CRH SSD
AUGUST 1993

CENTRAL REGION TECHNICAL ATTACHMENT 93-21

SEVERE THUNDERSTORMS ERUPT OVER SOUTH-CENTRAL KANSAS

Eric P. Schminke
National Weather Service Office
Wichita, Kansas

1. Introduction

On June 19, 1992, south-central Kansas was hit by two periods of severe thunderstorms that spawned tornadoes, large hail (to the size of softballs), and damaging winds of 70 to 80 mph. This event was unusual for two reasons: 1) The storms occurred during "off-peak" hours, i.e. in the morning versus late afternoon/evening and 2) the second round of severe convection followed in almost the same path as the first, forming as a result of an outflow boundary from the severe convection that occurred earlier that morning. This paper will discuss the first round of storms to hit that morning.

2. Synoptic Conditions

2.1 Surface

The early morning of June 19, started with scattered altocumulus (AC) at 9000-10000 feet. At 0600 UTC, a warm front was approaching extreme southern Kansas. This front would help serve as focus for convection. A light (less than 10 kts) southeast surface flow prevailed across most of Kansas with dew points of 65°F or more at Wichita (ICT), Liberal (LBL) and Medicine Lodge (P28). In central Kansas, dew points were generally around 55°F (Figure 1).

2.2 Upper Air

On June 19, low-level shear was evident between 0000 UTC and 1200 UTC. At 0000 UTC, 925 mb data showed southeast flow at 15 kts over southwest Kansas with northwest flow 10 kts over eastern Kansas (Figure 2). At 700 mb, west-northwest flow of 20-25 kts prevailed over most of Kansas (Figure 3) increasing to 30-45 kts at 500 mb. A 45-kt jet was situated over eastern Kansas at this level (Figure 4). A 70 kt jet at 300 mb extended from the desert southwest to western Missouri (Figure 5).

At 1200 UTC, shear was pronounced at 850 mb. A southwest 30-kt flow over southwest Kansas existed, while a north flow 10 kts persisted over the east (Figure 6). Between 700 and 500 mb winds veered slightly, but the prominent feature was a northwest 55-kt jet at 500 mb over northeast Kansas (Figures 7 & 8). This placed central and south-central Kansas on the right-rear quadrant of the jet, where severe convection was favored (Reiter, 1963).

At 0000 UTC, the 850 mb level was fairly dry with temperature/dew point spreads of 10° - 15°C prevailing over Kansas. However, widespread moisture (dew point spreads less than 5 degrees), was advecting north from Oklahoma and northeast Texas. The air mass was dry above 700 mb in response to a 700-mb ridge over the southern Plains. At 1200 UTC, the air mass surrounding south-central Kansas was fairly dry at all levels.

3. Satellite Imagery

At 0630 UTC, satellite imagery detected a band of AC (cloud type based on surface observations) extending from central and south-central Kansas to the southeast. It is possible that the radiative cooling from this AC helped to destabilize the atmosphere and trigger the convection (Figure 9) (Means, 1945). By 0730 UTC, convection was setting up over central Kansas with the first thunderstorm forming near Hutchinson (Figure 10).

At 0830 UTC, intense thunderstorms were indicated from central Kansas around Hutchinson to Wichita and by 1000 UTC it had erupted into a massive complex of intense/severe thunderstorms covering nearly all of the southeast fourth of the state (Figures 11 & 12). Storm movement was east at 20 kts, placing Wichita on the right-rear flank of the storm complex. It is important to note that 1200 UTC upper air data showed southwest flow 20-30 kts at 850 mb across west Texas into southwest Kansas providing warm inflow to the complex (Figure 6).

4. Thunderstorm Development

At 0810 UTC, the National Severe Storms Forecast Center (NSSFC) issued a mesoscale convective discussion (MCD) advising rapidly developing convection over central and northwest Kansas. There was no mention of south-central Kansas. A lightning detection system (LDS) graphic indicated a small area of lightning in central Kansas near Hutchinson.

