inch maximum near Lubbock.

Fig. 2a is the 48 hour 500 mb height and vorticity forecast for 12Z 2 September 1986 with Fig. 2b the accompanying verifying analysis. Nothing too out of the ordinary catches the forecasters attention here. In fact, even though there are some weak vorticity features near the precipitation maximums, there are no pronounced blow-ups often seen on the LFM. This is probably due to the decrease in evaporative cooling in the new NGM convective parameterization. This tends to eliminate faulty 500 mb vorticity features created by large precipitation centers. Unfortunately this has apparently shifted the problem into the lower layers of the model atmosphere.

Fig. 3a is the 48 hour 850 mb height and temperature forecast valid 12Z 2 September 1986 while Fig. 3b is the verifying analysis. Notice the anomalous warming forecast in the low levels near the precipitation maximum over western North Carolina and west Texas and the development of areas of lower heights in the model forecast.

This is reflected further in Fig. 4a and 4b which are the 48 hour Mean Sea Level (MSL) pressure forecast for 12Z 2 September 1986 and the verifying initial MSL pressure analysis. Note the forecast development of surface waves near the precipitation maxima and the resultant pre-mature breaking down of the surface ridge along the Appalachians. Also disruptions of the 1000-500 mb thickness field on the 48 hour forecast are evident.

A second case is the NGM 48 hour forecast valid for 00Z 21 August 1986. Fig. 5a presents the 48 hour NGM QPF forecast valid for 00Z 21 August 1986. Note the precipitation maximum near the Kentucky/North Carolina border. There is also a small maximum indicated over southwestern Minnesota. For comparison, the 24 hour observed precipitation chart for 12Z 21 August 1986 (Fig. 5b) is presented.

Fig. 6a is the 48 hour NGM 500 mb height and vorticity forecast valid 00Z 21 August 1986 with Fig. 6b being the accompanying 500 mb initial analysis of heights and vorticity for 00Z 21 August 1986. There are small scale vorticity features on the forecast not present on the analysis, but again the NGM shows the lack of vorticity blow-up due to a precipitation maximum.

A problem with the model forecast is again evident in the low level forecasts. Fig. 7a is the 48 hour 850 mb height and temperature forecast for 00Z 21 August 1986. The 850 mb forecast shows the development of a low over western South Carolina with an implied increase in the low level baroclinicity over the Carolinas/eastern Kentucky. Also there is development of a thermal ridge from eastern Nebraska to northern Wisconsin with a strong warm advection from Iowa northeastward to upper Michigan. When comparing the forecast to the actual analysis (Fig. 7b), one finds that the development in the Carolinas and the thermal ridge from Nebraska to Wisconsin was overdone.

These problems are also reflected in the 48 hour MSL pressure forecast valid 00Z 21 August 1986 (Fig. 8a) and the verifying MSL pressure analysis (Fig. 8b). The NGM generates false surface waves over northwestern Iowa and western North Carolina. The verifying initial analysis shows at least a 7 mb

error in the MSL forecast in both locations due to the lack of development of such lows in the real atmosphere.

A third case for 00Z 13 August 1986 (Fig. 9 - 12) illustrates an example where the precipitation maxima is more elliptic with the corresponding error in the 850 mb and Mean Sea Level pressure forecast less pronounced as the error is spread over a larger area.

The NGM, contrary to the LFM, appears to have problem by 48 hours in distributing the latent heat developed during the convective process. The NGM, for the most part, appears to reflect the increase of latent heat in the low level mass field thereby adversely affecting the low level forecasts of model between 36 and 48 hours.

Having examined several cases during a month's time, it appears that the larger the precipitation maxima, and the more concentric the precipitation "bulls-eye", the more pronounced the error becomes. This becomes fairly obvious after examining data for 12Z 2 September 1986 and 00Z 21 August 1986.

The watch word for the forecaster is to beware of 48 hour forecast surface and 850 mb developments in the NGM when they are associated with precipitation blow-ups.

