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RAFS INITIAL ANALYSIS PROBLEM

The following paper is from the October 1986 issue of the "NMC Monthly Performance Summary". It discusses an apparent analysis problem that led to a rather poor NGM forecast. It serves as a reminder of the need to constantly monitor initial analyses during forecast preparation.

Section IV: Regional forecast from 00Z 13 October 1986

by

N. Phillips

The 48-hr NGM forecast from 00Z 13 October was very bad, whereas the preceding and following forecasts were quite good. The 48-hr LFM forecast from 00Z 13 October was much better than the NGM forecast. Figure 1 shows the initial, verifying and 48-hour forecasts in question from the two operational regional models.

Dennis Deaven of Development Division arranged to run the NGM from the Cressman hemispheric analysis and to run the LFM from the regional analysis at 00Z 13 October. Figure 2 shows the 48-hour results at 250 mb, where the errors are most dramatic. (Note the difference in the units of the two types of graphics.)

Figure 3 summarizes the forecast and observed centers at 48 hours (500 mbs and sea-level) from the 4 forecasts. The results from the Cressman (CR) analysis are uniformly better than those from the regional (ROI) analysis. (And there is some indication that the NGM does a slightly better job from the Cressman analysis than does the LFM.)

The RAFS system was rerun without normal mode initialization. The results were almost indistinguishable from the operational RAFS forecast.

The conclusion seems inescapable that the problem lies in the initial RAFS fields.

A possible interpretation of the error is as follows. Figure 4 shows the 0-hr NGM 250 mb field and the difference between this and the 250-mb field of the first guess. The negative centers in North Dakota and in Northern New Mexico seem to be due to the first guess missing the small-scale intensity of the two circulation centers, whereas the RAFS analysis and initialization seem to have done very well by the data (See Figure 6.)

A possibly significant difference appears in the region southwest of San Diego, where the RAFS analysis+initialization system has increased the height by almost 50 meters. A similar change occurred at 500 mbs. On the other hand, the difference between the NGM and LFM 0-hr fields (not shown) looks very much like the bottom of Figure 4 ---i.e. the LFM did not modify the first guess in this area southwest of San Diego like the RAFS did.

This means that the NGM begins its forecast from the RAFS analysis with an enhanced flow from the northwest parallel to the coast, extending from San Francisco to the lower part of

Baja California.

In turn, this means that the vorticity in the southern part of the trough that extends from North Dakota to San Diego is larger in the NGM initial conditions, and this vorticity is very likely being advected more effectively to the southeast in the NGM than in the LFM initial conditions.

Figure 5 shows the successive 12-hrly errors in the operational NGM forecast. At 12 hours the major feature is the negative center in central Mexico, extending northward into Colorado. This is consistent with the postulated extra advection of vorticity into northen Mexico. This feature intensifies at 24 hours. the positive error to the north has also increased, somewhat, from +25 meters at 12 hours in North Dakota to +80 meters in northern Missouri.

At 36 hours the error amplification continues. But the southern part of the negative error now takes second place to its northern partner (-123) in Kansas, and the positive center begins to experience the greatest increase, from +80 to +221. The change from 36 to 48 hours is similar to that between 24 and 36, with a further slight dominance of the northern one of the negative centers, and a major increase from +221 to +405 meters in the positive center.

The jet stream at 250 mbs (upper part of Figure 4) was quite strong. (Note the several reports exceeding 100 knots in northern Mexico and in Texas on Figure 6.) The large height errors in the forecast must mean that significant distortions were being made in the foreast vorticity pattern at 250 mbs associated with the jet.

The overall error pattern is that of an initial negative error in the bottom of the trough, followed by its intensification and movement to the northeast, and the development in advance of it of a large postive error. It seems to me that this is what one would expect from giving an intial southward impulse to a strong, barotopically unstable jet moving from west to east. The eventual domianace of the positive error after 24 hours would be similar to the downstream amplification of Rossby waves that is a common part of meteorological experience.