At 0815 UTC, radar indicated a moderate thunderstorm 20 miles northwest of Hutchinson with max top at 27,000 ft. At 0825 UTC, just 10 minutes later, the storm intensified with an intense core (VIP-5) to 12,000 feet and max tops to 42,000 feet. From 0815 UTC to 0825 UTC, storms rapidly developed southwest of Wichita from moderate to strong intensity (Figure 13).

At 0830 UTC, reports of frequent lightning and torrential rains on the west side of Wichita were received. Next, Norman, Oklahoma (OUN) informed of a VIP-5 core to 30,000 feet directly over Wichita. At 0915 UTC, a second call from Norman informed that OUN's WSR-88D detected a possible tornado in the Hutchinson storm. Minutes later, reports of two funnels over north Wichita were received. Between 0930 UTC and 1130 UTC, several funnels were sighted over west Wichita with golf ball size hail and 70-mph wind gusts.

5. Causes

Initially no thunderstorms were expected that night, so why did these storms develop so quickly and become severe? The warm front approaching extreme southern Kansas served as focus for convection, so low-level warm advection was in progress (Means, 1945). At 0600 UTC, dew points around 65°F were common, so low-level moisture was abundant in this region. The air dried in the mid-levels by 700 mb allowing for destabilization. A mid-level jet max of 45 kts at 500 mb moved over eastern Kansas at 0000 UTC and increased to 55 kts by 1200 UTC (Figure 8). The jet prevailed from the northwest placing central and south-central Kansas in the right-rear quadrant, an area very favorable for severe weather development. Since direct circulation is found at the entry to the jet, (warm air rising, cold air sinking), rising motion would be expected on the right-rear quadrant (Uccellini, 1990). Shallow low-level warm advection occurred with northwest flow aloft.

The AC played a role in that radiative cooling from the tops further cooled the mid-levels, resulting in increased instability (Means, 1945). The radiative cooling generally reaches a maximum during early morning. At 0730 UTC, satellite imagery showed that convection had started in areas where the AC was located (Figure 10). At this time the mid-level jet increased over eastern Kansas (Figures 4 & 8). The convection would increase during the next 3-4 hours.

The most intense/severe thunderstorms occurred between Hutchinson and Wichita. Satellite imagery shows why. The storms covered most of the southeast fourth of Kansas by 1000 UTC placing Wichita and Hutchinson on the southwest flank of the complex where one would expect the most intense updrafts. The 1200 UTC 850-mb plot (Figure 6) showed southwest flow of 30 kts providing good inflow to the complex and strengthening it further. This is analogous to a supercell in that the greatest updrafts would be found here (Rotunno and Klemp, 1982).

Vertical wind profiles showed warm advection with winds veering from southwest at 30 kts at 850 mb to west at 20 kts at 500 mb (Figures 6-8). Surface winds from 0600 UTC to 0800 UTC were southeast at 10 kts. With low-level winds veering sharply in this fashion, one should see an ominous picture developing; supercells. This is especially true considering the upper-level northwest flow that occurred during the period.

6. Conclusion

On June 19, strong low-level warm advection and abundant moisture combined with northwest flow aloft to destabilize the atmosphere. Strengthening of the mid-level jet and radiative cooling from the AC resulted in further destabilization.

If the aforementioned are witnessed, especially during late spring, one should be wary of rapid convection, perhaps reaching severe limits. When analyzing surface and upper air graphics, be alert to the location of the mid- and upper-level jet maxima, surface boundaries, low-level moisture and mid-level cloudiness (AC). Knowing the locations of these elements will greatly aid in forecasting severe convection.

7. Acknowledgements

The author wishes to thank Jeffrey Hedges, Meteorologist and Michael Stewart, Scientific Operations Officer at WSO Wichita for their constructive commentary. Special thanks also go to Leo Ritter, Data Acquisition Program Manager, for his assistance in preparing the graphic displays for this report.