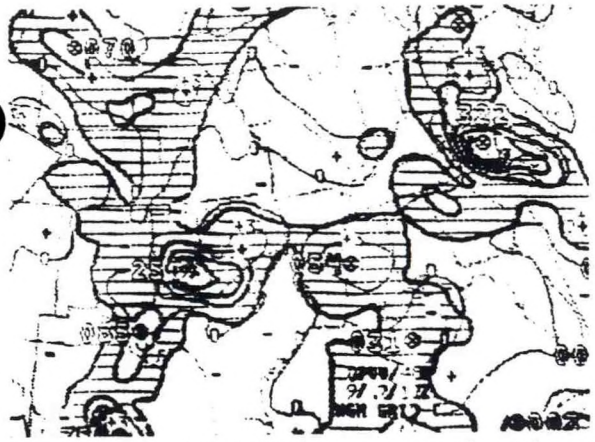

Figure 1a. NGM 48 hour Quantitative Precipitation Forecast (QPF) and vertical velocity forecast valid 12Z 2 September 1986.

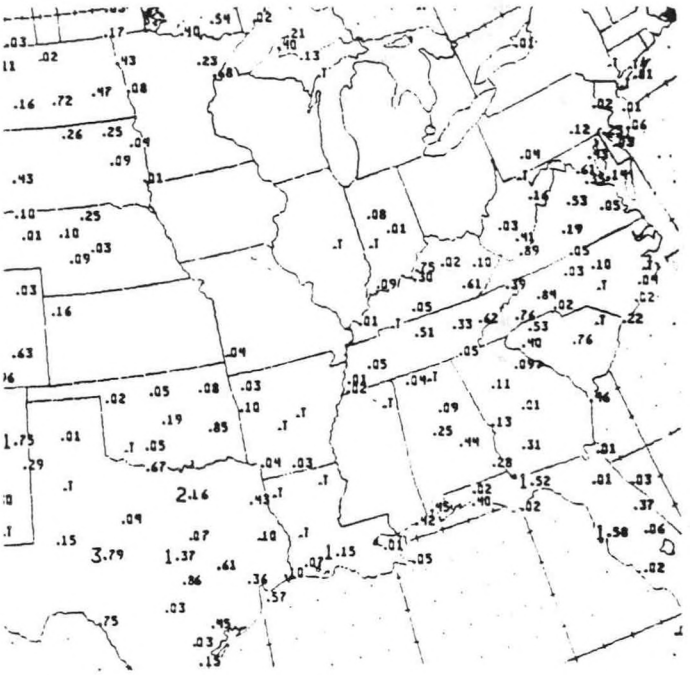

Figure 1b. Observed 24 hour precipitation ending at 12Z 2 September 1986.

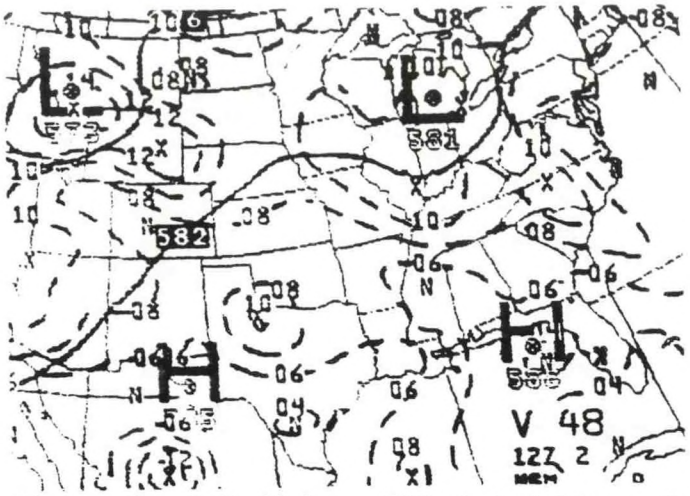

Figure 2a. NGM 48 hour 500 mb heights and vorticity forecast valid 12Z 2 September 1986.

