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A CASE OF MID-LEVEL VORTICITY CONTRIBUTION TO TORNADIC DEVELOPMENT

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On the evening of March 14, 1987 between 1655 and 1715 CST, two tornadoes touched down in south-central Nebraska. The first F1 tornado at 1655 CST occurred three miles north of Red Cloud, Nebraska, south of Grand Island; damage was minor. The second F1 tornado occurred at Nelson, Nebraska southeast of Grand Island. Three houses were damaged in the town of Nelson. See Fig. 1 for the exact locations of these towns.

These tornadoes occurred back in the cold air northwest quadrant of a strong surface low (see Fig. 2). The 00Z March 15, 500 mb analysis showed a closed low in south-central Nebraska. An intense vorticity maximum was just south of the closed low (see Fig. 3). The 700 mb analysis also indicated a low in south-central Nebraska. Thus, there was an abundance of mid-level vorticity in the mid-levels. In addition, PVA in the area was also strong.

Showalter stability indices ranged from a +1 at Omaha to -1 at Topeka at 00Z March 15th. Cloud tops, as seen from the satellite pictures (Figs. 4a and b), were in the light gray shade of the mb curve, indicating fairly warm, low cell tops (-41 to -52°C). Grand Island radar showed cell tops of only 25 to 30 thousand feet. Though the tops of the thunderstorms were low, the most intense cells became VIP-5 levels.

The mid-level circulation is evident from the satellite imagery at 2300Z and 2330Z. The tornadoes developed in association with the comma-shaped band of colder cloud tops that was bowing northward, as the individual convective cells in south-central Nebraska moved northwest. It is interesting to note that in this unusual case the strong mid-level vorticity was probably one of the most significant contributors to the formation of these tornadoes back in the cold air. The moisture channel image was especially impressive, showing the lobe of vorticity maximum rotating across the region and giving the appearance of what could be called a satellite "hook" signature.

Conclusion

Using satellite pictures in conjunction with radar is important in evaluating the severe potential of thunderstorms in this case, and should be applicable in similar cases. Noting the "hook" shape in the convective tops in the zone of strong mid-level vorticity, and taking into account that the strong convection

from radar is occurring in the vicinity of the "hook", should alert the forecaster to the possibility of tornado development. This should often be a concern even if the thunderstorm tops are relatively low, as often is the case in the Central Plains in March, and in spite of the fact that stability indices indicate only moderate instability.