8. References

Means, L. L., 1945: The Nocturnal Maximum Occurrence of Thunderstorms in the Midwestern States. University of Chicago Press, Miscellaneous Reports No. 16, pp 6, 37.

Reiter, E. R., 1963: *Jetstream Meteorology*. University of Chicago Press, 136 pp.

Rotunno, R. and J.B. Klemp, 1982: Influence of Shear and Induced Pressure Gradients on Thunderstorm Motion. *Mon. Wea. Rev.*, **110**, 136-151 pp.

Uccellini, L. W., 1990: The Relationship Between Jet Streaks and Severe Convective Storm Systems. *Preprints, 16th Conference on Severe Local Storms*, AMS (Boston) MA, 121 pp.

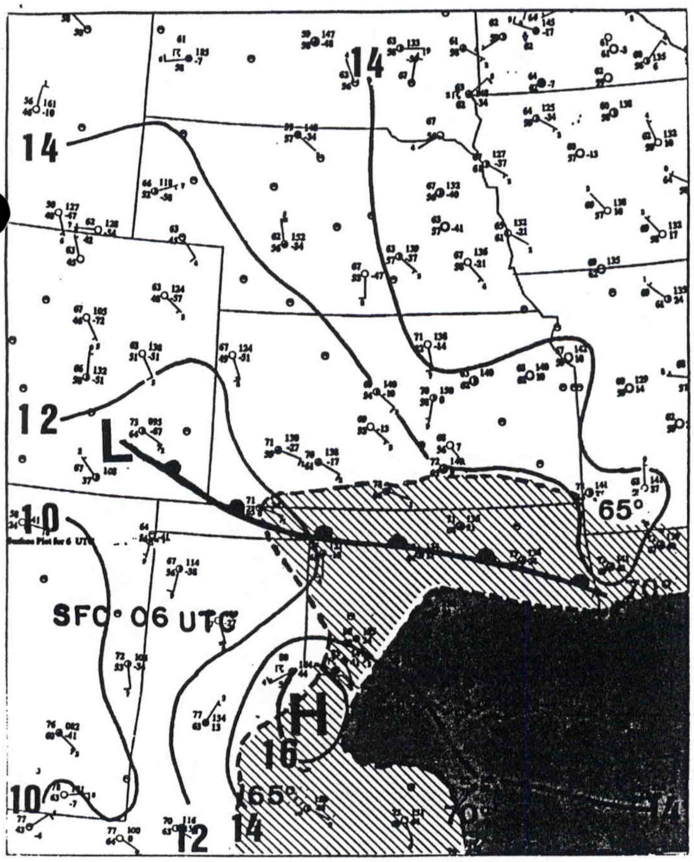

Figure 1
0600 UTC 19 June 1992 surface plot

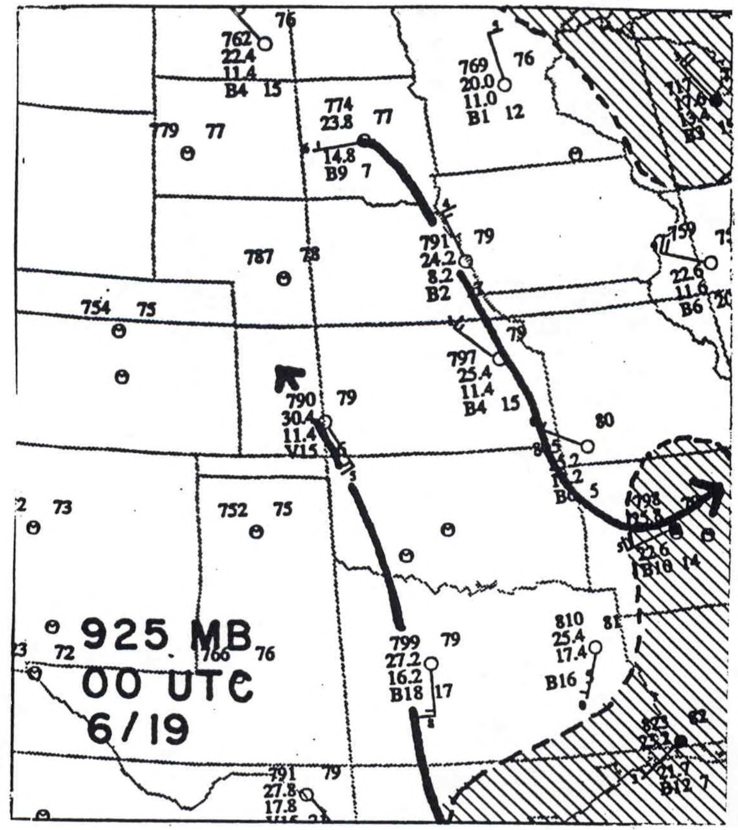

Figure 2
0000 UTC 19 June 1992 925 mb plot