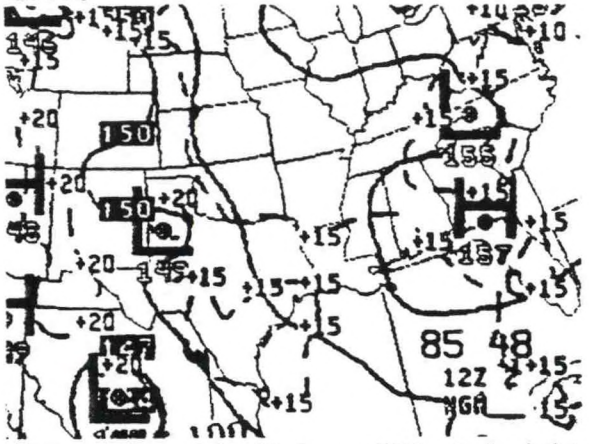

Figure 3a. NGM 48 hour 850 mb heights and temperature forecast valid 12Z 2 September 1986.

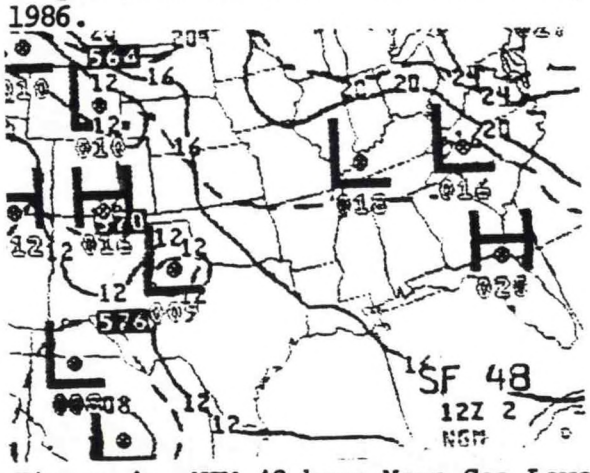

Figure 4a. NGM 48 hour Mean Sea Level (MSL) pressure and 1000-500 mb thickness forecast valid for 12Z 2 September 1986.

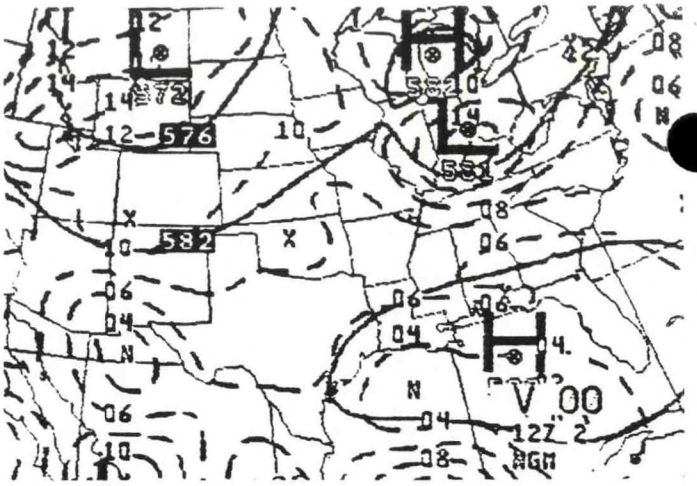

Figure 2b. NGM initial 500 mb heights and vorticity analysis for 12Z 2 September 1986.

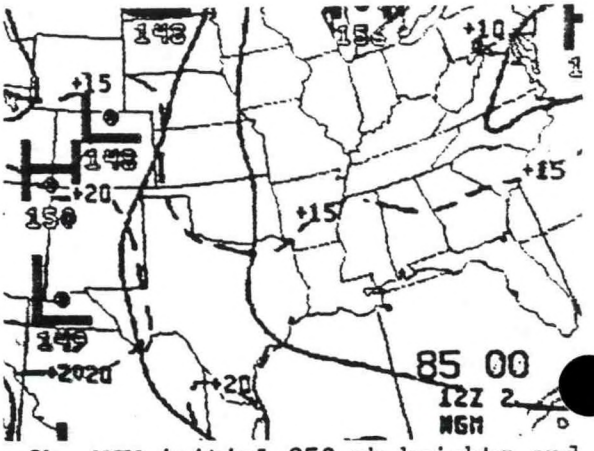

Figure 3b. NGM initial 850 mb heights and temperature analysis for 12Z 2 September 1986.