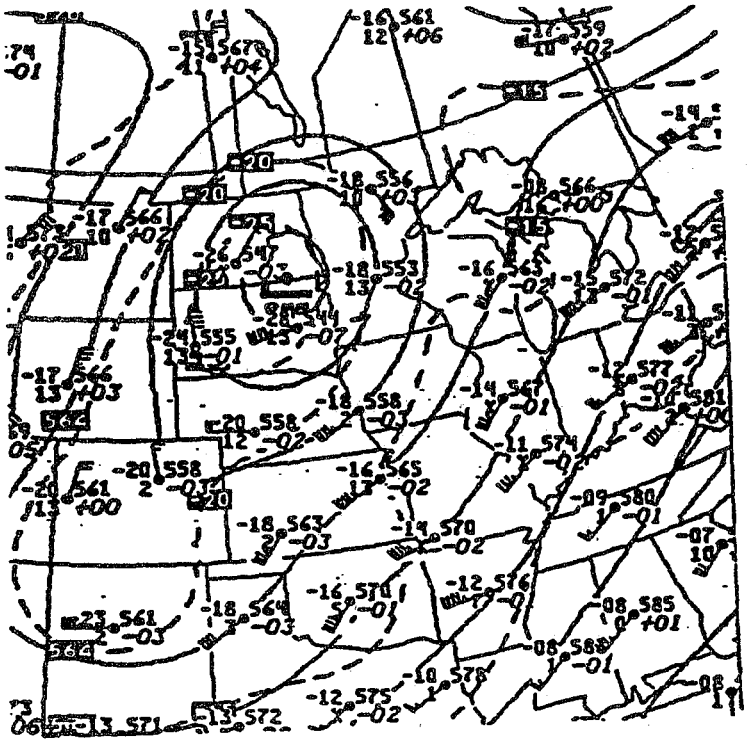


FIG. 1A RAFS 500-mb analysis
00Z 13 Oct.

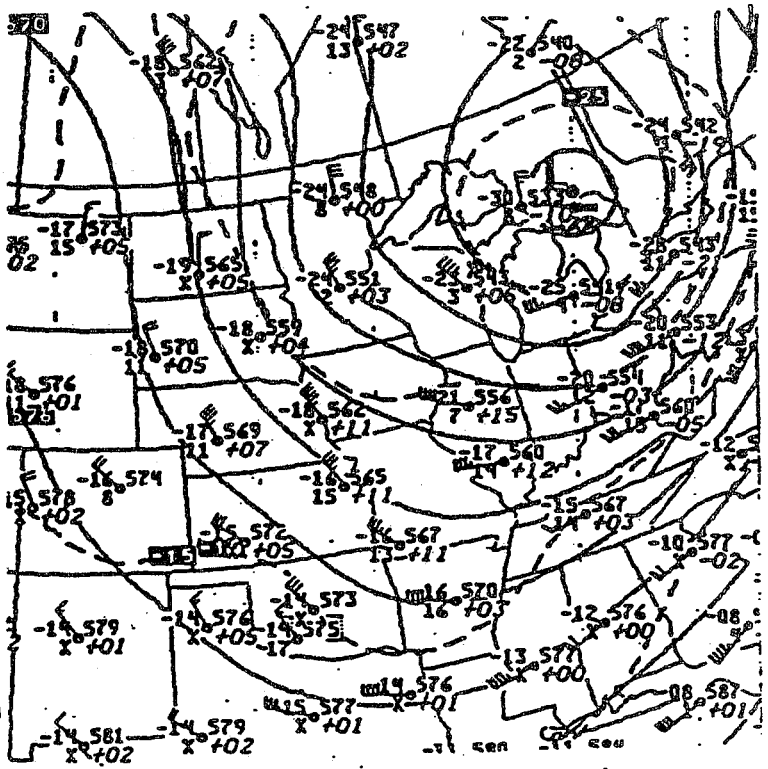


FIG 1B RAFS 500-mb analysis
00Z 15 Oct.

