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**REVIEW OF THE NMC NUMERICAL GUIDANCE SUITE IN
1987
AND A PREVIEW OF CHANGES IN 1988
PART V**

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6. Performance Assessment of the MRFS during 1987: Frank Hughes

The following are some general qualitative comments on the MRFS, some of which are illustrated by Figures E-1 and E-2. First, with respect to the sea level pressure predictions:

- o In general, they are much better than in previous years, and are now used as much as ECMWF prognoses.
- o It is fairly common to see excessive deepening of cyclones in the northeastern Pacific, such as that predicted near Vancouver in Figure E-1. In the real atmosphere, the low is 20mb less deep (Figure E-2).
- o In the past, the MRFS exhibited a strong tendency to develop spurious tropical lows. This is now much reduced.
- o Highs in the western states are much more realistic in the current version.
- o The heat trough in the southwestern states in the warm season is handled much better.
- o Arctic highs are still underforecast in intensity, especially in central and western Canada.
- o The arctic front is frequently not well delineated in the pressure field.
- o In cold outbreaks, the plunge of arctic air southward through the plains remains too slow.
- o Inverted troughs off the East coast are usually under forecast; this affects the type, onset, and intensity of precipitation.
- o The MRFS appears to be quite good with the speed and depth of lows over the open ocean, regardless of flow. Near land, however, they are frequently too deep.

- In cases where weak lows move across the southern states, the MRFS tends to be too far south (too "suppressive" in local jargon) and too weak.
- On the other hand, lows moving across the northwest of the lower 48 states and southern Canada tend to be too far north and too deep.
- The MRFS still has difficulty with Nevada cyclogenesis and the normal track eastward through the Rockies; but the right indications are often present.
- The MRFS sea level prediction rarely displays an unreasonable relationship to the 500mb level.
- Alberta Clipper cyclones are not moved fast enough by the MRFS, nor are their prediction of intensity or warm advection sufficiently strong. This is true especially if the systems are approaching a long wave trough in the vicinity of the east coast.
- Lows moving into western Canada are frequently too far north on Day 5; subsequent runs usually correct part of this error.
- There are an excessive number of cyclogenesis events forecast along the east coast by Day 7. In the past winter these were common at Day 5. An example of this is included as Figure E-3.

Verification scores are not available at the time this is written. However, it is likely Days 3, 4, and 5 MRFS sea level forecasts, and MOD forecasters' interpretations, will be record highs for 1987. Occasionally, we have noted a Day 5 or even Day 6 forecast better than Days 1 or 2. Thus, we are much encouraged by improvements in the MRFS sea level pressure forecasts, even though there is still much room for further improvements.

Now, some comments about thickness predictions.

- The current MRFS thickness forecasts are usually helpful in locating polar and arctic fronts.
- The forecasts exhibit a tendency toward cold advection in the central and eastern lower 48 states by Day 7, along with the excessive cyclogenesis noted earlier (note Figure E-3).
- One result of this is that the distinction between the polar and arctic fronts is blurred with time.

On the whole, the thickness predictions are helpful in making objective temperature guidance.

With respect to relative humidity predictions;

- o The RH is often excessive south of the storm track, in up-slope regions of the Rockies, and in the warm season more than the cold. Note, for example, the strong northerly flow aloft and at the surface over Montana in Figures E-4 and E-5; still the relative humidity prediction is greater than 90% over much of Montana (Figure E-6), and almost an inch of precipitation is forecast there (Figure E-7).
- o The RH sometimes lags the associated vorticity maximum, especially in the southern U.S.
- o RH predictions are of some, but only limited, help in locating fronts, and forecasting precipitation and temperatures.

We are somewhat disappointed in the MRFS RH forecasts, but they have improved over the MRF86.

MRFS precipitation forecasts are still excessive in their precipitation forecast amount, which improves the skill of the MRFS forecasts. We have observed fewer precipitation "bombs"--grossly excessive amounts at a very few points--in the current MRFS than in past years. In sum, the MRFS precipitation guidance has improved, and this has contributed to a record year for MOD forecasters at Days 3, 4, and 5.