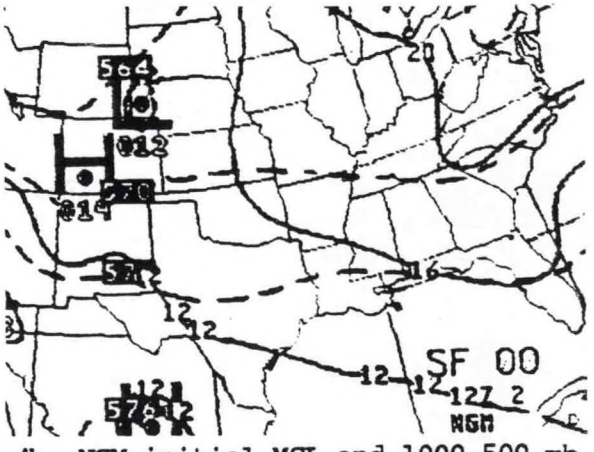

Figure 4b. NGM initial MSL and 1000-500 mb thickness analysis for 12Z 2 September 1986.

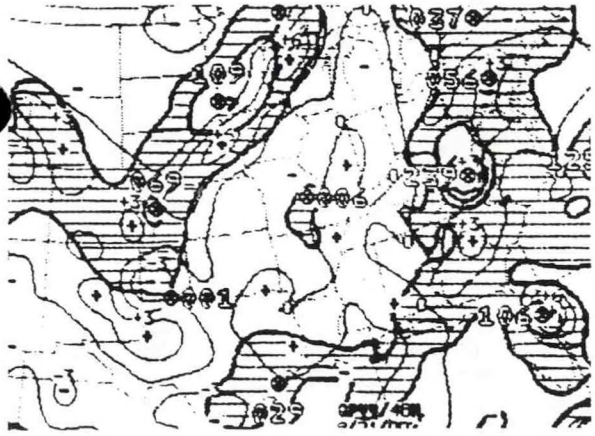

Figure 5a. NGM 48 hour QPF and vertical velocity forecast valid 00Z 21 August 1986.

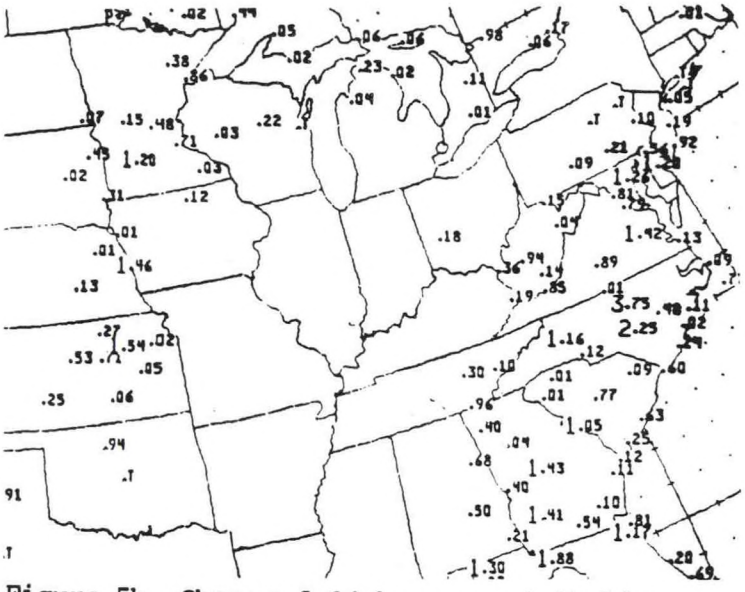

Figure 5b. Observed 24 hour precipitation ending at 00Z 21 August 1986.

