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AN INTERESTING CASE OF DIFFERING LFM AND NGM INITIAL ISOTACH ANALYSES

On 12Z 24 November 1986, there was an interesting difference between the NGM and LFM analyses in the upper troposphere. A storm approaching the North American west coast from the central Pacific was evident on the NGM height and vorticity analysis with a vorticity center stamped near 48N/158W (Figure 1). In an attempt to ascertain the quality of the analysis near the storm (vorticity) center, the data available at 250 mb were checked against the NGM 250-mb and LFM 200-mb isotach analyses (Figures 2a, 2b). The LFM 200-mb analysis was used since no analysis is available on AFOS from the LFM at 250 mbs. It is apparent from these figures that the LFM isotach analysis is probably better than that of the NGM, since the LFM more accurately reflects the 170-knot aircraft wind report at 150W than does the NGM. The NGM showed a 130-knot contour at that location. This wind report and associated jet being a representative observation of the approaching storm, it would be logical to assume that the LFM should handle the speed and development of the short wave better than the NGM.

In this case, however, in spite of the more strongly analyzed jet on the LFM, the 24-hour forecasts of the NGM and LFM are quite similar (Figures 3a, 3b - valid 12Z 25 November 1986). Both show this short wave extending NNW to SSE through 50N/130W. The LFM, in fact, is slightly slower with the movement of the main vorticity center than the NGM and does not make up for this slower movement by developing a stronger system.

Comparing the 24-hour forecasts with the verifying NGM analysis valid 12Z 25 November 1986 (Figure 4), it is apparent that both the 24-hour NGM and LFM were too slow with the movement of this short wave. By this time, it had already moved well northeastward from its forecast position to an inland location over western British Columbia. So the NGM analyzed the jet too weakly and was too slow. The LFM looked like it had a better analysis, yet was also too slow. Both models missed another nearby vorticity center near 46N/133W. In fact the two models resemble one another near the northwest coast much more than they resemble the real atmosphere.

Why didn't the LFM handle the timing of this short wave better given its better analysis? Why didn't the NGM analyze the upper level winds better in the first place? And why did the two models produce such similar forecasts from seemingly very different analyses? Certainly, the data were available for the NGM just as they were for the LFM. It is possible but unlikely that the NGM rejected the 170-kt wind report. Physically, what is going on in these model runs - and what can we learn from this situation?

The answer to these questions lies in the fact that we are looking at two distinctly different analysis methods when comparing the NGM and LFM. Furthermore, we are viewing output from them at two very different points in the initialization procedure.

The LFM performs its initial analysis of the data directly on the standard pressure surfaces at which data are collected and displayed. Therefore, the 170-knot wind observation was probably closely analyzed for on the 250-mb chart. It was also well reflected at 200 mbs. These constant pressure analyses are what are delivered to the field. However, before the LFM model sees this data, it is vertically interpolated to sigma coordinates and subjected to an initialization (smoothing) procedure to ensure a good balance between initial mass and motion fields. Strong gradients around jets may be lost in the process, especially since vertical resolution in the LFM is quite coarse. The initialized fields (in sigma) are not seen in the field.

The NGM, on the other hand, has its analysis performed directly in the sigma coordinate system of the model. The NGM has coarse vertical resolution in the vicinity of the jet, comparable to the LFM. The analysis is 3-dimensional, and thus a constant pressure surface wind such as the 250-mb 170-knot wind, will be vertically interpolated, through the analysis procedure, to a nearby sigma surface. The resultant analysis in sigma is then put through an initialization step (smoothed). Finally, it is vertically interpolated to constant pressure surfaces for field display purposes. What the forecasters see doesn't really exist in the model; rather, what they see is a vertically interpolated and smoothed representation of the model initial state.

It should be apparent now that given the same data input into these two model runs, differing analyses will probably be output to the field - especially in areas of strong shear where the LFM analysis will probably fit the data better and the NGM initialized field may be smoothed more.