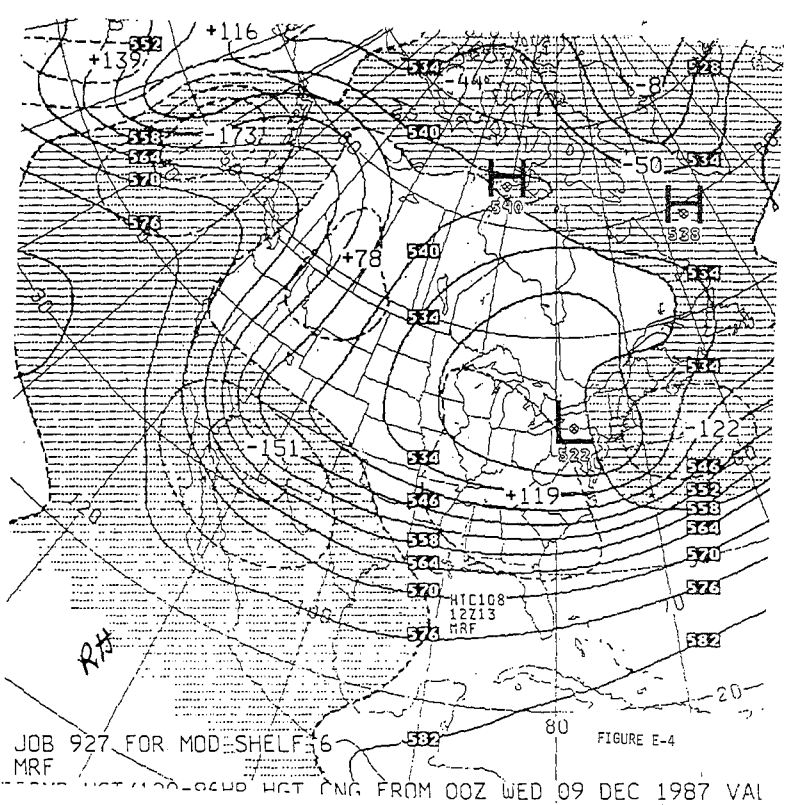
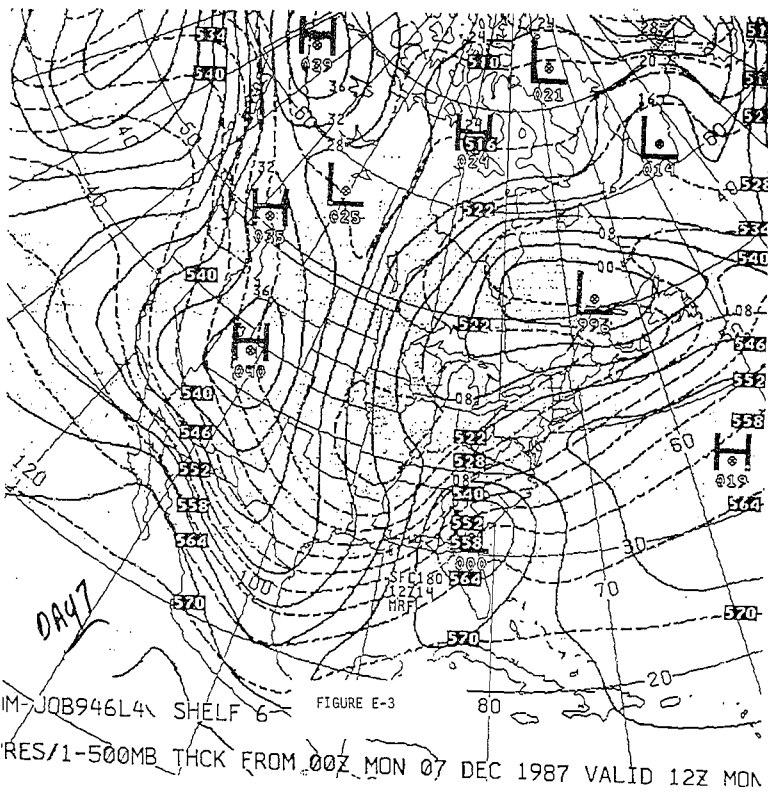
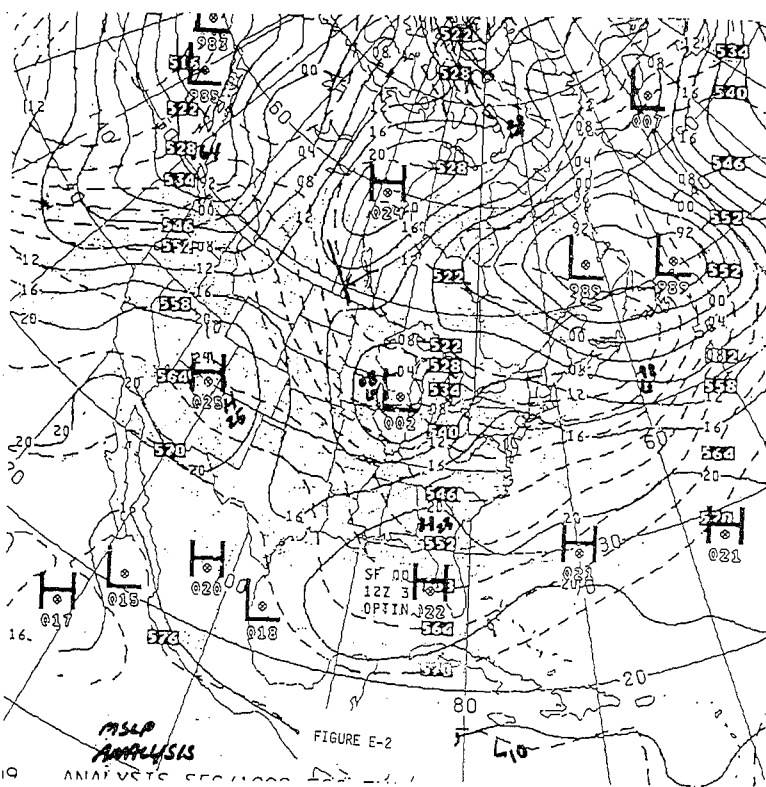