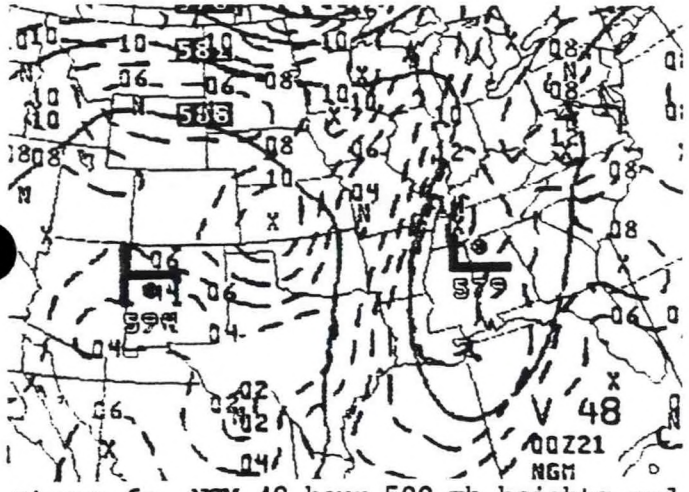

Figure 6a. NGM 48 hour 500 mb heights and vorticity forecast valid at 00Z 21 August 1986.

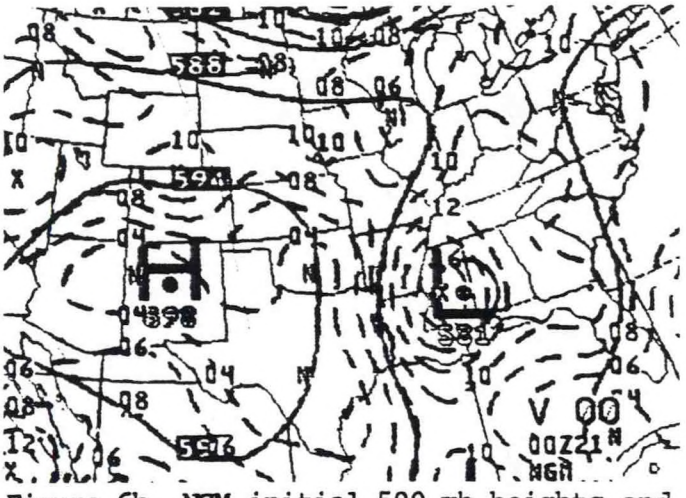

Figure 6b. NGM initial 500 mb heights and vorticity analysis for 00Z 21 August 1986.

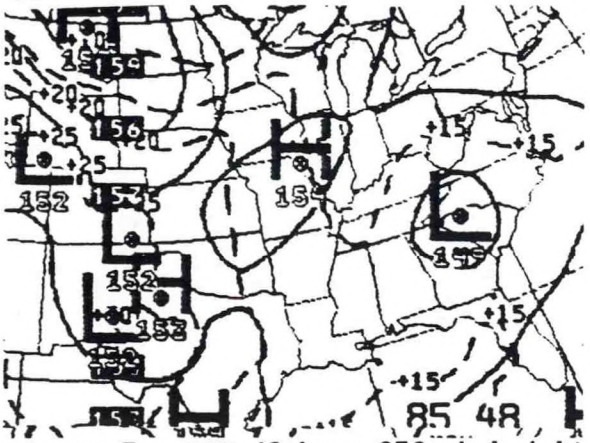

Figure 7a. NGM 48 hour 850 mb heights and temperature forecast valid for 00Z 21 August 1986.

