CRH SSD
SEPTEMBER 1986

CENTRAL REGION TECHNICAL ATTACHMENT 86-19

EARLY AND REGIONAL MODEL PERFORMANCE FOR THE MICHIGAN FLOOD OF SEPTEMBER 9-12, 1986 -- A QUICK LOOK

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One of the worst floods in recorded Michigan history occurred from rains which fell during the period from Tuesday, September 9, through Friday, September 12, 1986. The preliminary storm total rainfall is shown in Fig. 1. Amounts exceeding 12 inches were reported in an east-west band across central lower Michigan from east of Muskegon to east of Saginaw. Amounts approaching 14 inches occurred in the southwest part of the area enclosed by the 12-inch isohyet.

This technical attachment is meant to be only a once-over-lightly look at the quality of the model (Early and Regional) guidance for the most intense segment of the rainfall. To treat the whole storm thoroughly would require more charts and data than are immediately available to the SSD and the end product would be too bulky to use as a technical attachment.

Since 12-hour precipitation charts are not available from central sources, we have constructed our own for the four 12-hour periods between 0000Z September 10 through 0000Z September 12. During the 12 hours ending at 1200Z Wednesday morning, September 10 (Fig. 2a), 1.25 inches fell at Saginaw. Across Lake Michigan, Green Bay, Wisconsin had 1.67 inches. During the day on Wednesday (Fig. 2b), heavy rains (3.75 inches at Muskegon, 2.51 inches at Grand Rapids, and 2.41 inches at Saginaw) fell across central lower Michigan.

The largest 12-hour value recorded during the night ending at 1200Z Thursday morning by the SAO network was at Saginaw (5.10 inches) (Fig. 2c). One can surmise from the storm total map that large amounts must also have fallen to the west of Saginaw then. As an aside, that night saw rains of around 2 inches in northeast Kansas and northwest Missouri, relieving a minor dry spell in that area. Also, good rains fell in southern Wisconsin and southeastern Minnesota. As we will see all of these rains were associated with one very powerful large-scale weather system.

Fig. 2d shows the rainfall lessening somewhat during the day on Thursday, with no amounts reported exceeding 3 inches.

We will discuss briefly the model guidance products based on the 1200Z data on Wednesday morning (after Saginaw already had 1.25 inches). Fig. 3 shows the 00-12 hr and 12-24 hr QPF's from both the Early and the Regional models. These forecasts are to be compared with Figs. 2b and 2c.

The Early model forecast a maximum of .96 inch over Wisconsin with the half inch isopleth extending into western lower Michigan during the first twelve hours (Fig. 3a). For that night (Fig. 3b) it forecast a maximum of 1.44 inches over northern lower Michigan, with all but extreme northwest and southeast Michigan forecast to have over 1/2 inch of rain.

The Regional model forecast larger amounts in Wisconsin and Michigan, with over an inch forecast at Muskegon during the day on Wednesday (Fig. 3c). The Wednesday night RGL forecast (Fig. 3d) was for a maximum of 2.25 inches over northwest lower Michigan. The forecast maximum was about a degree of latitude north of where the heaviest rain probably occurred that night. At Saginaw the forecast was for about an inch (they got 5.10 inches).

One cannot expect the models to catch the detail of such heavy precipitation, so their QPF performance could be rated as good, with the RGL faring better than the ERL. Other forms of RGL guidance will be discussed next, since forecasters don't rely completely on the QPF from the models.

In Fig. 4 are shown the 00-, 12-, and 24-hr charts from the RGL run made Wednesday morning. The charts on the left are 500 mb heights and vorticity charts, while those on the right are 850 mb height and temperature with the boundary layer winds superimposed. Since it hasn't been documented to the field we will mention here that the boundary layer winds are those of the lowest sigma layer in the model centered at 982 mb (if the surface pressure is 1000 mb). (It would be nice to also have the winds for the next model layer above at 943 mb, since this is about the height of boundary layer wind maxima, but one thing at a time.)