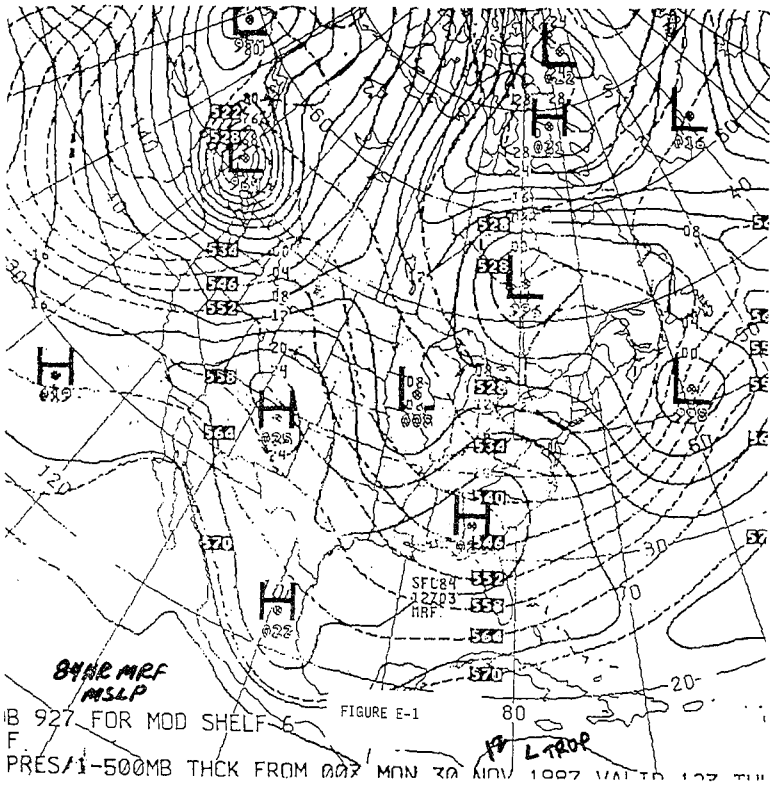
Finally, some comments on MRFS predictions at the 500mb level.