It should also be apparent that comparing the analyses of the LFM and the NGM to the data is like comparing apples and oranges. We're looking at two distinctly different phases of the initialization process. In this case, the similarity of the 24-hour forecasts suggests that the LFM may have been smoothed as much as the NGM was, except after the horizontal analysis, which was sent to the field. What was possibly a poor LFM jet initialization was transparent to the field. Additionally, the NGM initial state may not have been as bad as it appeared due to the extra vertical interpolation and resultant smoothing done simply for display purposes.

In summary, forecasters need to be aware of the significantly different way in which NGM initial fields are prepared for forecaster display compared to the LFM. Direct detailed comparisons may not be valid.

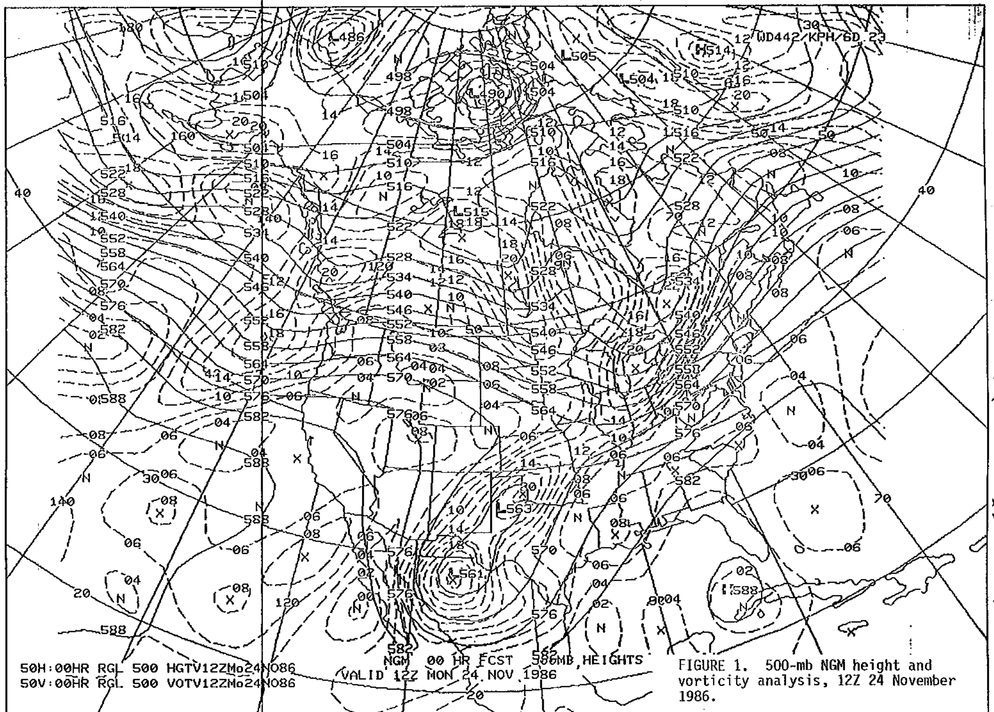

FIGURE 1. 500-mb NGM height and vorticity analysis, 12Z 24 November 1986.