The 500 mb charts show a trough over southern Nevada at 1200Z which was forecast to move to northeastern New Mexico in 24 hours. No great amounts of PVA are seen over Michigan (there is even some NVA), so the pertinent feature at 500 mb seems to be the long fetch of southwesterly flow which hydrostatically and geostrophically encourages southwesterly low level flow as seen in the charts on the right. Appreciable warm advection at 850 mb is forecast over Michigan, so conditions in the lower layers seem to be a crucial factor in producing the heavy rains. Certainly that a lot of moisture was being carried northeastward by the low level flow is evident.

Fig. 5 is the surface geostrophic wind with the sea level isobars superimposed for 0000Z Wednesday evening. This shows a 50 knot wind over northwest Indiana flowing into a region of markedly lighter (20 to 30 knots) winds over Michigan. Using stone-age hydrodynamics one could reason that the fast moving air from Illinois and Indiana "piled up" over Michigan as it reached the frontal (warm advection) zone.

In conclusion, we would like to mention that the MIC at Ann Arbor (Bob Snider) described the NMC guidance as "excellent." A flood watch was issued for the entire area well in advance of any heavy rainfall, and continued until it was replaced by a flood warning in some areas and cancelled elsewhere. The North Central River Forecast Center provided excellent forecasts and guidance. Local authorities responded well to the NWS watches and warnings.

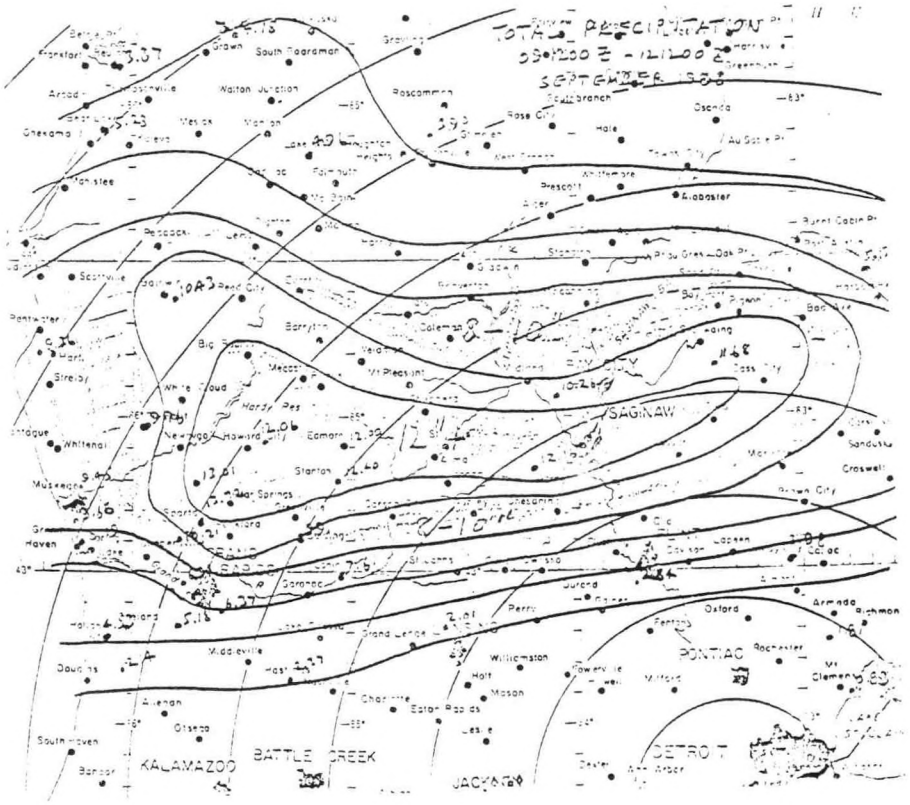


Fig. 1. Storm total precipitation 12Z 9 September to 12Z 12 September 1986.