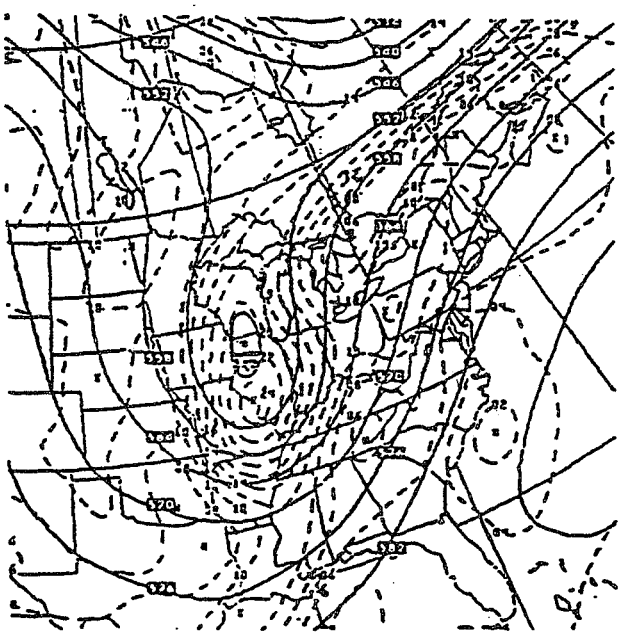


FIG. 1C NGM Operational 48-hr
forecast valid 00Z 15 Oct.