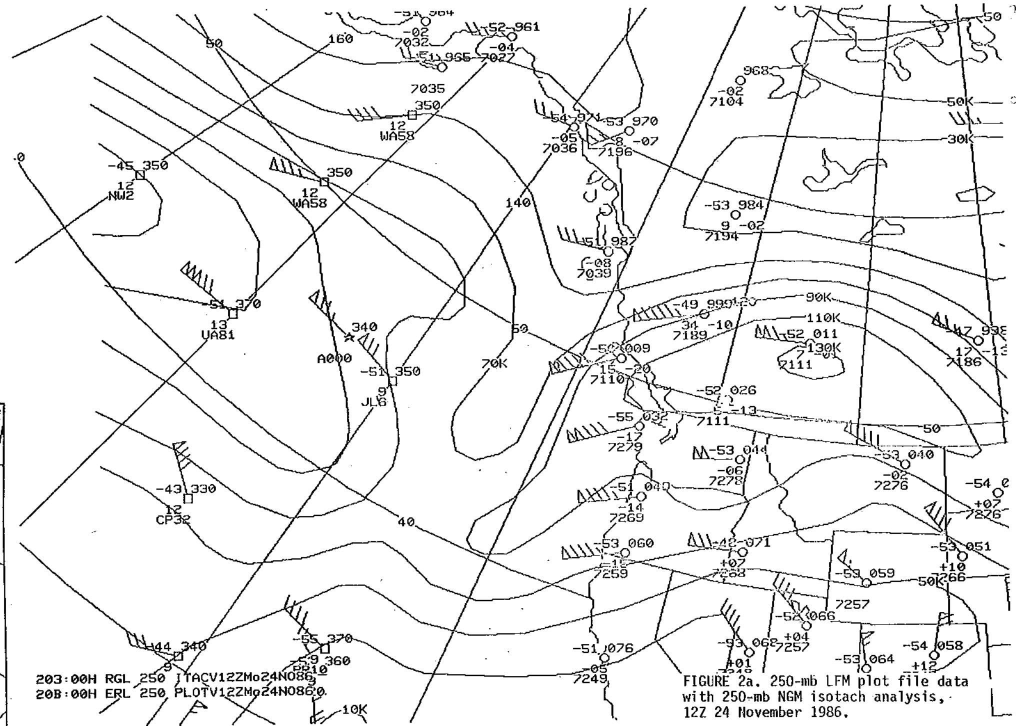

FIGURE 2a. 250-mb LFM plot file data with 250-mb NGM isotach analysis, 12Z 24 November 1986.

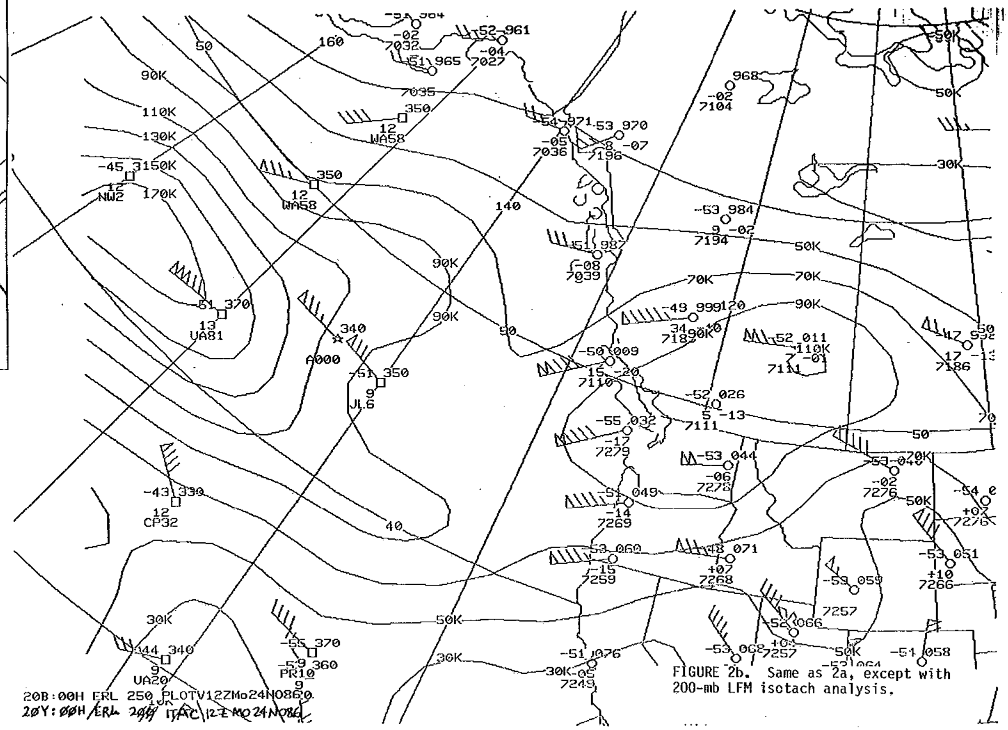

FIGURE 2b. Same as 2a, except with 200-mb LFM isotach analysis.