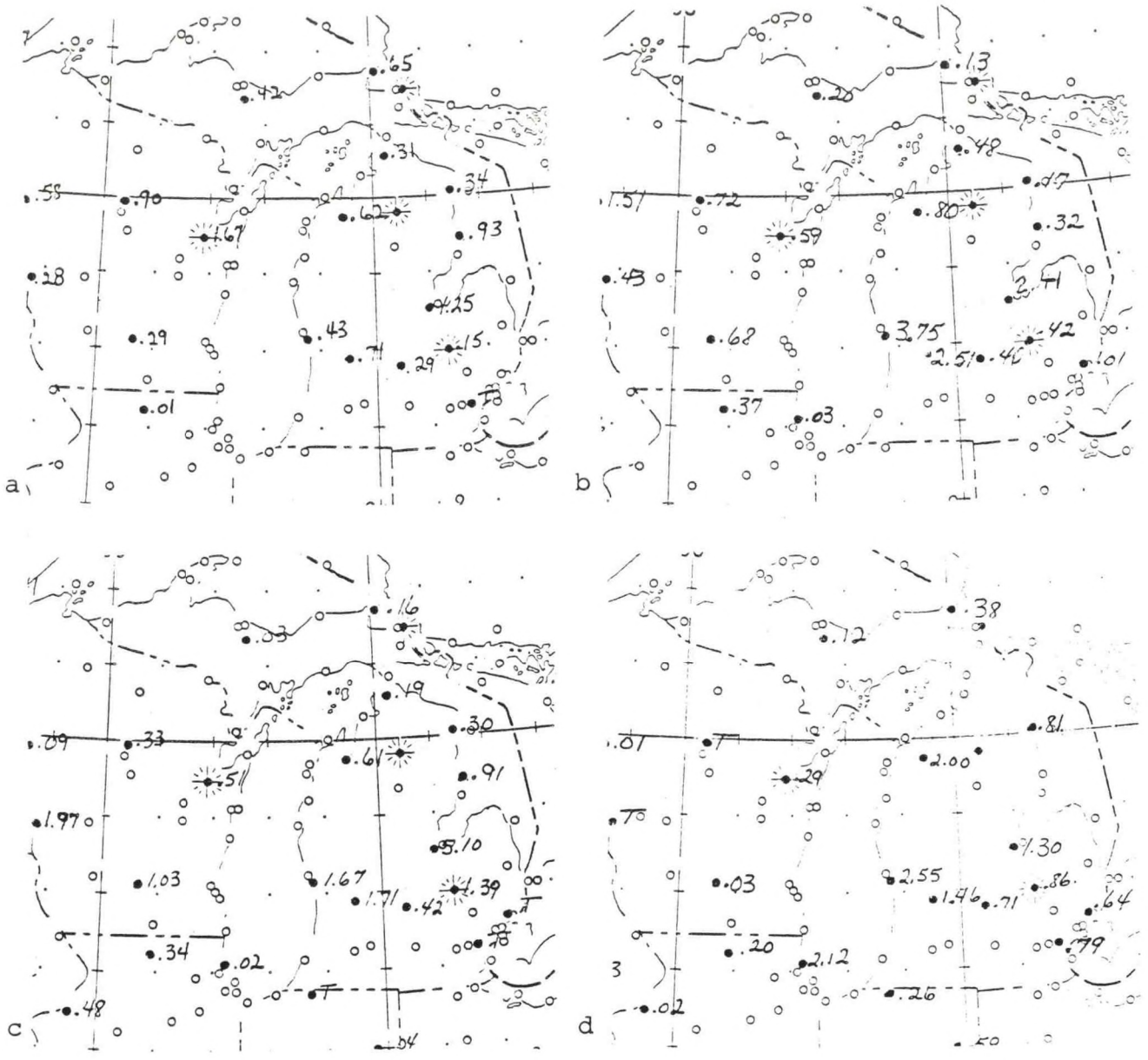
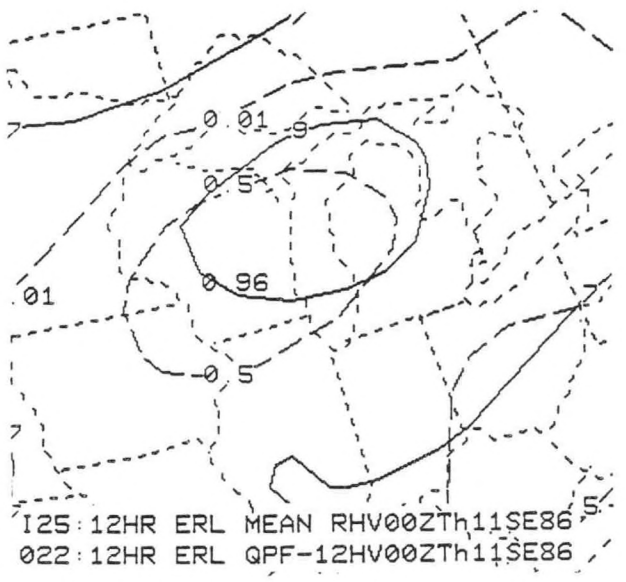
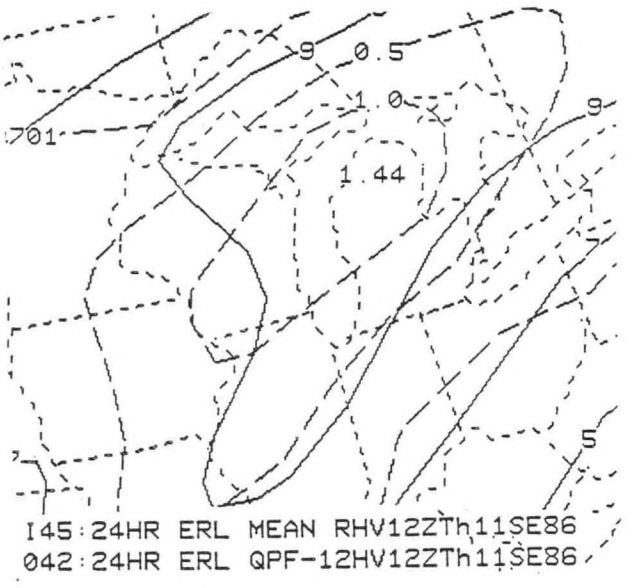