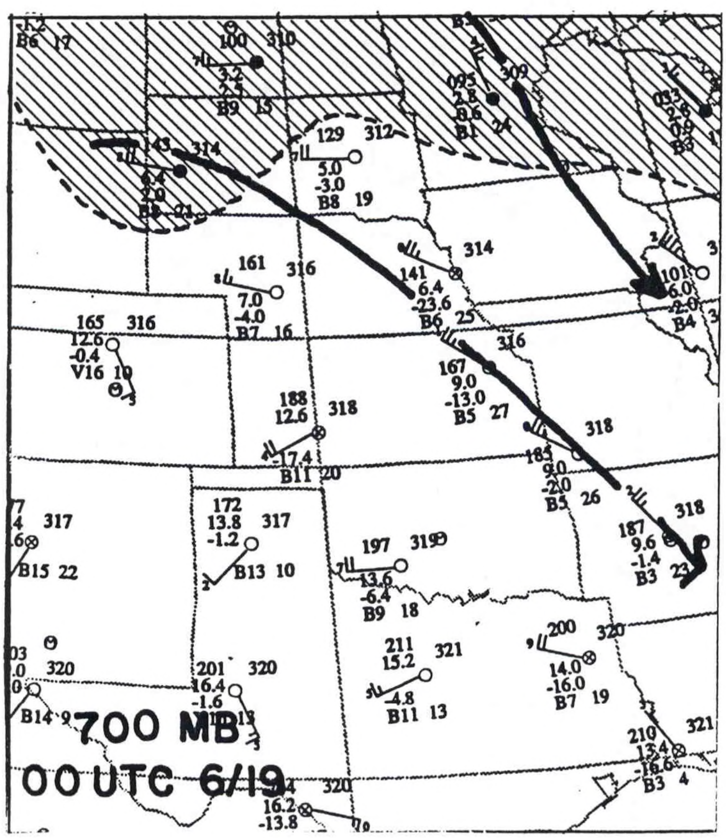

Figure 3
0000 UTC 19 June 1992 700 mb plot

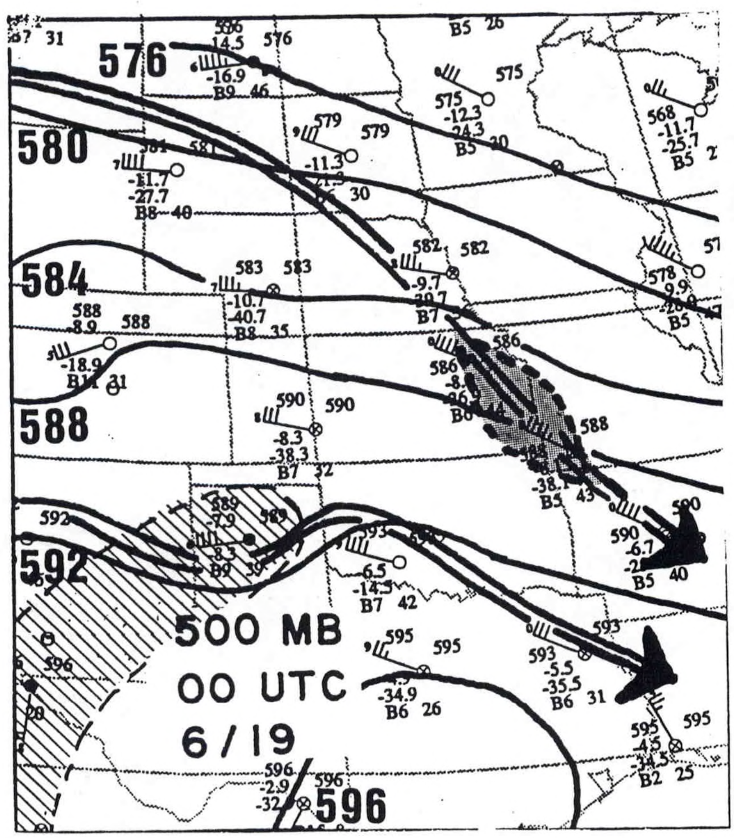

Figure 4
0000 UTC 19 June 1992 500 mb plot

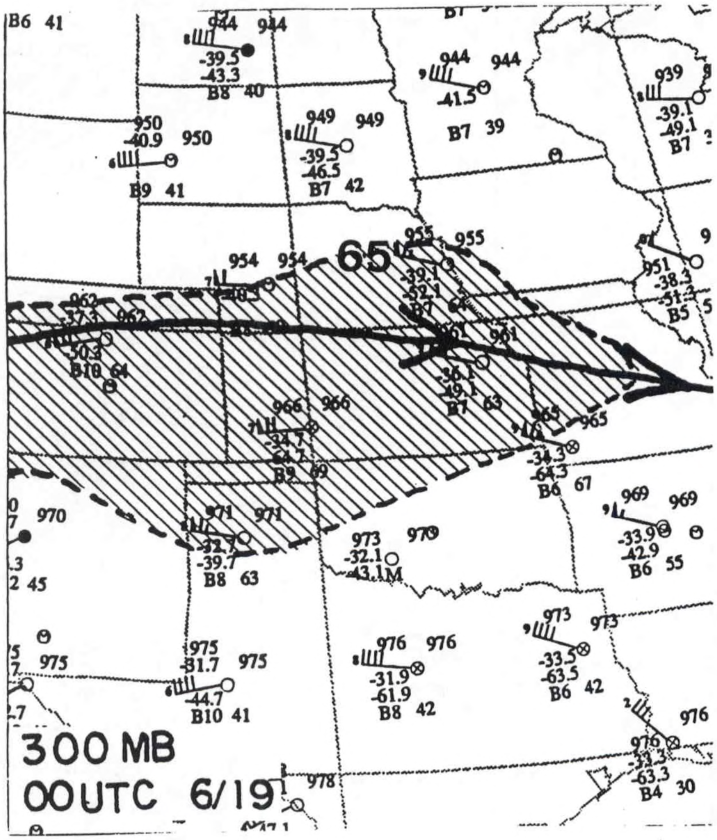

Figure 5
0000 UTC 19 June 1992 300 mb plot