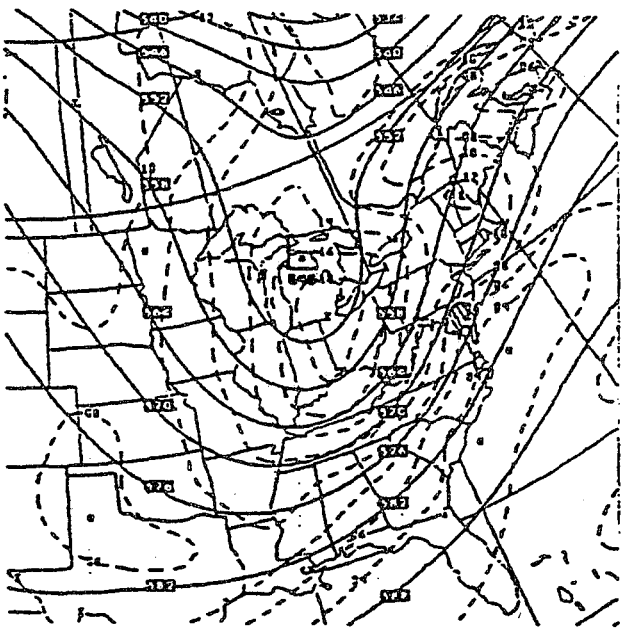
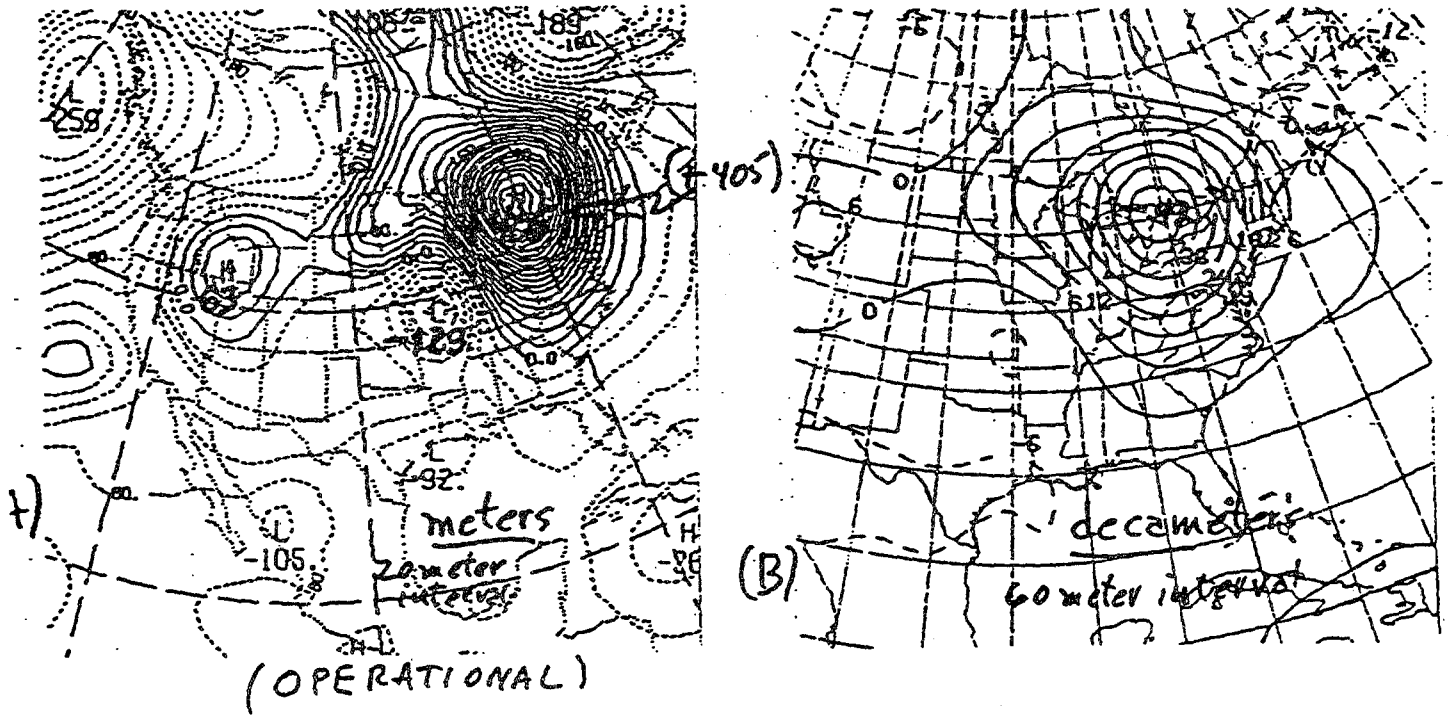


