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CENTRAL REGION TECHNICAL ATTACHMENT 86-14

DEVELOPMENT OF SEVERE THUNDERSTORMS IN RELATION TO THE MOISTURE CONVERGENCE CHART

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On Thursday, April 24, 1986 spotty severe weather occurred across south-central Iowa in Warren and Marion counties. This severe weather was primarily in the form of hail. Little wind occurred with these thunderstorms.

The following is a chronological order of events that occurred that evening and the performance of the moisture convergence chart.

At 3:00 p.m. (all times are CST) a slowly moving cold front extended from western Wisconsin through central Iowa to central Kansas. There was a convergent area maximum across northeast and south-central Kansas (see Figs. 1a and 1b).

By 6:00 p.m. no thunderstorms had developed. However, an examination of the 23Z surface analysis indicated a weak wave had developed along the cold front in northeast Kansas. The moisture convergence chart indicated a convergent minimum had decreased to a -65 (see Figs. 1c and 1d).

Between 6:00 p.m. and 6:15 p.m. a couple of weak thunderstorms developed just northeast of Kansas City and near Creston. A look at the 6:00 p.m. CST surface chart indicated the wave had moved into extreme southeast Nebraska. However, the area of maximum convergence weakened and moved southwest into northeast Kansas (see Figs. 1e and 1f).

A look at the Omaha and Topeka soundings indicated a "shotgun" sounding. That is, a cap was evident between 800 and 750 mb. If a parcel of air broke through that cap, the surrounding air was unstable. A rather large positive area existed. The equilibrium level was around 40,000 feet.

An examination of the 850 mb chart indicated some moisture and warm advection. At 700 mb it was dry. The 500 mb level had winds of 20 to 25 knots, not really conducive to severe weather (see Fig. 2).

However, the thunderstorms continued to grow. Moisture was limited and these storms were scattered. They were concentrated over Clarke and southern Warren and Marion Counties. The thunderstorms grew gradually to 40 to 45,000

feet between 7:30 p.m. and 8:30 p.m. By 9:30 p.m. there was a top to 50,000 feet, 10,000 feet above the equilibrium level (see Fig. 3).

An examination of the 8:00 p.m. surface data indicated the weak wave continued in southeast Nebraska. The moisture convergence maximum had moved into northwest Missouri and the values had increased to a -38 (see Fig. 4). The maximum convergence area was some 75 to 100 miles away from the area of convective activity.

From around 10:30 p.m. until midnight, large hail occurred with these thunderstorms. During this time a couple of the storms had level 5 to 39 thousand feet, near the equilibrium level. The storms decreased in intensity shortly after midnight. However, the small cluster continued to maintain itself through 4:00 a.m. as it moved east into Illinois (see Figs. 3d, e, and f).

In this case, the moisture chart was a good indicator of the thunderstorm formation. However, once the thunderstorms started they self-propagated. The bubble highs were strong enough to break the cap. Marginal low level moisture along with warm air advection kept the thunderstorms going. It should be kept in mind that once convection begins, a decrease in low level moisture convergence does not necessarily mean that the thunderstorms already in progress will decrease with time. Other factors such as 850 mb warm air advection, surface boundaries and instability seem to play a more important role in sustaining thunderstorms.