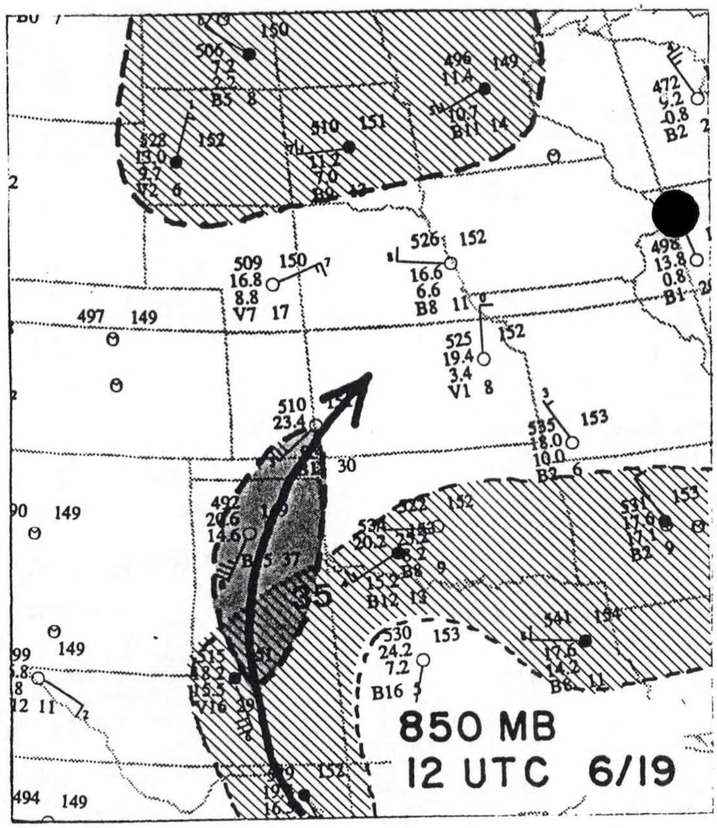

Figure 6
1200 UTC 19 June 1992 850 mb plot

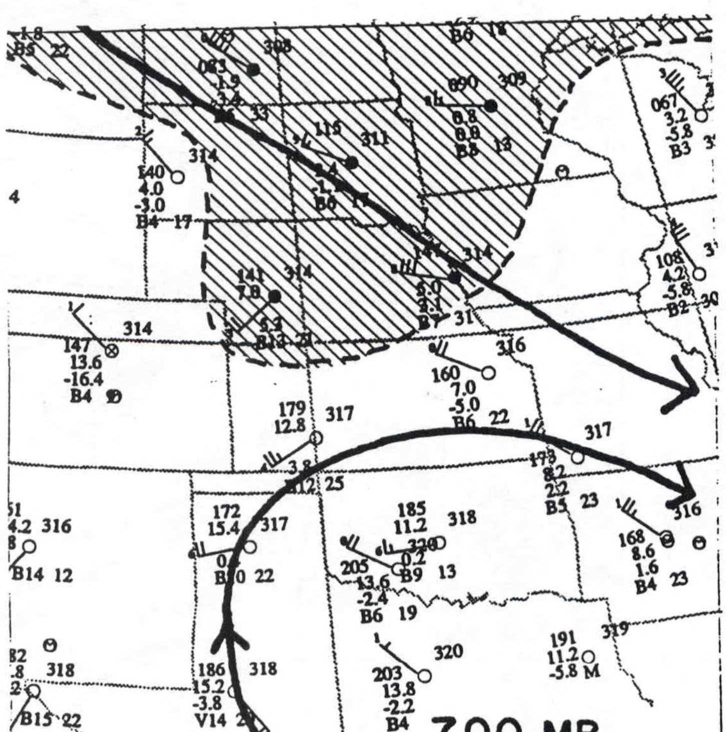

Figure 7
1200 UTC 19 June 1992 700 mb plot

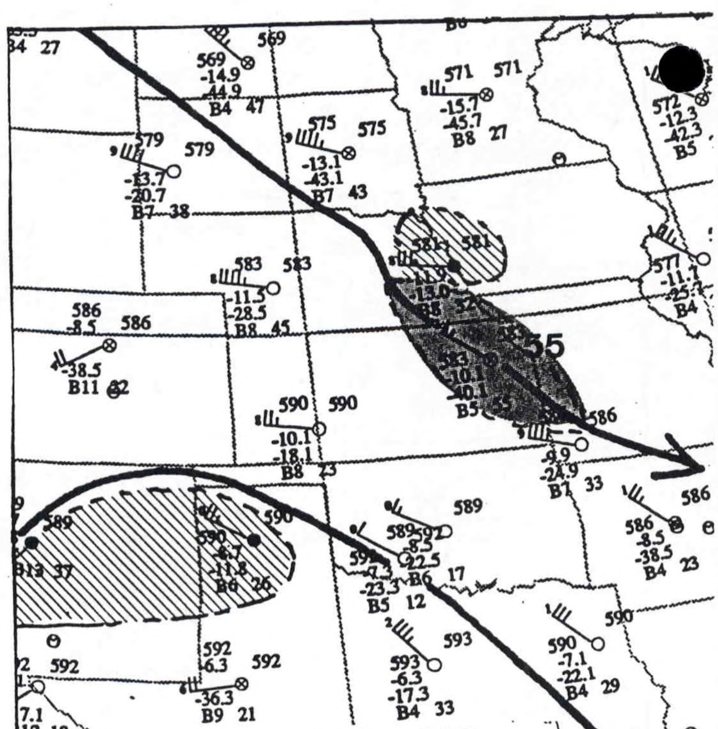

Figure 8
1200 UTC 19 June 1992 500 mb plot