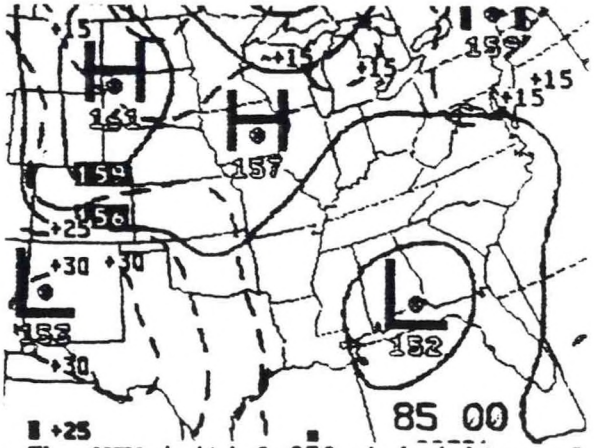

Figure 7b. NGM initial 850 mb heights and temperature analysis for 00Z 21 August 1986.

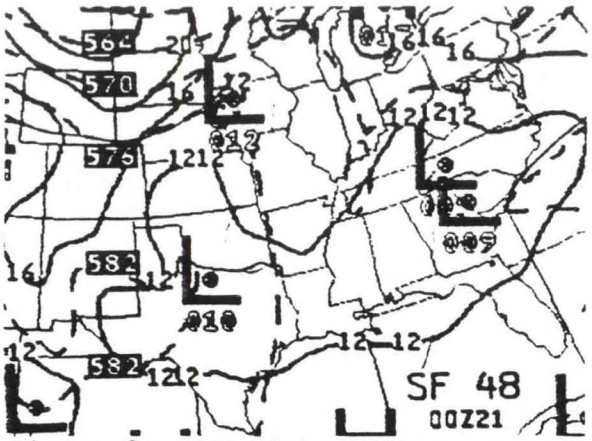

Figure 8a. NGM 48 hour MSL pressure and 1000-500 mb thickness forecast valid for 00Z 21 August 1986.

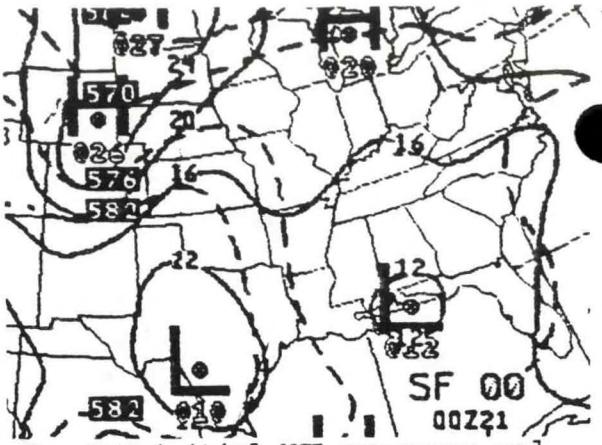

Figure 8b. NGM initial MSL pressure and 1000-500 mb thickness analysis for 00Z 21 August 1986.

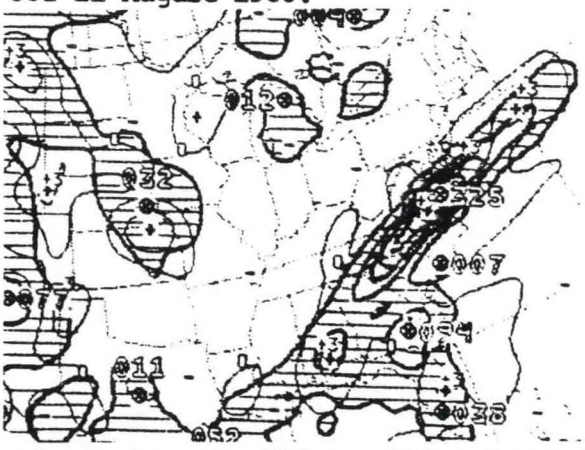

Figure 9a. NGM 48 hour QPF and vertical velocity forecast valid 00Z 13 August 1986.