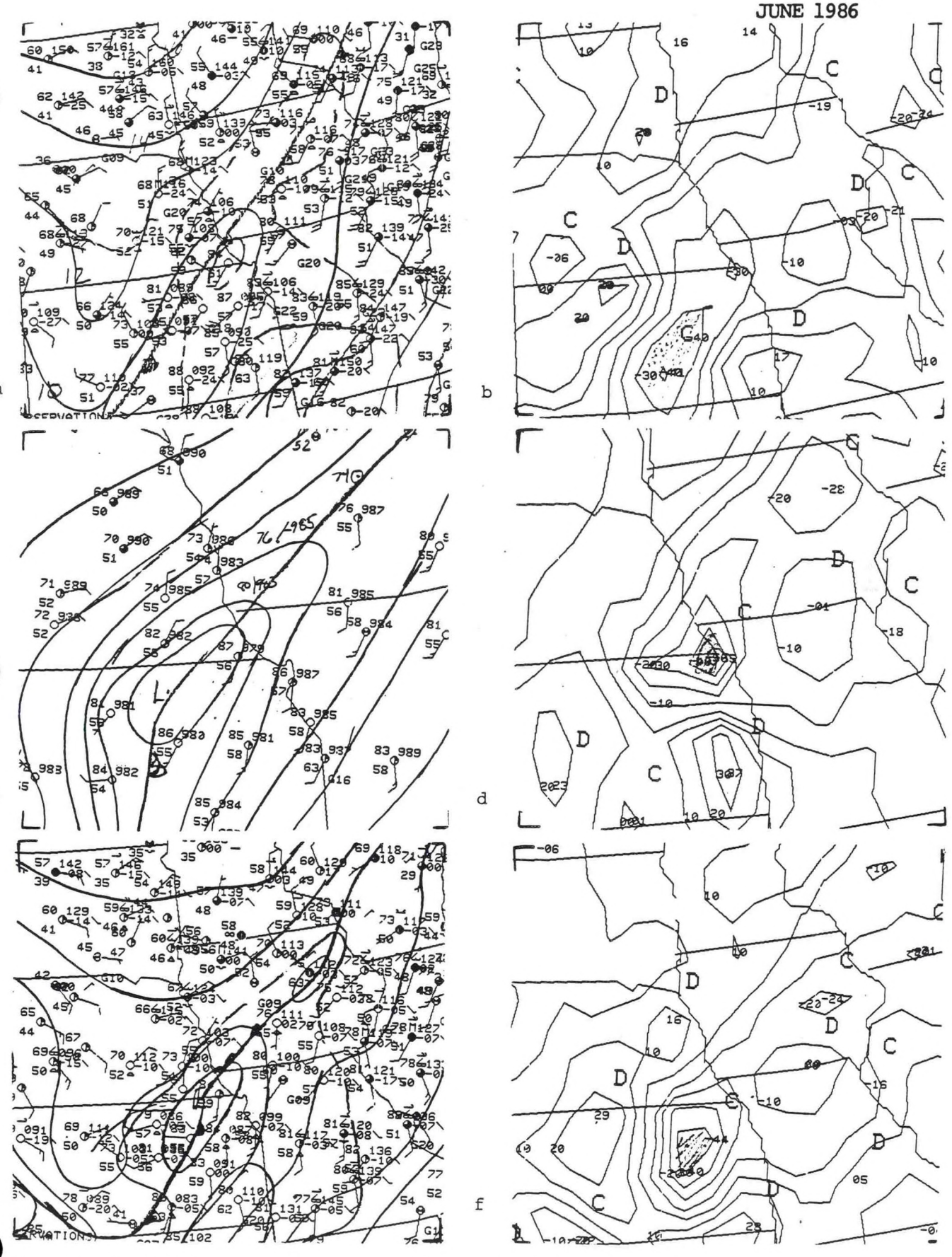

Fig. 1. Surface/sea level pressure charts (left) and moisture convergence charts (right) for a) and b) 2100 GMT 24 April, c) and d) 2300 GMT 24 April, and e) and f) 0000 GMT 25 April 1986.