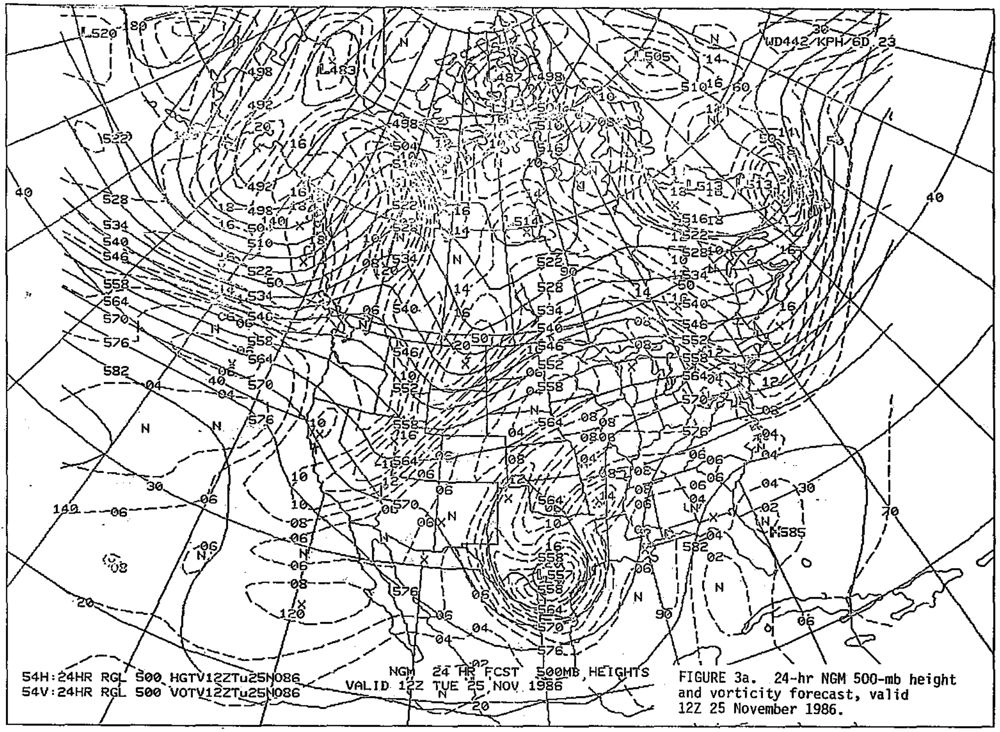

FIGURE 3a. 24-hr NGM 500-mb height and vorticity forecast, valid 12Z 25 November 1986.