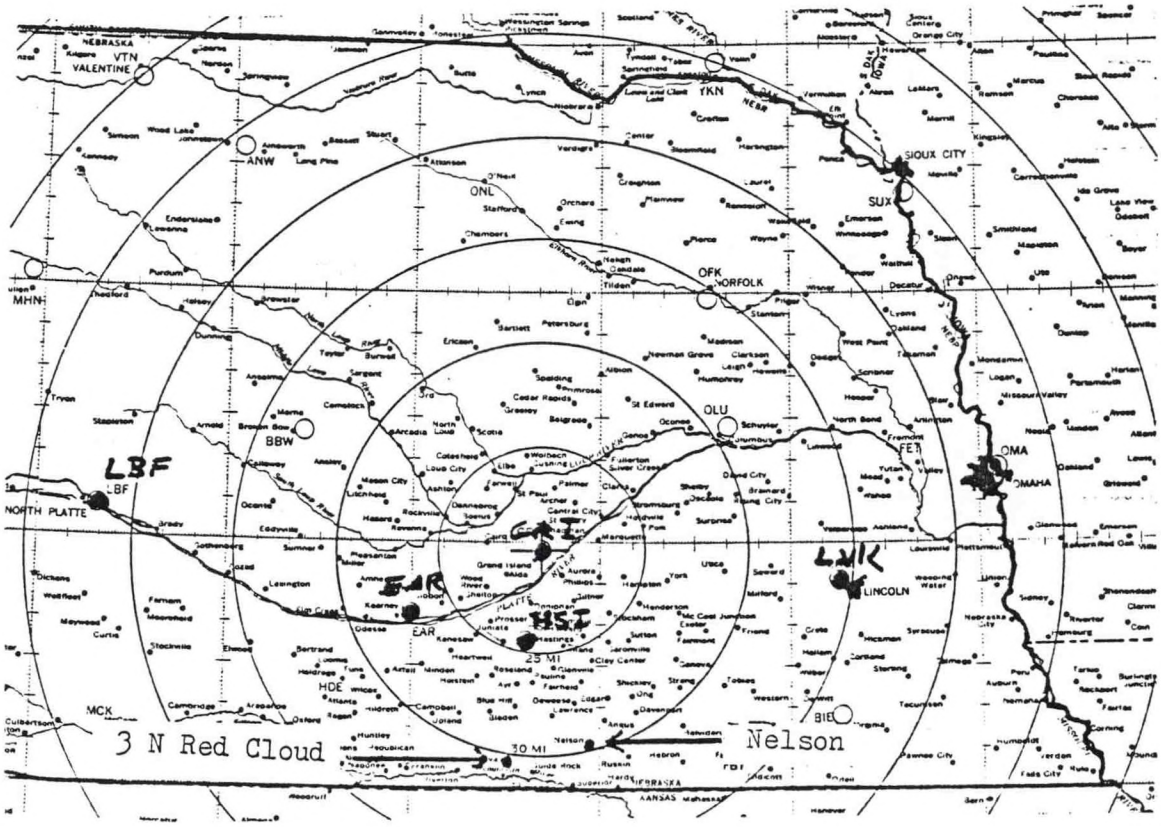

Fig. 1. Locations of small towns where tornadoes occurred in south-central Nebraska.

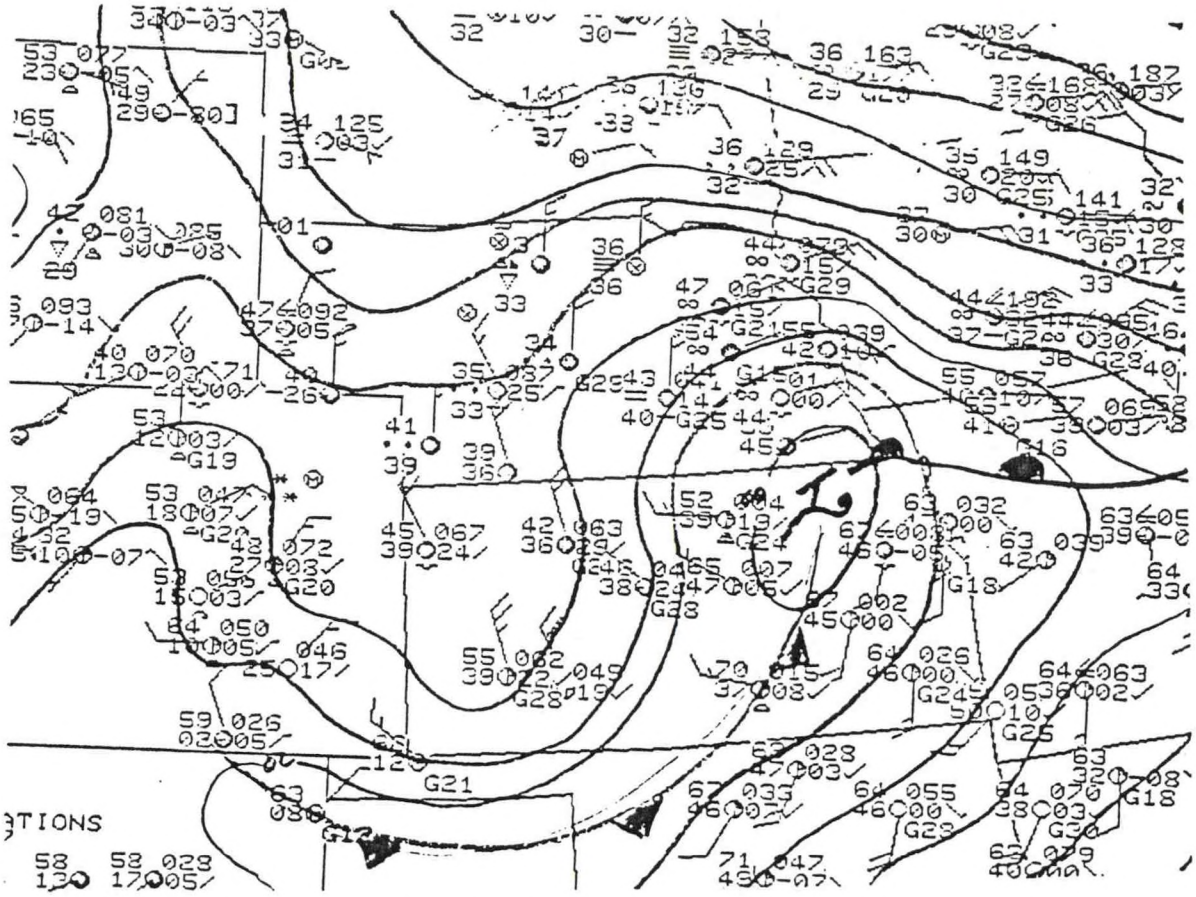

Fig. 2. Surface analysis at 00Z March 15, 1987.