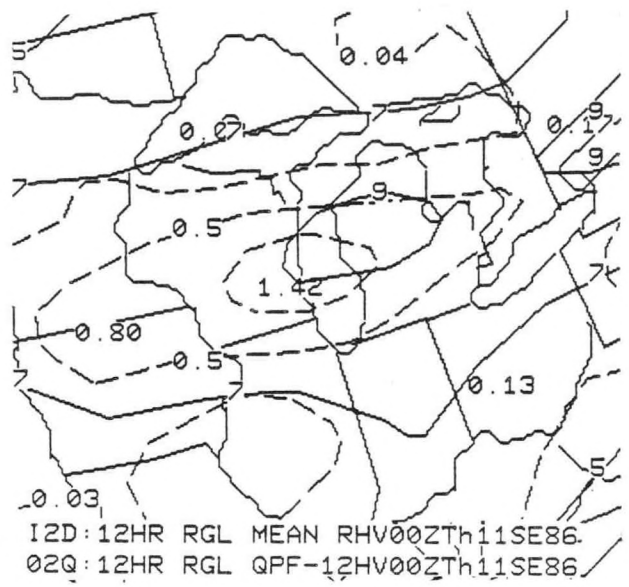
Fig. 2. 12-Hr precipitation amounts: (a) 00-12Z 10 September, (b) 12-24Z 10 September, (c) 00-12Z 11 September, and (d) 12-24Z 11 September 1986.