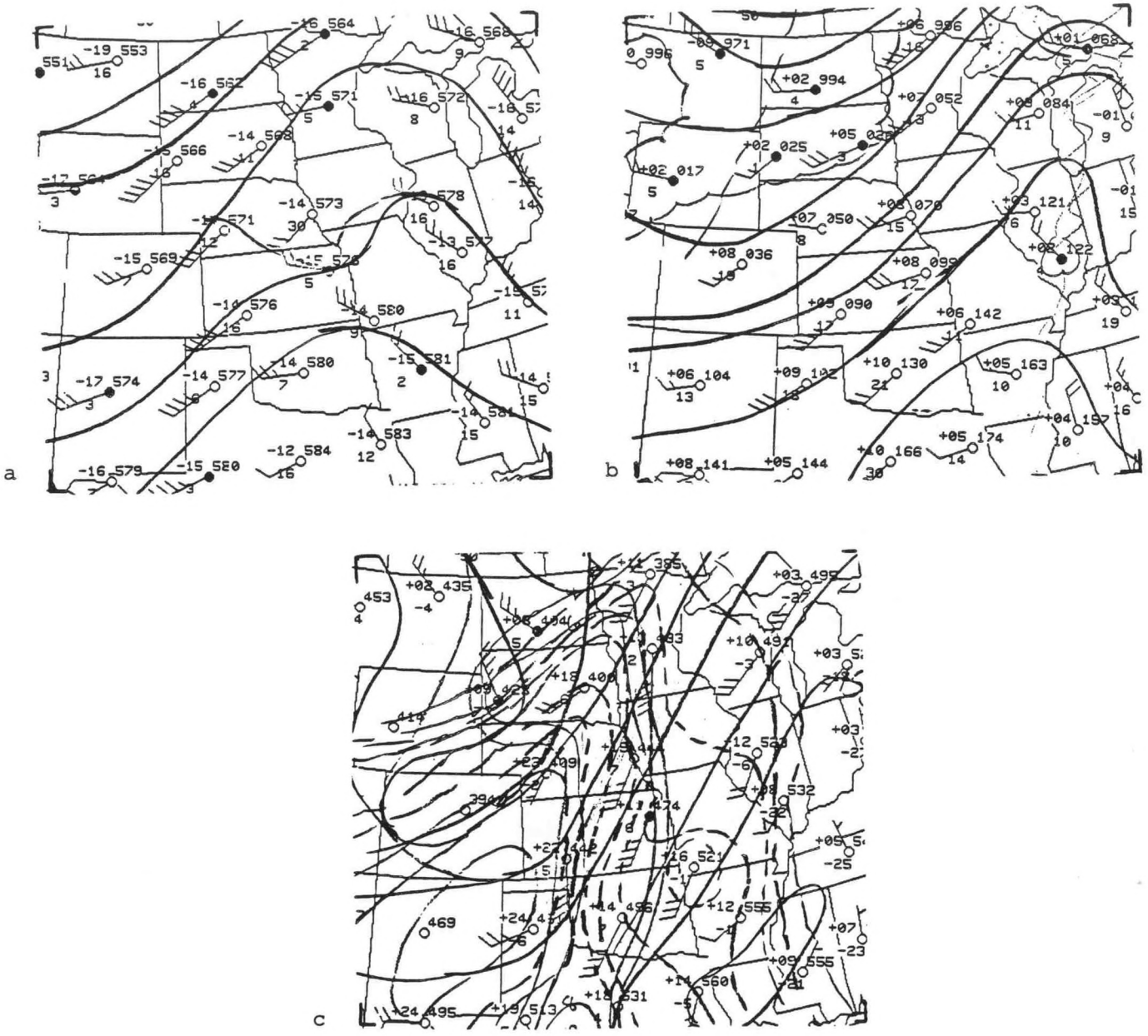

Fig. 2. Upper air charts for 0000 GMT 25 April 1985: a) 500 mb, b) 700 mb, and c) 850 mb.