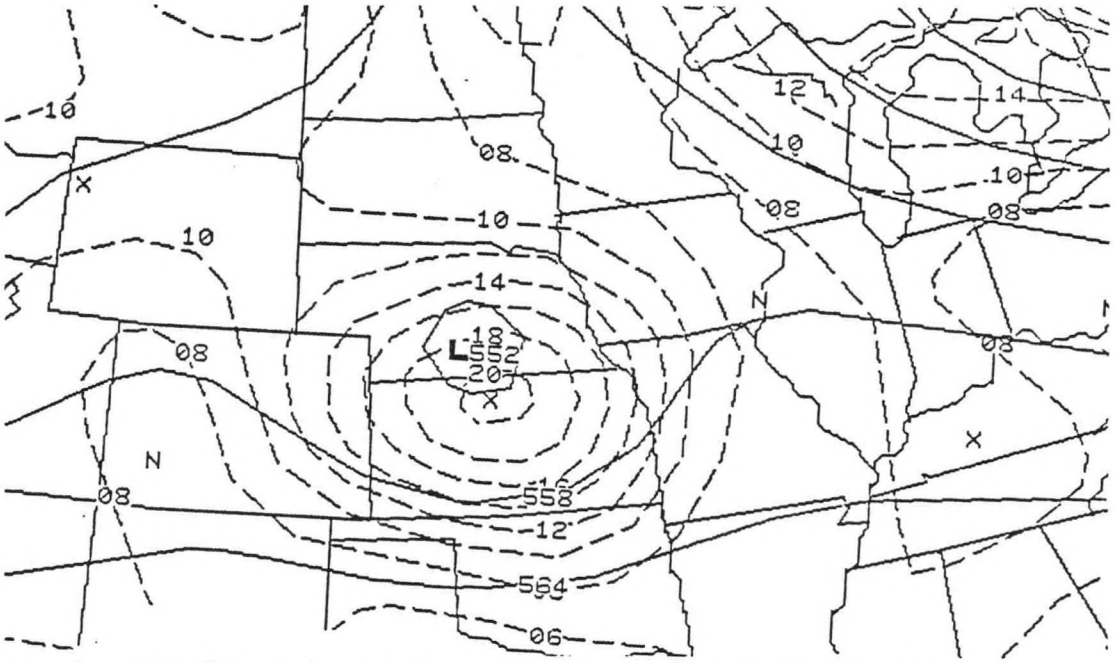

Fig. 3. NGM 500 mb/vorticity analysis at 00Z March 15, 1987.