- o Predicted heights tend to be too low, especially in subtropical ridges.
- o Occasionally the MRFS fails to delineate split flow regimes with separate northern and southern streams. The northern stream tends to be too strong, and the southern too weak.
- o The MRFS likes to phase short waves in the northern and southern streams in cases where they actually remain separate. This results in an erroneous full-latitude trough, especially in the eastern U.S.
- o MRFS patterns lose amplitude with time, with the westerlies sinking southward. It is too early to tell to what extent the introduction of gravity wave drag (Section 3) has corrected ~~this problem.~~

- o Last winter, the MRFS had trouble correctly taking lows near the pole into southeastern Canada. We cannot tell yet if MRF87 will do likewise.

- o The MRFS is somewhat better now at representing the amplitude of short wave troughs than in the past.
- o The MRFS exhibits more continuity from day to day out to 5 days than in the past.
- o Often more change is forecast from the first five days (D+3) to the second five (D+8) than actually occurs. One last short wave, not forecast by the MRFS, usually holds the mean pattern in place longer than is forecast.
- o The MRFS has a strong tendency to forecast a trough in the eastern U.S. This can be a serious problem in the summer in the second (D+8) period.
- o The MRFS exhibits poor skill in a strongly retrogressive mean flow pattern south of 55N.

Overall, we find the current MRFS much improved, and it is likely the 500mb forecasts will be record highs for 1987. It is usually more useful than the ECMWF model beyond five days, since the T80 was introduced, and also because of the changes that warmed the ECMWF too much. We usually use the MRFS in cold and the ECMWF in warm advection patterns.



