NWS-CR-TA-90-4

(DISTRIBUTION:)

CRH SSD
JANUARY 1990

CENTRAL REGION TECHNICAL ATTACHMENT 90-4

OPERATIONAL UTILITY OF THE 120 HOUR MRF PROG

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1. Introduction

The primary guidance used by the forecaster at a typical National Weather Service Forecast Office to prepare the Extended (3-5 day) Forecast is the NMC Medium Range Forecast (MRF) model. The model output is available to the forecaster from 0-132 hours once per day from the 00Z forecast cycle. On a global or hemispheric scale, models like the MRF have shown tremendous improvement in skill over the last five to ten years. However, the extended forecast product is limited in scale to the size of a state. What is the skill of the MRF on this scale? How useful is the MRF in making the 3-5 day forecast?

A project was undertaken starting in the spring of 1988 to verify the 120-hr 500 mb prog from the MRF. This prog was chosen as it verifies in the middle of the 3-5 day forecast period. The progs were selected on a random basis with usually one or two progs being verified each week. The verification scheme was a subjective evaluation of whether or not the prog provided meteorologically useful guidance to the Bismarck forecaster. This included criteria such as timing of systems, proper orientation of the flow and location of the main belt of westerlies. The verification area was limited to the area surrounding North Dakota. The project was expanded to include the 120-hr surface prog in October 1988.

The forecasters in our office clearly realize that one cannot use a 120-hr prog in the same way as a 12 or 24-hr prog. The level of skill and detail between the two are vastly different. However, because output from the model has day-by-day resolution and because of the desire of the forecaster to provide the most useful product to the public, the forecaster is severely tempted to include resolution in the forecast that may be beyond the skill level of the model.

2. Climatology

North Dakota is near the main belt of westerlies during the entire year so that migratory synoptic scale systems are frequent even during the summer months. Also, North Dakota is far removed from oceanic moisture sources. A mean flow at 500 mb from the west or northwest is generally dry after crossing the Rocky Mountains. A prolonged southerly component is needed to allow moisture from the Gulf of Mexico to work toward North Dakota. Closed lows at 500

mb are the major precipitation producers for North Dakota. Westerly or southerly flow is usually mild while northerly flow usually brings below normal temperatures. Because of this, the orientation and location of the main belt of westerlies as well as the handling of closed lows were closely scrutinized in this study.

3. Summary of Results

During the warm season (April-mid October 1988), thirty-six 500 mb progs were evaluated. Of this group, exactly 1/2 were rated as being meteorologically useful. These progs averaged about a 50 meter height error (measured at Bismarck) with a 30 meter negative bias. The poorer subset of progs showed about an 80 meter height error and the same 30 meter negative bias. A simple comparison of these two statistics tells little about the relative worth of the progs.

Of the 18 poorer progs, seven were due to orientation or location of the main belt of westerlies. An example is shown in Figure 1. Another common error (six cases) was in handling closed lows (Figure 2). A less common but repeatable error was the too slow movement of medium scale synoptic waves embedded in the westerlies. On the other side of the coin, Figure 3 shows an exceptionally good forecast of a closed low.

The overall performance during the 88-89 cool season was slightly better with 20 of 35 500 mb progs providing good meteorological guidance. The average height error of these 20 progs was about 50 meters with about a 25 meter negative bias. The subset of 15 poorer progs had an average height error of 45 meters with no substantial bias.

Of the 15 poorer progs, seven involved poor orientation or location of the main belt of westerlies. Another six were associated with the handling of closed low circulations. This is very similar to the warm season results. A difficult forecast problem in the winter is associated with strong northerly flow. If the main belt of westerlies is over or west of North Dakota, a bitter Arctic blast will occur. However, if the westerlies are just to the east only a glancing blow is received. The MRF resolved this correctly in most cases.

Evaluation of the surface progs during the cool season showed an average error of only about 6 mbs. Not surprisingly, the quality of the 500 mb pattern was a good indicator of the quality of the surface prog. Unfortunately, this is not a hard and fast rule. Figure 4 shows an example of a quite excellent 500 mb prog with a very poor surface prog. On a few occasions the reverse was also true.

4. Conclusions

The 120-hr MRF prog provided useful meteorological guidance to the forecaster at Bismarck better than half of the time. No significant height or pressure biases were found in the study. The surface progs were equally as good as 500 mb in providing useful guidance. The study indicated that sub-

stantial errors in location and intensity are likely with closed low systems at 500 mb. It also showed that the MRF is at times a day too slow in moving medium scale synoptic waves through North Dakota.