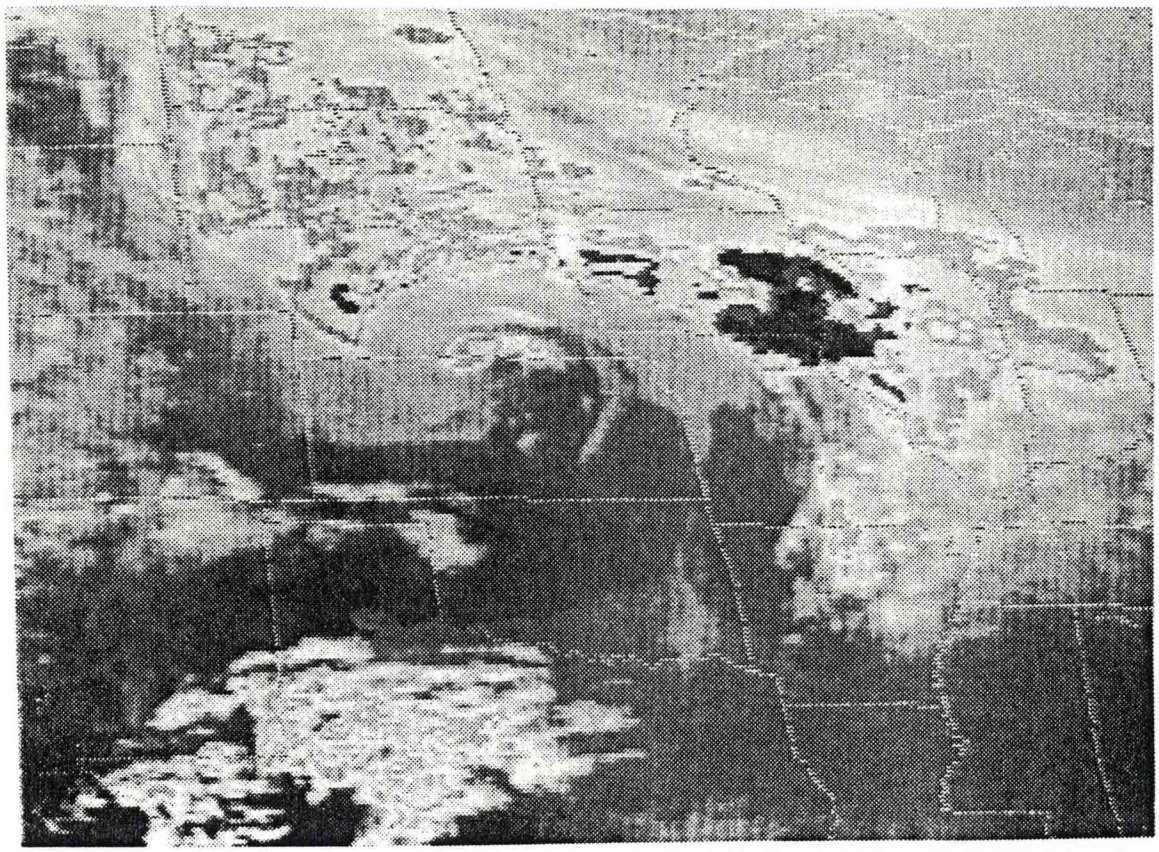

Fig. 4a. Satellite picture at 2300Z March 14, 1987.

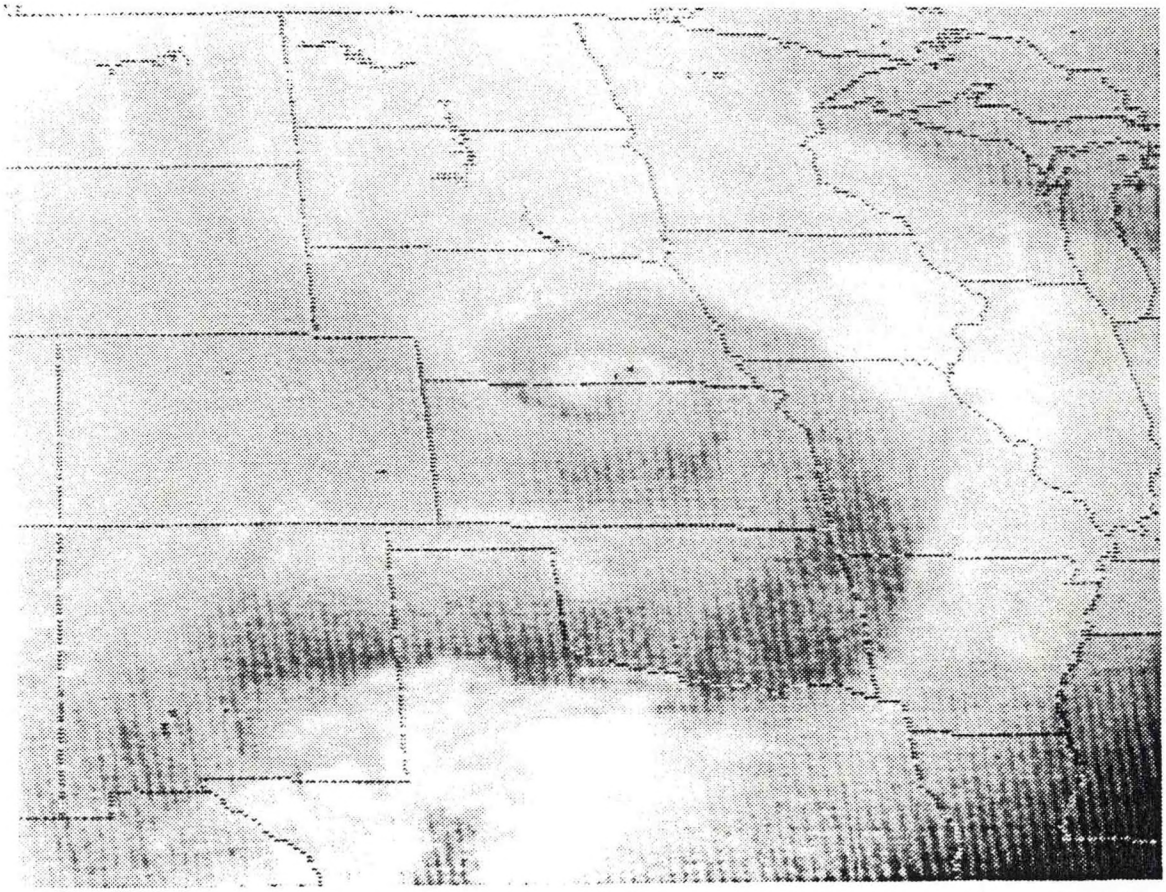

Fig. 4b. Moisture channel picture at 2330Z. Two dots are the approximate locations of the tornado touchdowns that occurred at 2255Z and 2315Z.