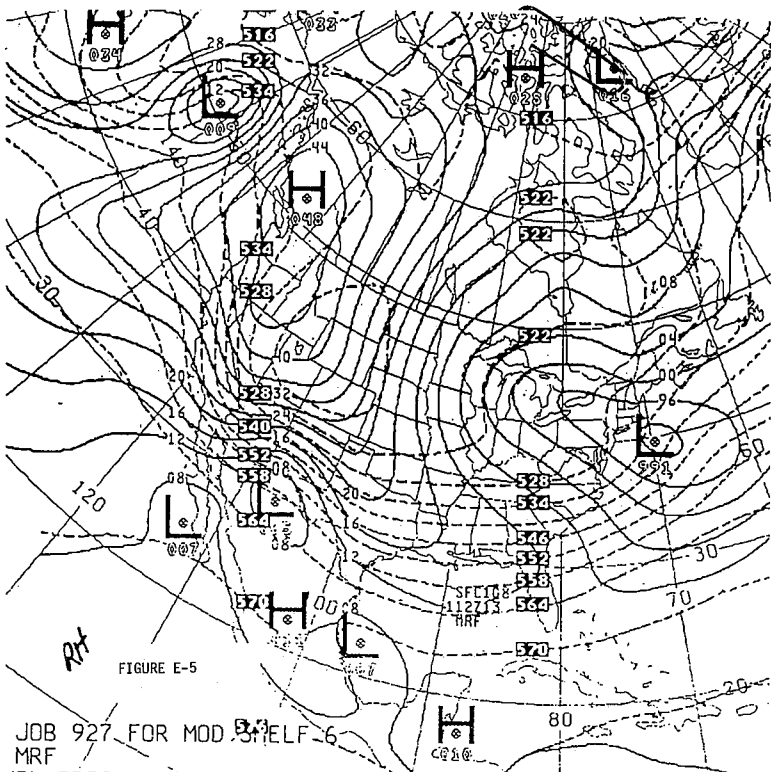


FIGURE E-5

JOB 927 FOR MOD SHELF 6
MRF

1 PRECIP ENDING 120HRS FROM 00Z WED 09 DEC 1987 VAL TO 12

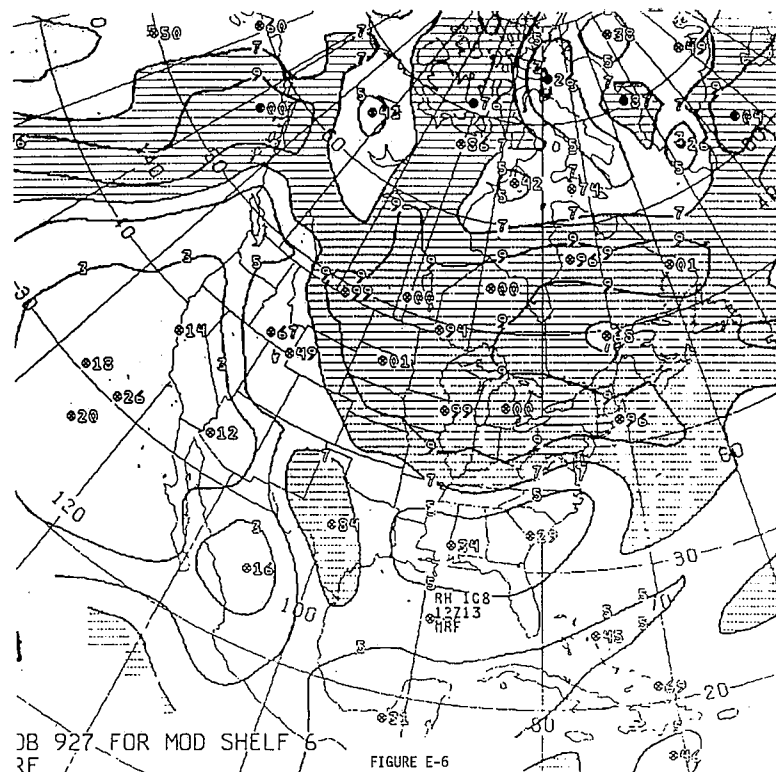


FIGURE E-6

JOB 927 FOR MOD SHELF 6
RF

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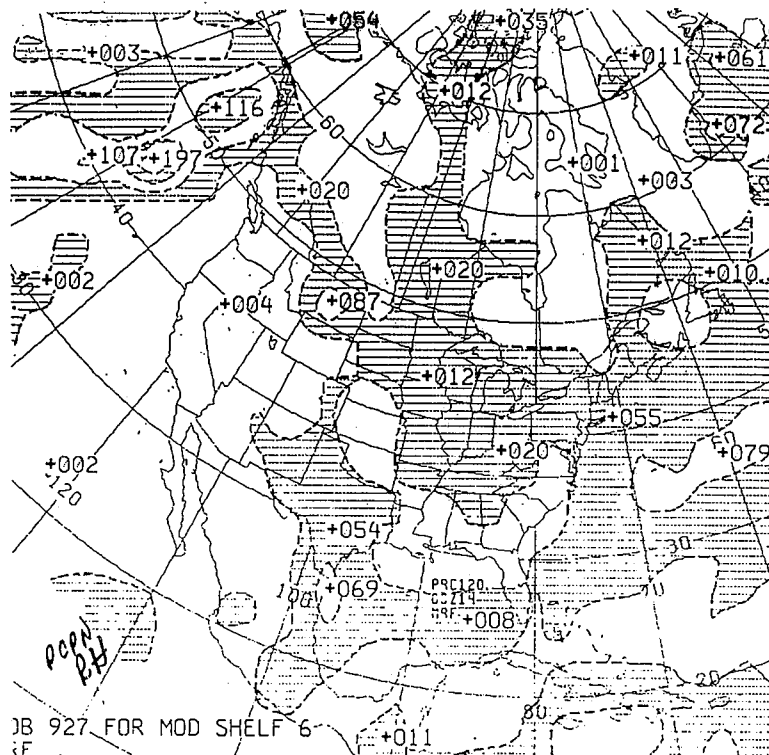


FIGURE E-7

JOB 927 FOR MOD SHELF 6
RF

1 PRECIP ENDING 120HRS FROM 00Z WED 09 DEC 1987 VAL TO 00Z