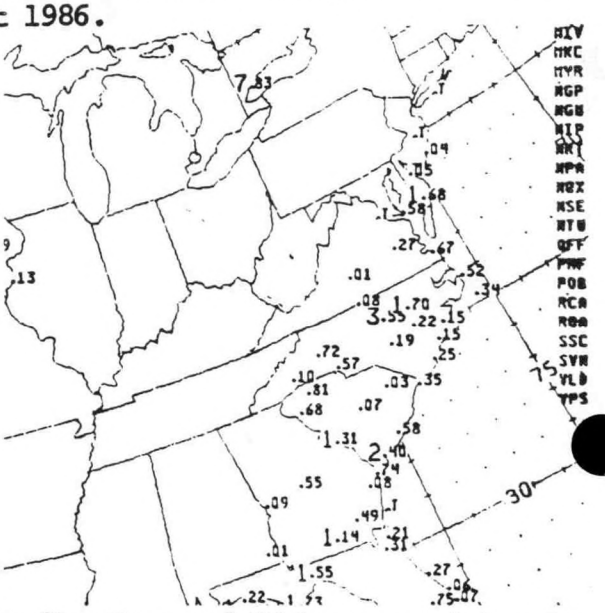

Figure 9b. Observed 24 hour precipitation ending at 12Z 13 August 1986.

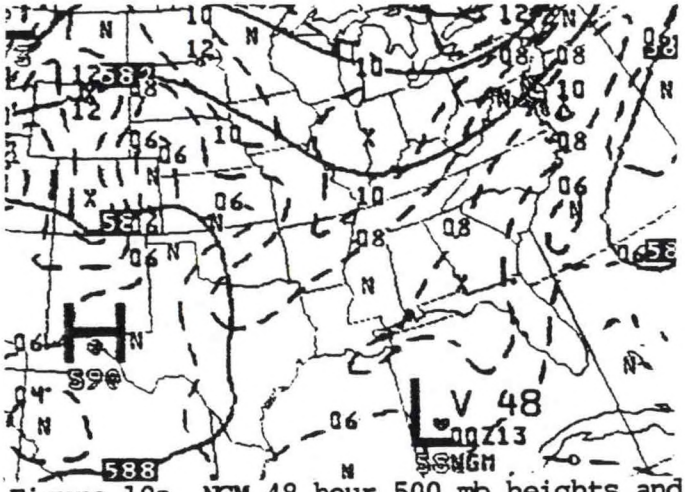

Figure 10a. NGM 48 hour 500 mb heights and vorticity forecast valid 00Z 13 August 1986.

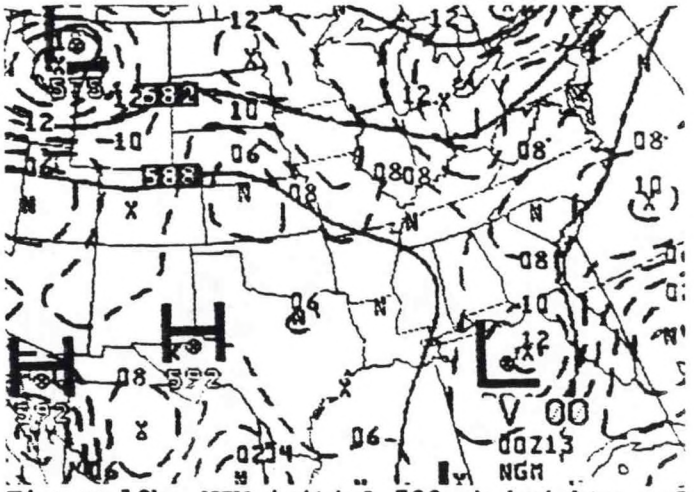

Figure 10b. NGM initial 500 mb heights and vorticity analysis for 00Z 13 August 1986.