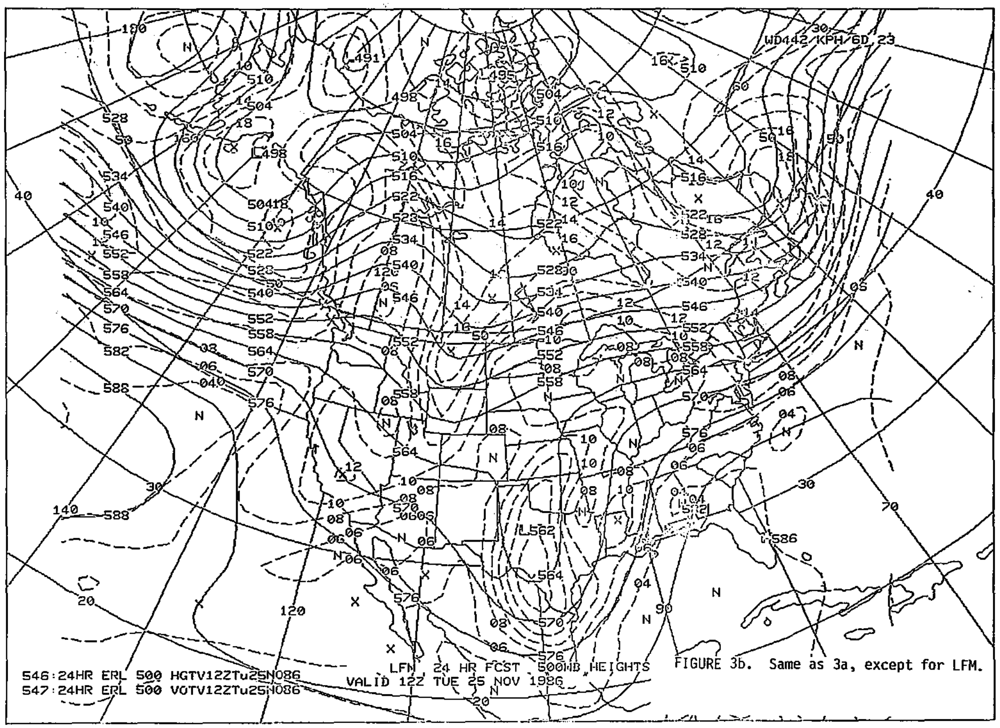

FIGURE 3b. Same as 3a, except for LFM.

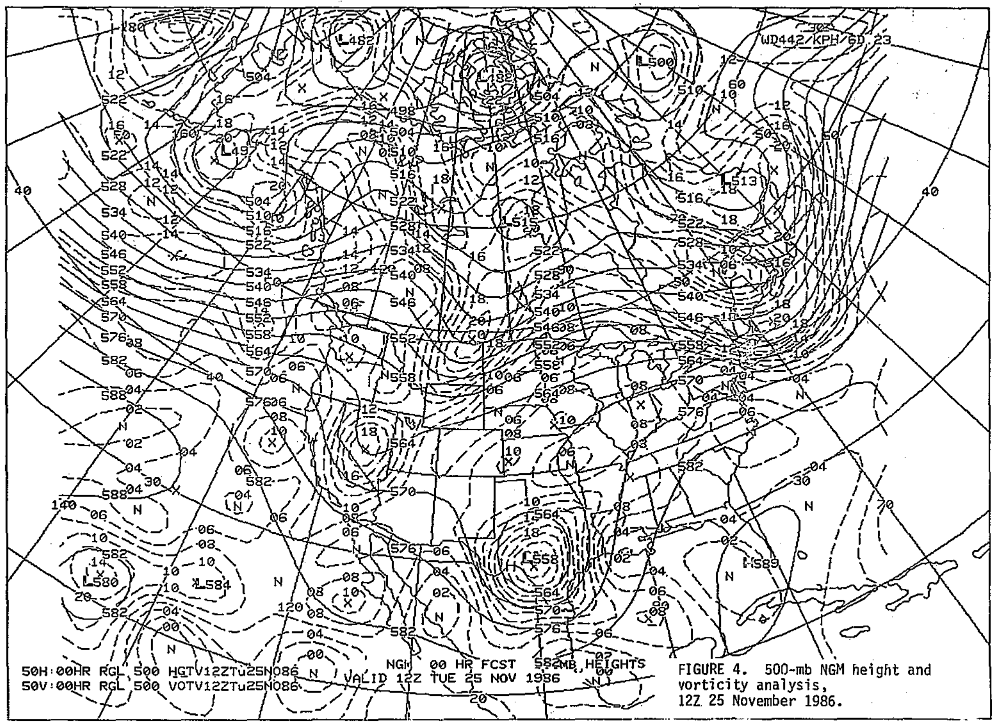

FIGURE 4. 500-mb NGM height and vorticity analysis, 12Z 25 November 1986.