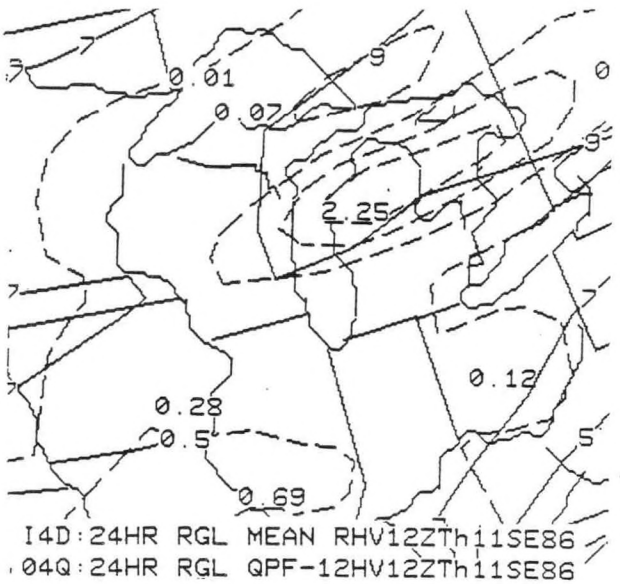
a I25:12HR ERL MEAN RHV00ZTh11SE86
022:12HR ERL QPF-12HV00ZTh11SE86