FIG 1D LFM Operational 48-hr
forecast valid 00Z 15 Oct

NGM from RAFS

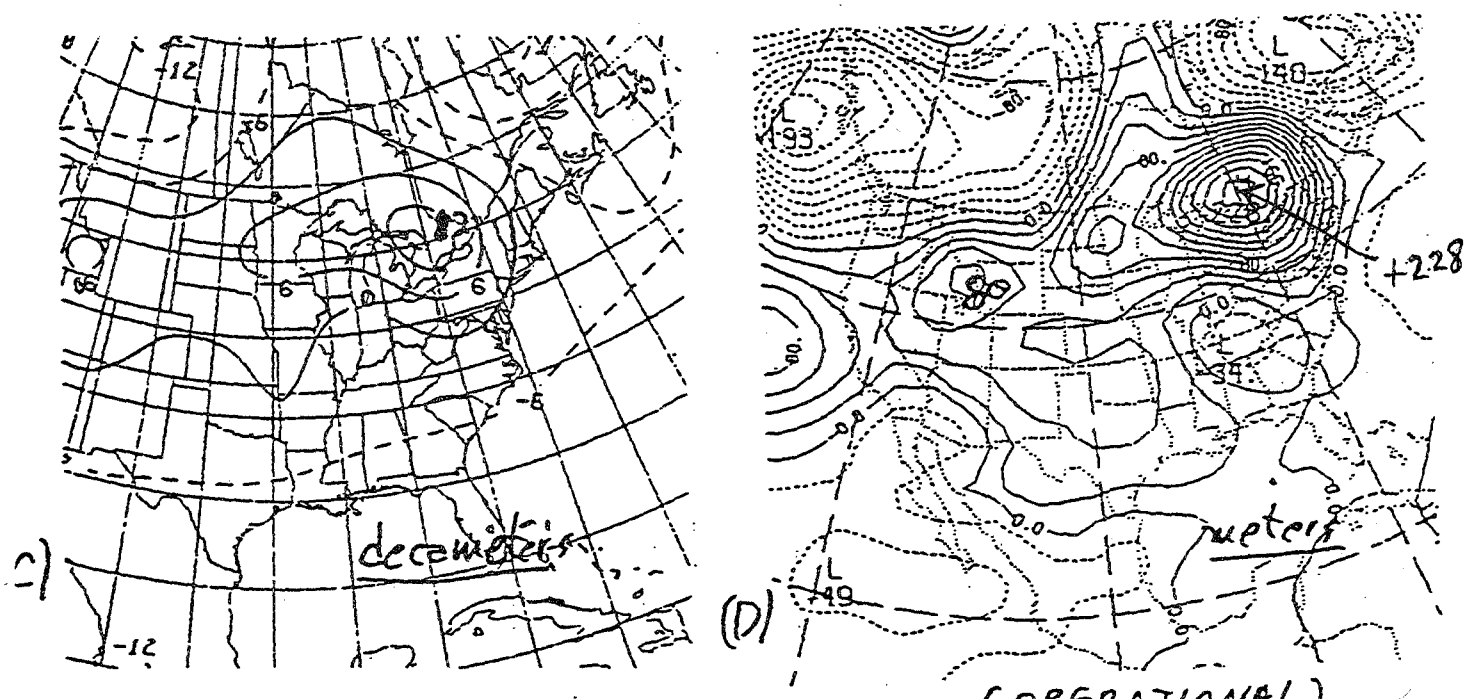
LFM from RAFS



(OPERATIONAL)

NGM from Cressman

LFM from Cressman



(OPERATIONAL)

FIG. 2 48-hour height errors at 250 mbs from 4 combinations of Cressman and Regional OI analyses followed by LFM or NGM forecast models.

