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# A CASE STUDY OF LFM GUIDANCE FOR AN INTENSE WINTER STORM IN THE NORTHEASTERN UNITED STATES

The following is a summary of the performance of LFM guidance relating to an intense winter storm that rapidly deepened and affected the northeastern United States on 16-17 March 1976. With this storm, heavy snowfall occurred in much of the area from northwestern Pennsylvania (around 6"), across central New York (6-14"), and into central and northern New England (greater than 10"). Forecasters now depend heavily on numerical guidance relating to this type of storm.

On Monday morning, 15 March, the 12Z surface analysis showed only weak indications that a major weather system could soon affect the eastern half of the United States. A wave was present over the Gulf Coast (Figure 1). Without computer guidance, it would have been difficult for a forecaster to confidently predict that a major storm would affect the northeast United States in the next 24 to 36 hours. But the 36-hour LFM prog, available from 12 hours earlier data (00Z March 15), was already predicting a well developed low in the western Carolinas at 12Z Tuesday morning (Figure 2), with precipitation extending into central Pennsylvania. Thus, on Monday morning, many forecast offices predicted the likelihood of snow in the northeast beginning on Tuesday. For example, the forecast issued by WSFO NYC at 1600Z Monday morning, read as follows for NYC:

> NATIONAL WEATHER SERVICE FORECAST OFFICE NEW YORK CITY
>
> 11AM FORECASTS MONDAY MARCH 15 1976
>
> NEW YORK CITY UPDATED
> CONSIDERABLE SUNSHINE BUT BREEZY THIS AFTERNOON WITH HIGH REACHING THE LOW 50S. CLEAR THIS EVENING THEN INCREASING CLOUDINESS LATER TONIGHT WITH SNOW LIKELY TUESDAY. LOW NEAR 30 AND HIGH IN MID TO UPPER 30S.
>
> PRECIPITATION PROBABILITY 10 PCT THIS AFTERNOON INCREASING TO 20 PCT TONIGHT AND 70 PCT TUESDAY.

The LFM, however, was not perfect. The primary surface low, which the 36-hour predicted to be over North Carolina (Figure 2), was located about 200 miles farther north (Figure 3). This probably led to the inaccurate forecasts of heavy snow that were issued by WSFOs for the West Virginia panhandle and western Maryland areas. The more northerly location of the storm center resulted in precipitation falling mostly as rain in these areas.

For verifying times after 12Z March 16, the LFM surface progs did a much better job in predicting the movement and intensity of the low. Verification data for LFM 12-, 24-, and 36-hour surface progs are presented in Table 1. The LFM 36-hour surface prog, valid 12Z March 17 (Figure 4), did a remarkable job in predicting the location and extreme deepening of the storm center. Compare this prog with the 12Z March 17 surface analysis (Figure 5).

Table 1. Error In LFM Predicted Surface Location and Pressure of Storm Center

| Verifying Time | 36-Hr Forecast Error Position | Pressure | 24-Hr Forecast Error Position | Pressure | 12-Hr Forecast Error Position | Pressure |
|---|---|---|---|---|---|---|
| 16/12Z | 3.2° Lat. | +3 mb | 6.8° Lat. | +4 mb | 0.2° Lat. | +3 mb |
| 17/00Z | 1.0° | +2 mb | 0.8° | 0 mb | 0.6° | -5 mb |
| 17/12Z | 1.2° | +6 mb | 0.4° | -1 mb | 0.4° | -2 mb |

The 36-hour LFM progs did not deepen the surface system enough and the 12-hour LFM progs tended to over-intensify the system.

At the 850 mb level, the LFM 12- and 24-hour progs tended to move the low between 1 and 3 degrees north of the actual track and also tended to over-intensify the system. A technique developed by Traveler's Research Corporation (Spiegler, 1970) uses the intensity and direction of movement of the 850 mb low to forecast snowfall distribution. For the period of heaviest snow, from 18Z March 16 to 18Z March 17, the band of heaviest snow occurred about 2 degrees south of the predicted band of heaviest snowfall using the LFM forecast 850 mb positions and the Traveler's Technique (Figure 6). Using the observed 850 mb low positions, the Traveler's Technique did an excellent job in locating the heavy snow. Thus, the LFM 850 mb progs would have alerted us to heavy snow, using the Traveler's Technique, but would have placed the heaviest snow too far north.

In conclusion, the LFM progs did an excellent job in assisting forecasters to predict the development of an intense winter storm in the northeast. There were errors, however, that led to a poor heavy snow forecast for some areas.