b I45:24HR ERL MEAN RHV12ZTh11SE86
042:24HR ERL QPF-12HV12ZTh11SE86

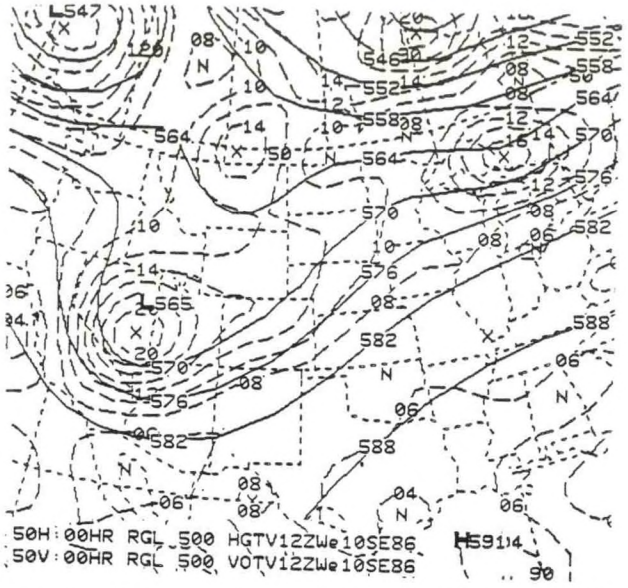


c I2D:12HR RGL MEAN RHV00ZTh11SE86
02Q:12HR RGL QPF-12HV00ZTh11SE86

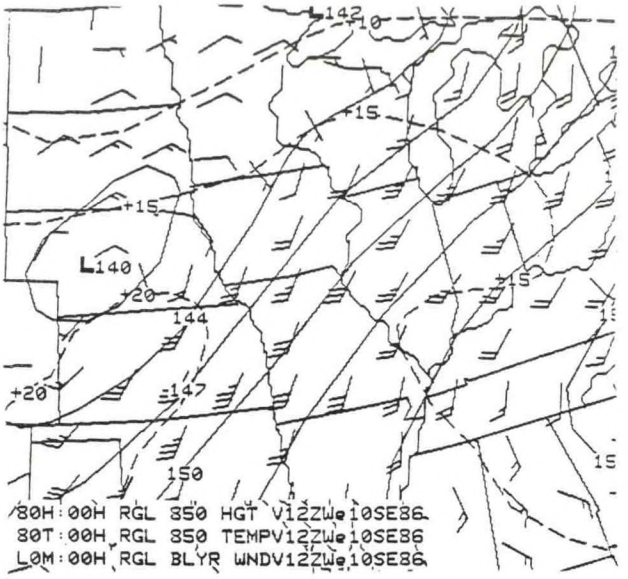


d I4D:24HR RGL MEAN RHV12ZTh11SE86
04Q:24HR RGL QPF-12HV12ZTh11SE86

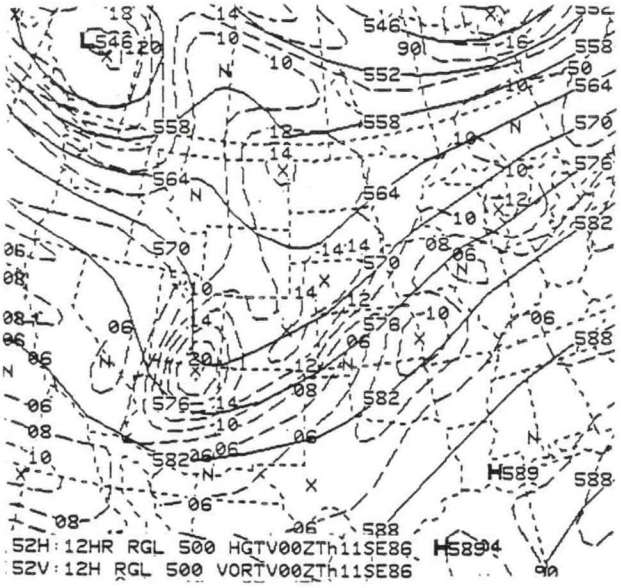
Fig. 3.


50H:00HR RGL 500 HGTV12ZWe10SE86
50V:00HR RGL 500 VOTV12ZWe10SE86

a


80H:00H RGL 850 HGT V12ZWe10SE86
80T:00H RGL 850 TEMPV12ZWe10SE86
L0M:00H RGL BLYR WNDV12ZWe10SE86

b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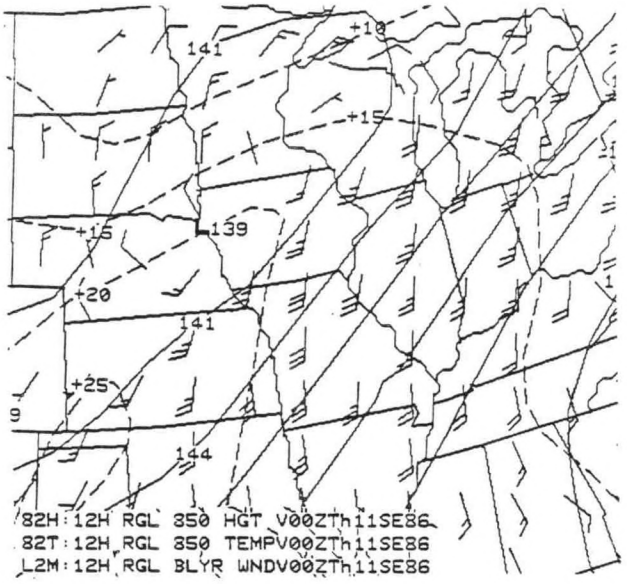
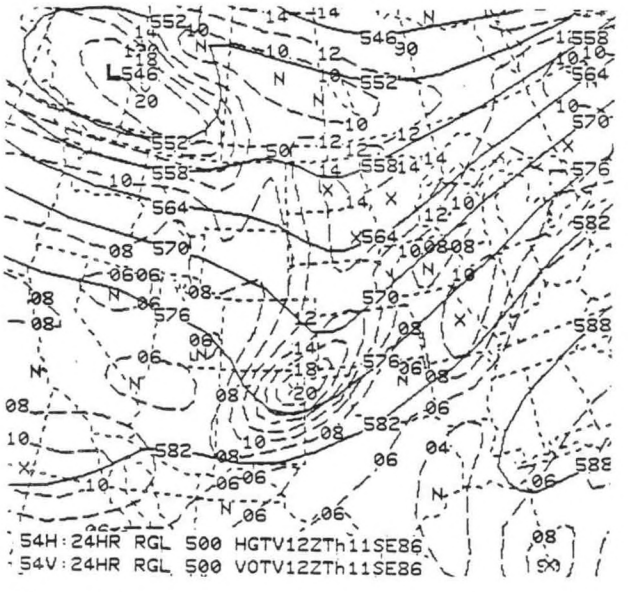
52V:12H RGL 500 VORTV00ZTh11SE86