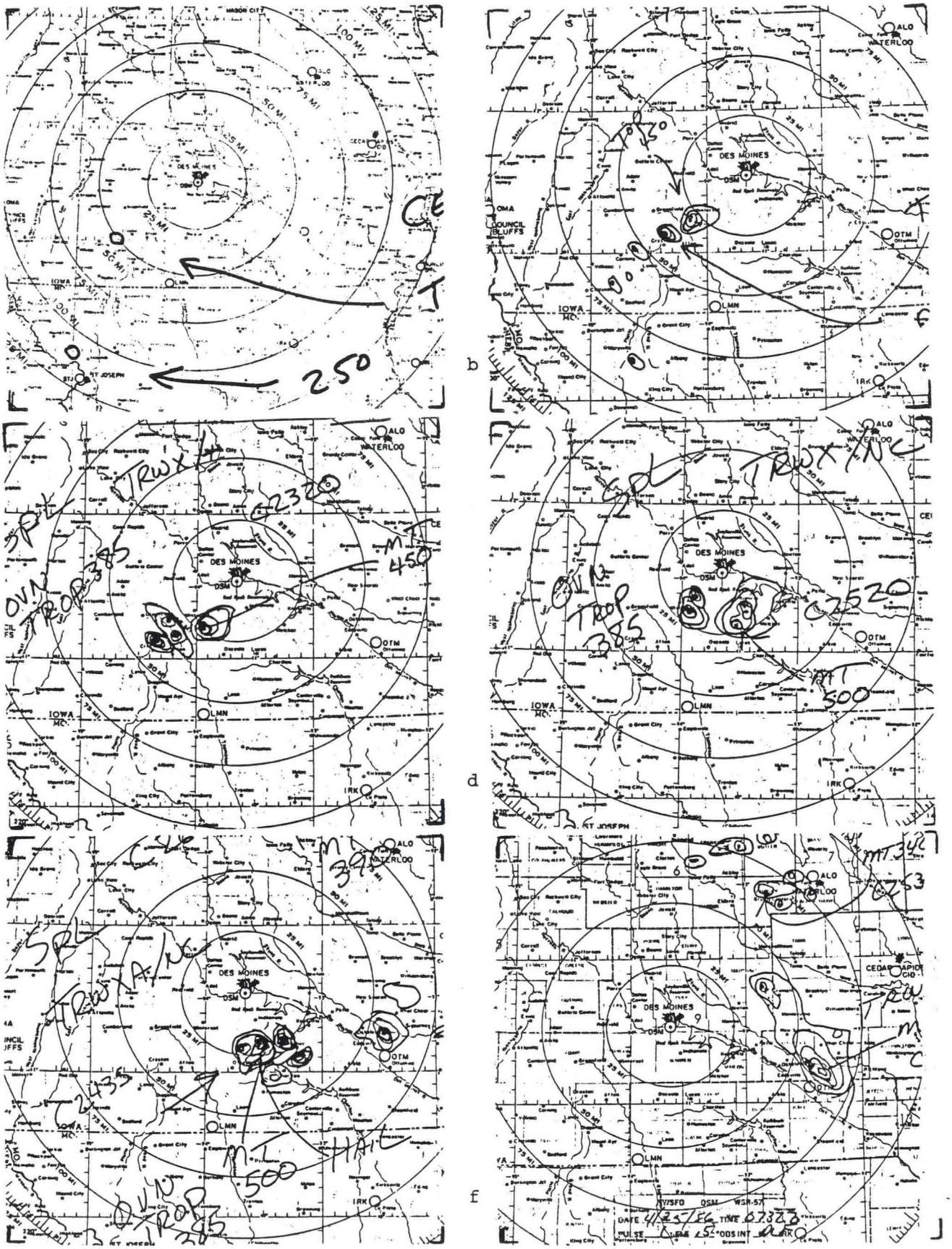

Fig. 3. Des Moines radar charts for a) 0031 GMT, b) 0131 GMT, c) 0235 GMT, d) 0332 GMT, e) 0537 GMT, and f) 0732 GMT 25 April 1986.

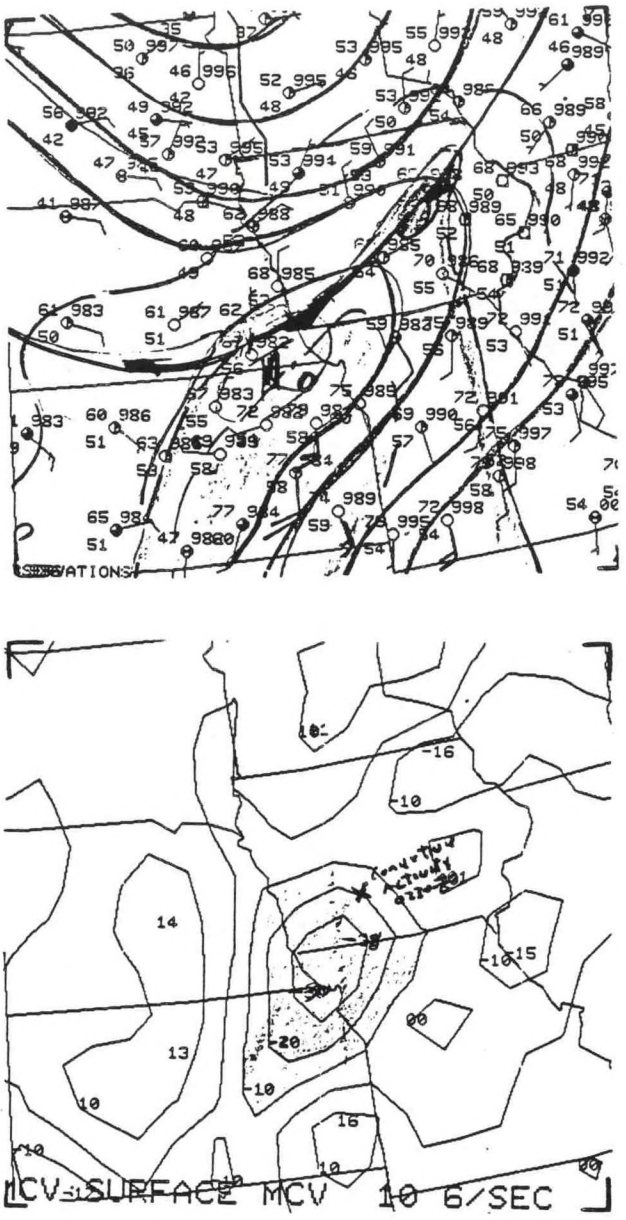

Fig. 4. Surface/sea level pressure chart (a) and moisture convergence chart (b) for 0200 GMT 25 April 1986.