For an additional reference on the performance of LFM 36-hour prognoses of East Coast Lows, the reader is referred to a study by Brown (1975).

REFERENCES

Brown, H. E., "Comparison of the Position and Central Pressure Errors of East Coast Lows on 36-hour PE and LFM Prognoses," NMC Technical Attachment, No. 75-4, July-August 1975.

Spiegler, David B., "Prediction of Snowfall Distribution About 850 mb Cyclones Along the Atlantic Seaboard, "Traveler's Research Corporation Final Report, Contract No. E-269-68(N), Hartford, Conn., January 1970, pp. 70.

SCIENTIFIC SERVICES DIVISION, ERH
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Attachments: Figures 1-6

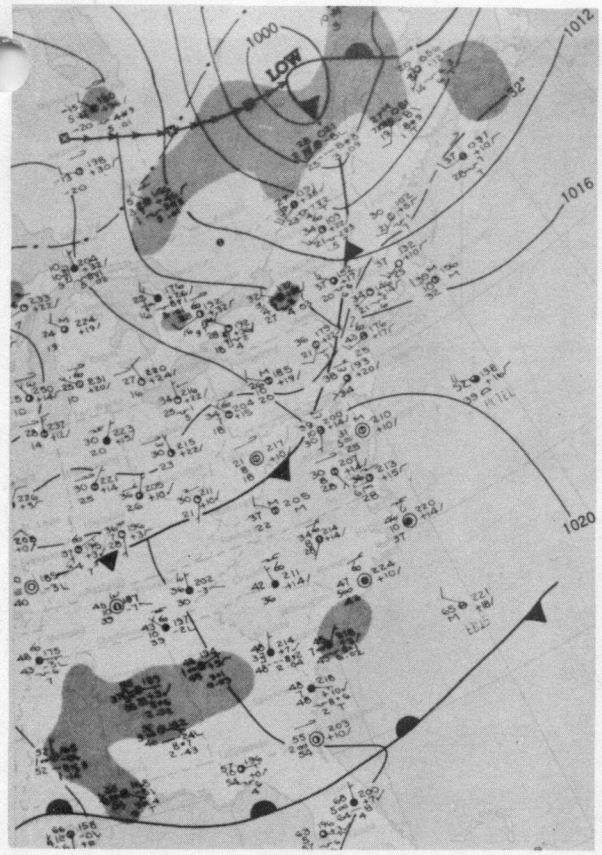


Figure 1. Surface Weather map
1200Z March 15, 1976

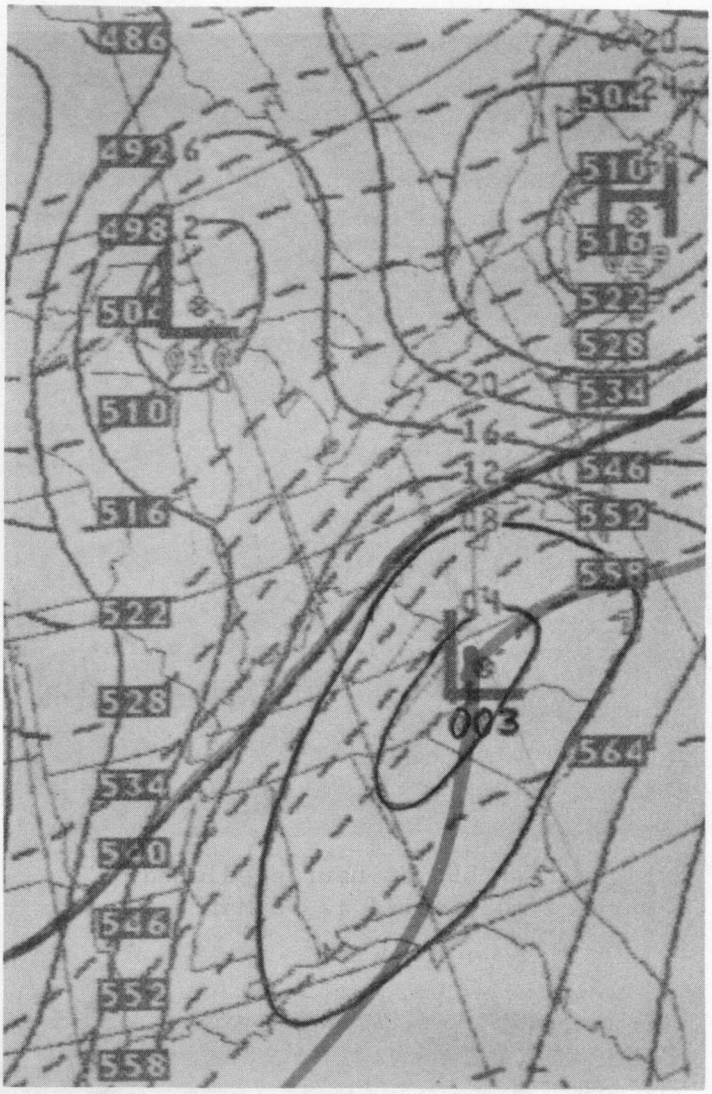


Figure 2. LFM 36-hour predicted surface map, valid 1200Z March 16, 1976

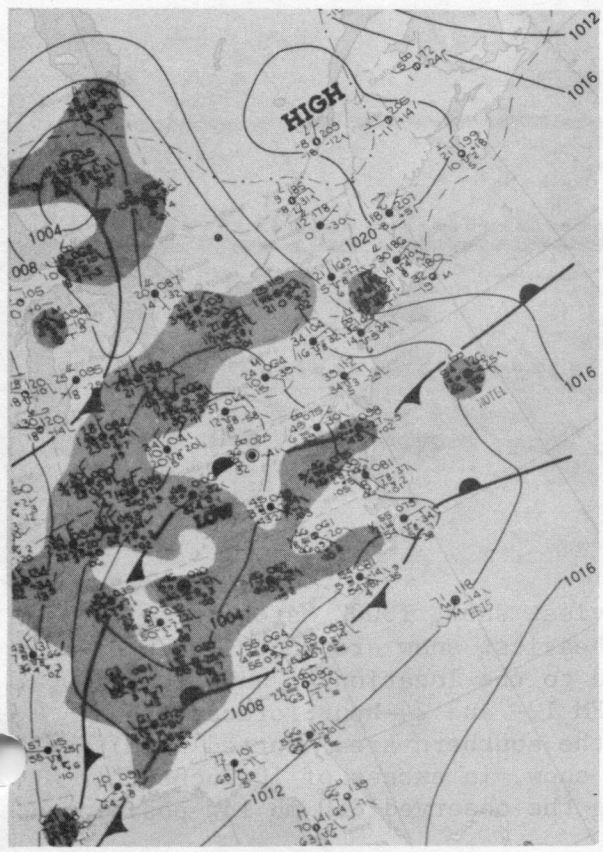


Figure 3. Surface Weather map
1200Z March 16, 1976

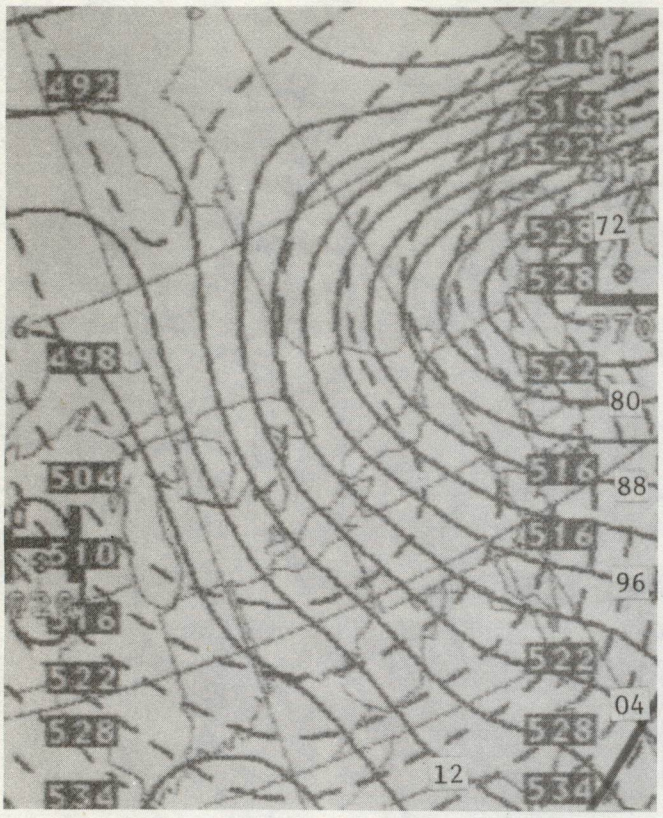


Figure 4. LFM 36-hour predicted surface map, valid 1200Z March 17

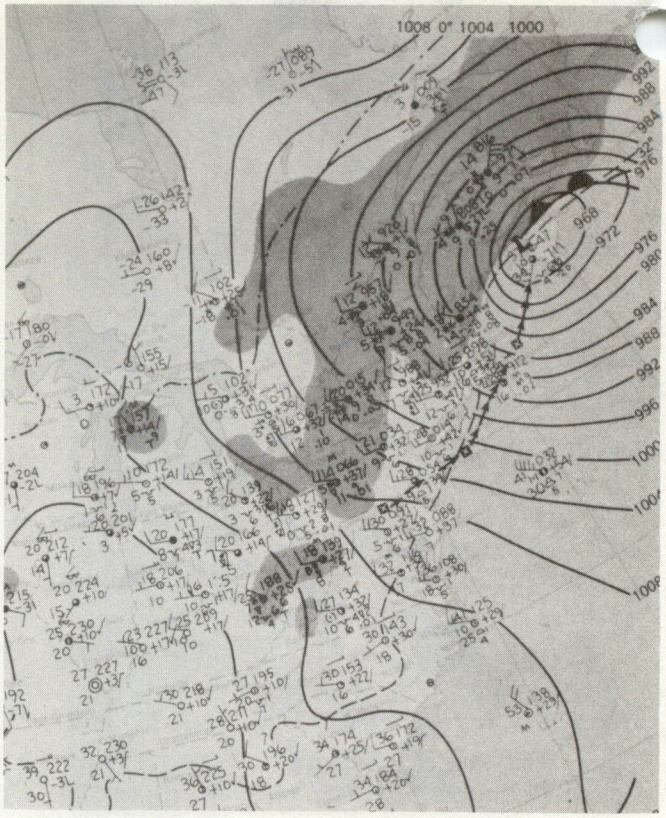


Figure 5. Surface Weather map 1200Z March 17