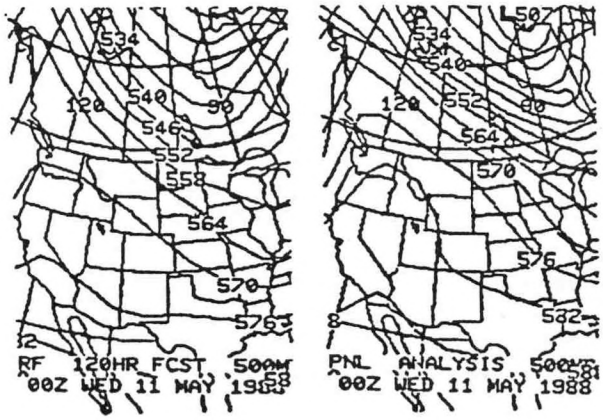

Figure 1. 120 hour MRF prog (left) and verifying analysis (right) for 00Z May 11, 1988.

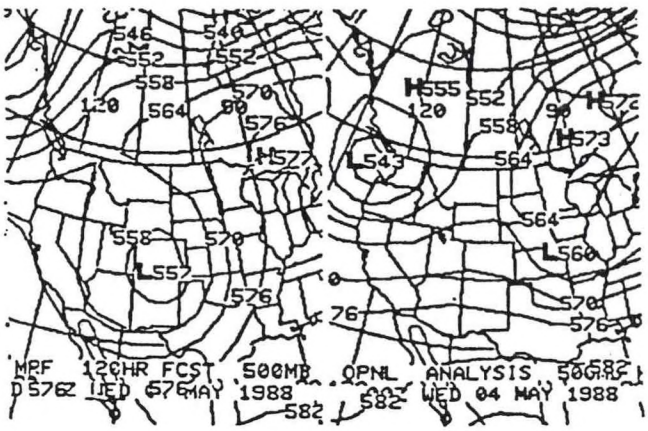

Figure 2. 120 hour MRF prog (left) and verifying analysis (right) for 00Z May 4, 1988.

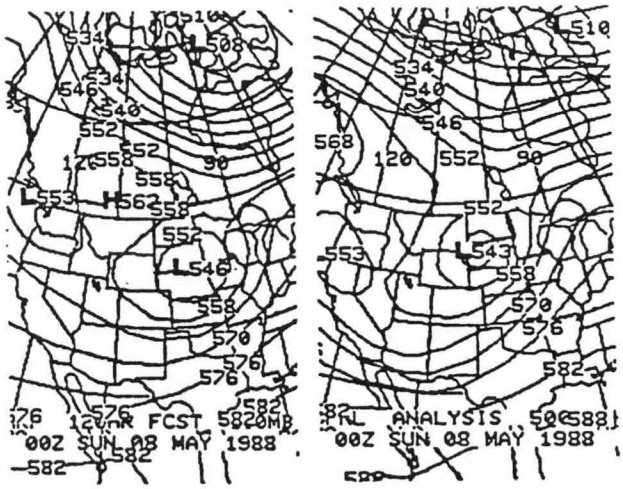

Figure 3. 120 hour MRF prog (left) and verifying analysis (right) for 00Z May 8, 1988.

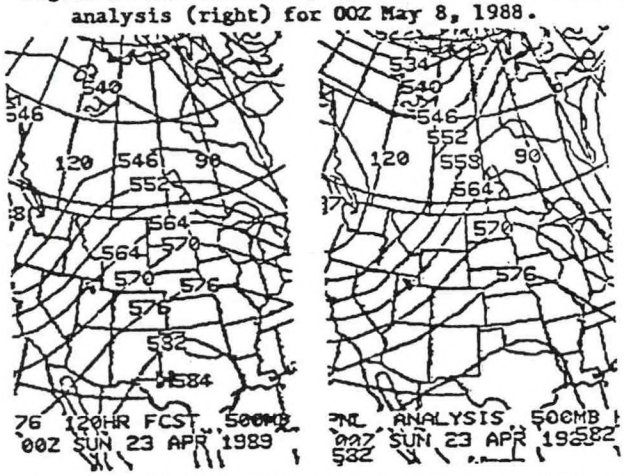

Figure 4. 120 hour MRF prog (left) and verifying analysis (right) for 00Z April 23, 1989.