NOTE DIFFERENCE IN UNITS

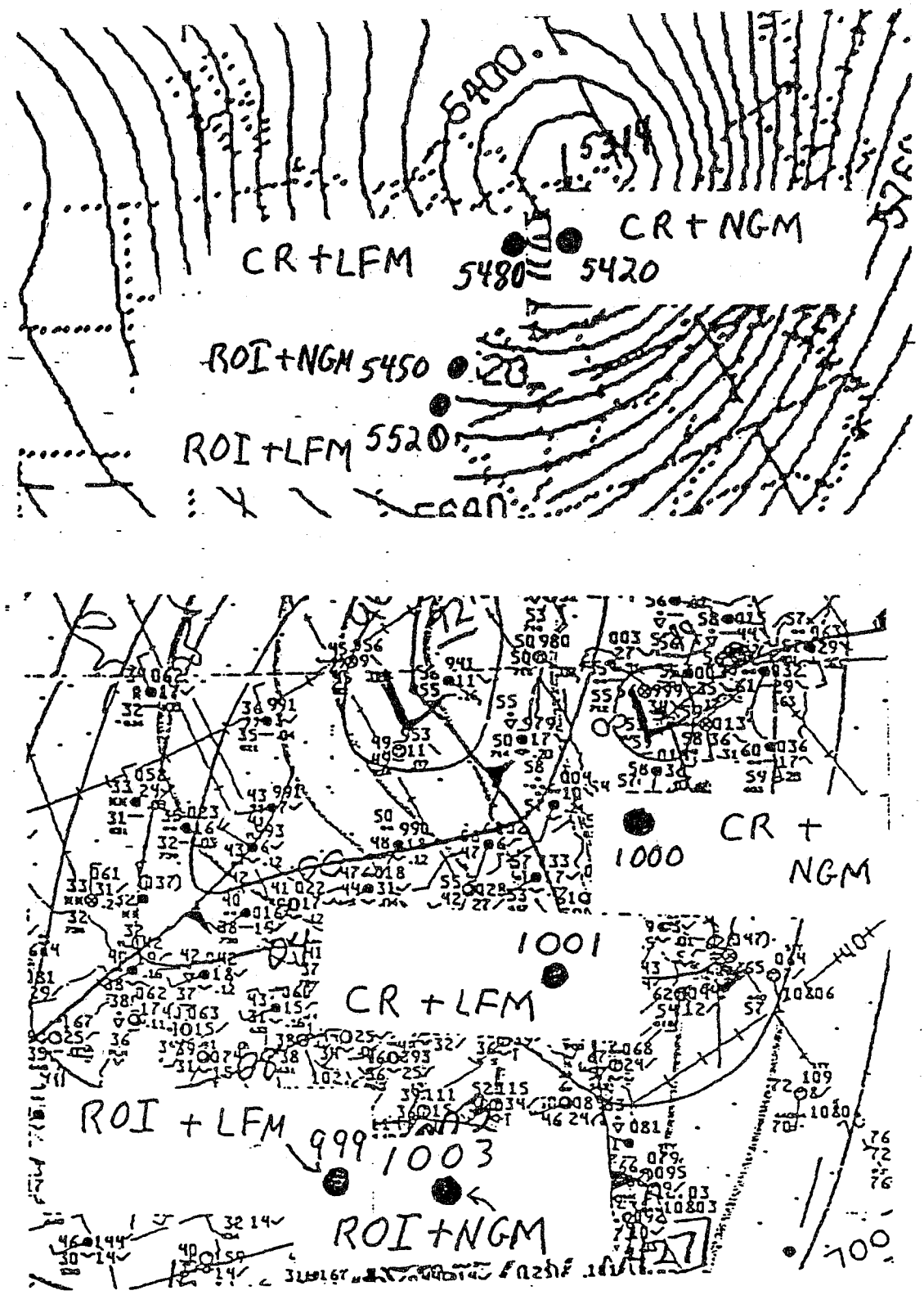