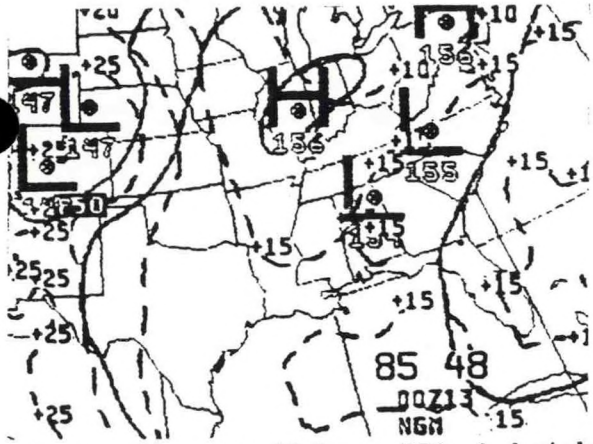

Figure 11a. NGM 48 hour 850 mb heights and temperature forecast for 00Z 13 August 1986.

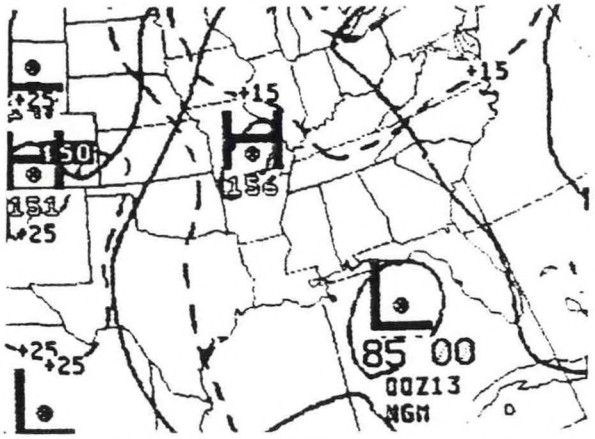

Figure 11b. NGM initial 850 mb heights and temperature analysis for 00Z 13 August 1986.

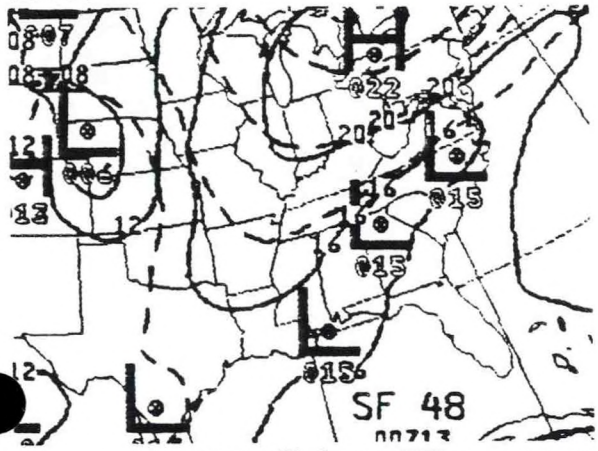

Figure 12a. NGM 48 hour MSL pressure and 1000-500 mb thickness forecast valid 00Z 13 August 1986.

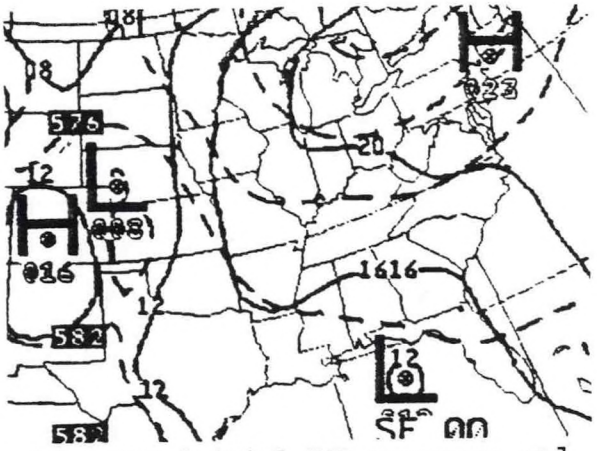

Figure 12b. NGM initial MSL pressure and 1000-500 mb thickness analysis for 00Z 13 August 1986.