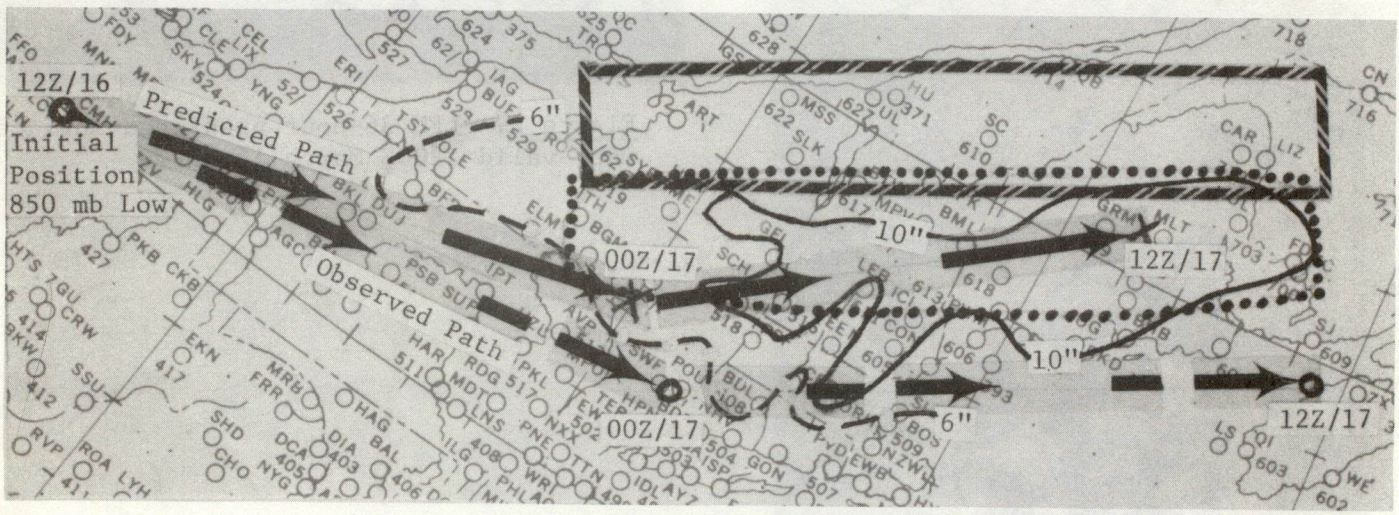


Figure 6. Predicted and observed areas of heaviest snow, 1800Z March 16 to 1800Z March 17. Two rectangular areas of predicted heaviest snow are shown, each determined using the Traveler's Technique applied to the location of an 850 mb low. The northern area (hatched line) is based on LFM 12- and 24-hour forecast low positions (from 1200Z March 16 initial data), the southern area (dotted line) is based on observed low positions. The heaviest snow, in excess of 10 inches, occurred mostly within the area predicted using the observed 850 mb low positions.