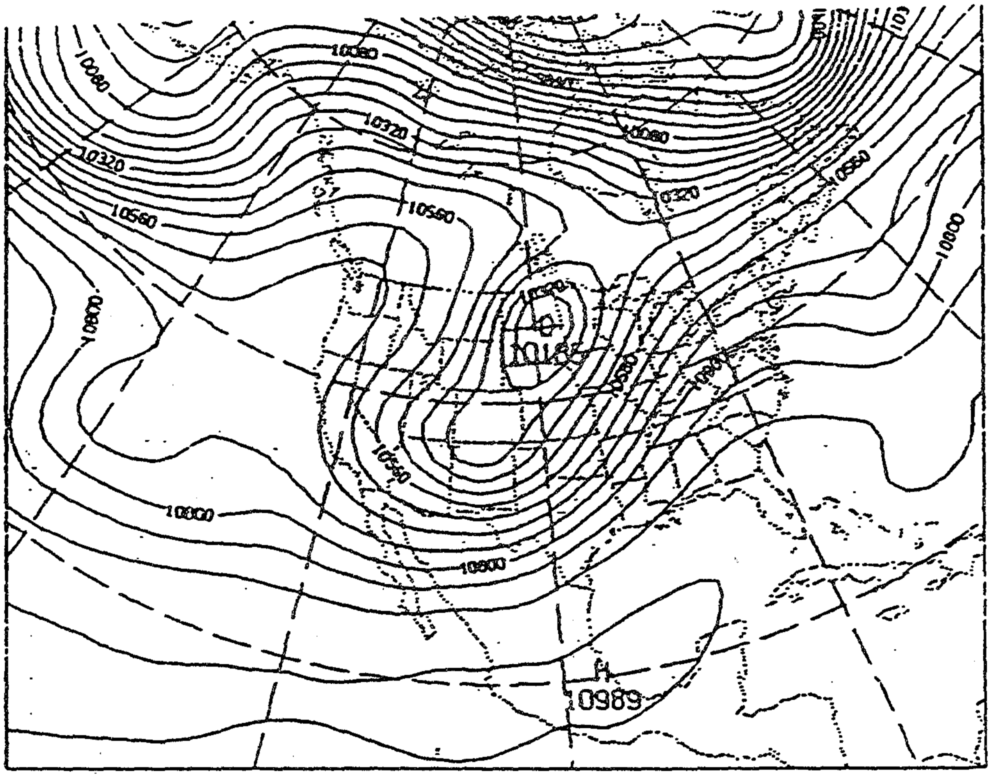
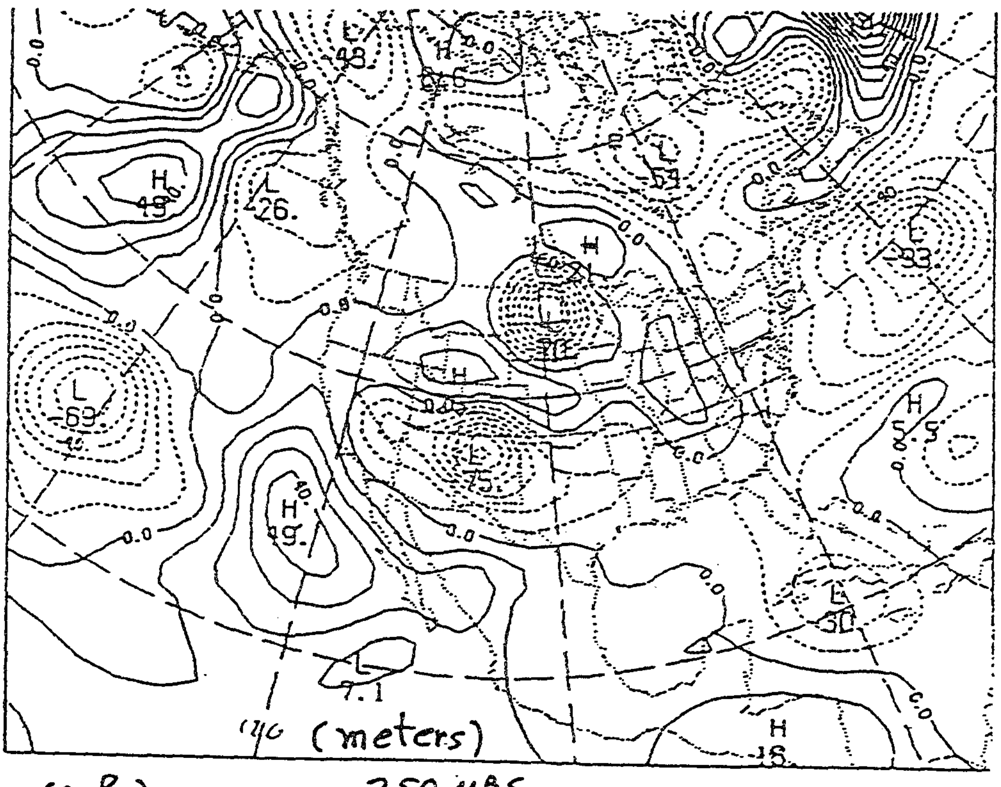