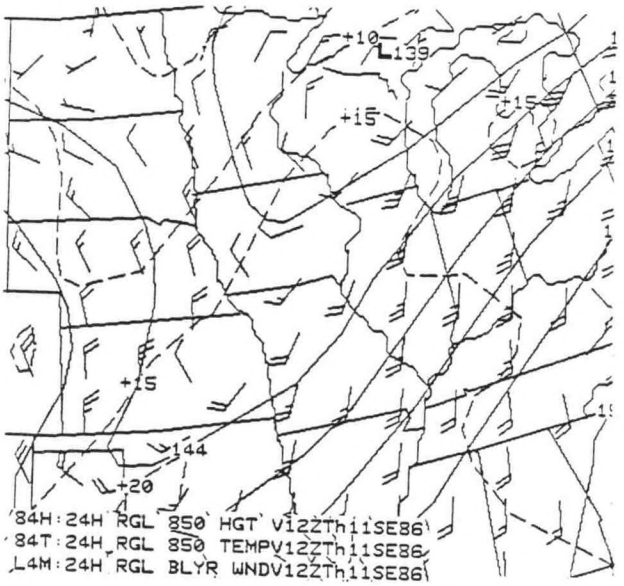
c


82H:12H RGL 850 HGT V00ZTh11SE86
82T:12H RGL 850 TEMPV00ZTh11SE86
L2M:12H RGL BLYR WNDV00ZTh11SE86

d


54H:24HR RGL 500 HGTV12ZTh11SE86
54V:24HR RGL 500 VOTV12ZTh11SE86

e


84H:24H RGL 850 HGT V12ZTh11SE86
84T:24H RGL 850 TEMPV12ZTh11SE86
L4M:24H RGL BLYR WNDV12ZTh11SE86

f

Fig. 4.

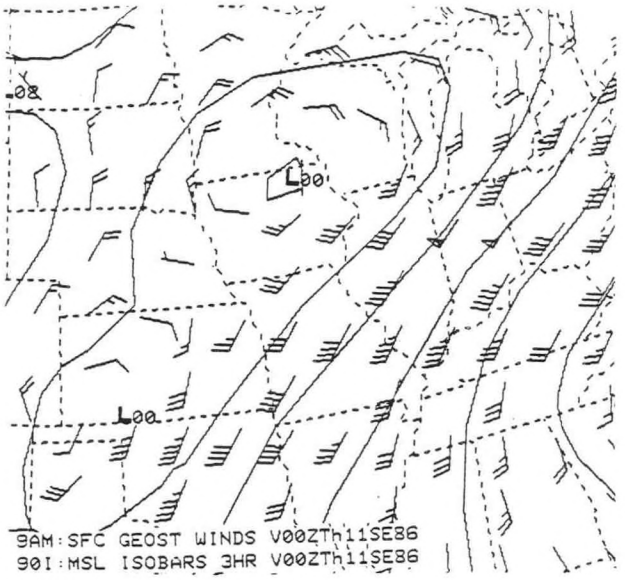

L
L
9AM:SFC GEOST WINDS V00ZTh11SE86
90I:MSL ISOBARS 3HR V00ZTh11SE86

Fig. 5.