FIG. 3 500-mb analyses and sea-level analysis at 00Z 15 Oct, with 48-hr forecast centers from systems using the Cressman (CR) or regional (ROI) 00Z 13 Oct analyses and the LFM or NGM forecast model.



(0-hr) 250 MBS

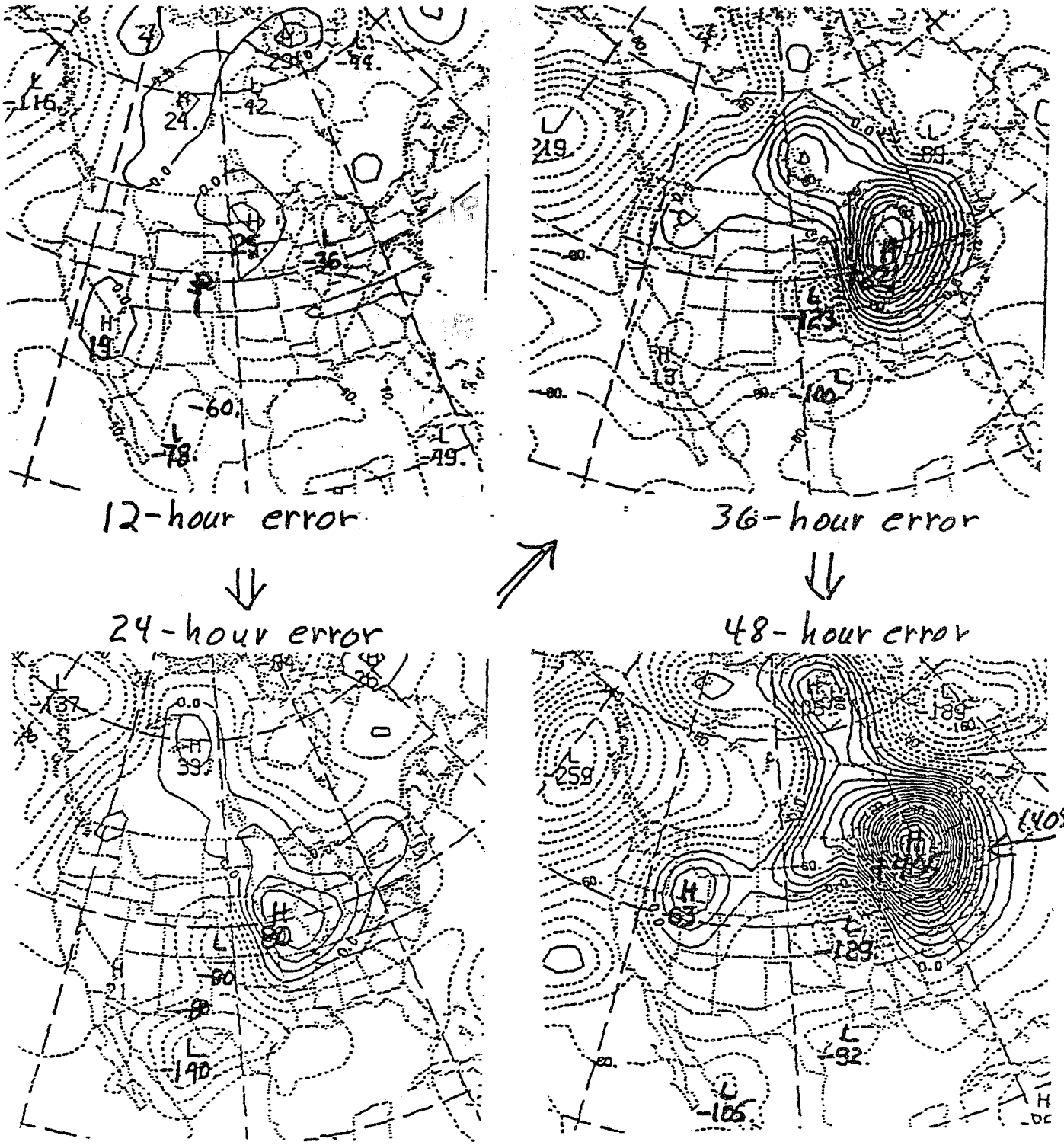
NGM 250 MBSINITIAL HGTS 86 10 13 0Z



(0-hr) 250 MBS

INITIAL NGM MINUS FIRST GUESS 86 10 13 0z

FIG. 4 0-hour 250-mb fields for NGM
00z 13 Oct. 1986



G. 5. 250-mb forecast errors at 12, 24, 36, and 48 hours from the operational NGM run beginning 00Z 13 Oct 1986. Contours at 20 meter intervals

Fig. 6 250-mb RAFS analysis for 00Z Oct 13