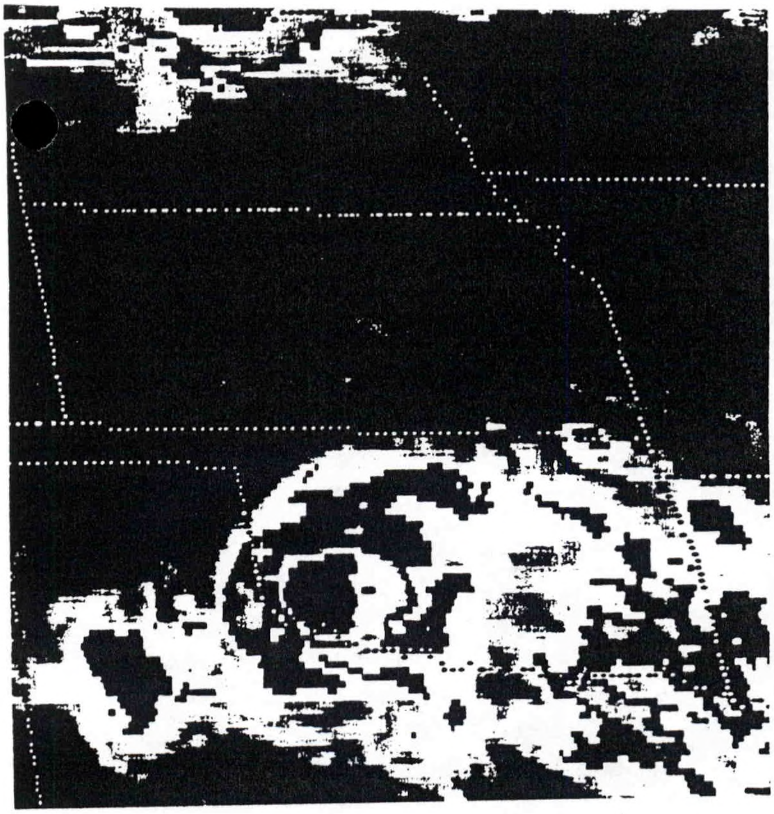

Figure 9
0630 UTC 19 June 1992
Satellite imagery

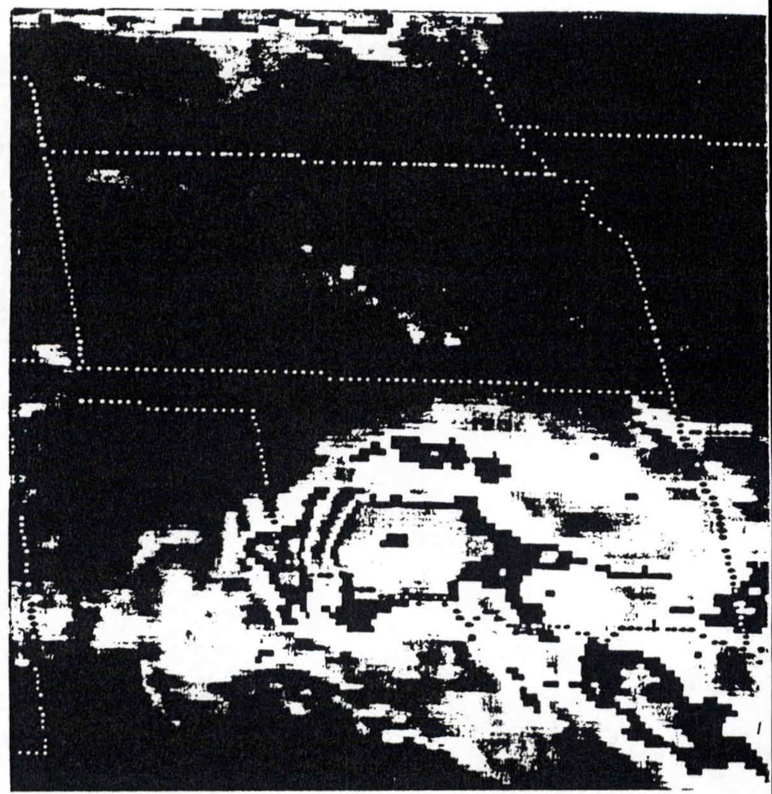

Figure 10
0730 UTC 19 June 1992
Satellite imagery

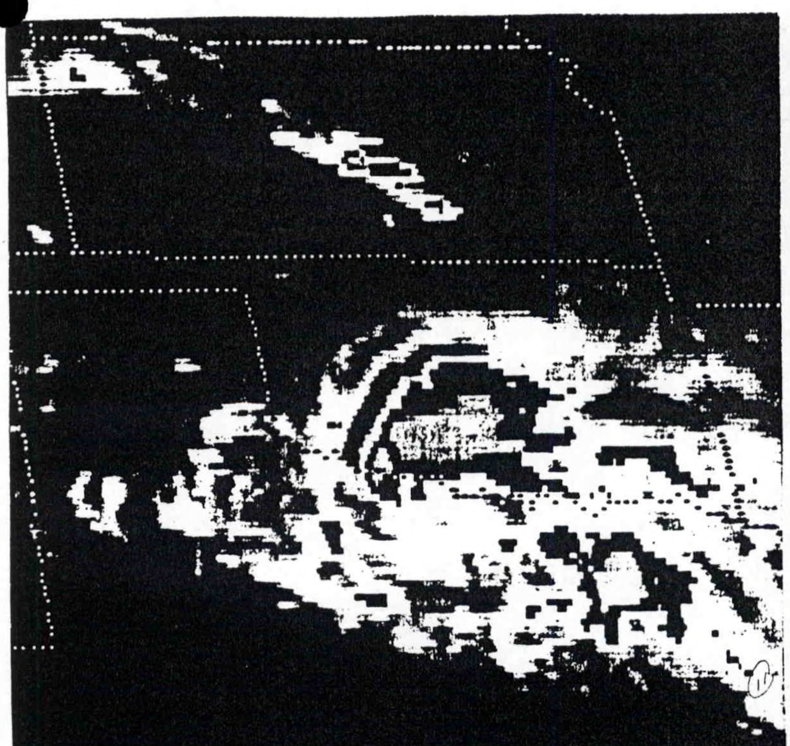

Figure 11
0830 UTC 19 June 1992
Satellite imagery

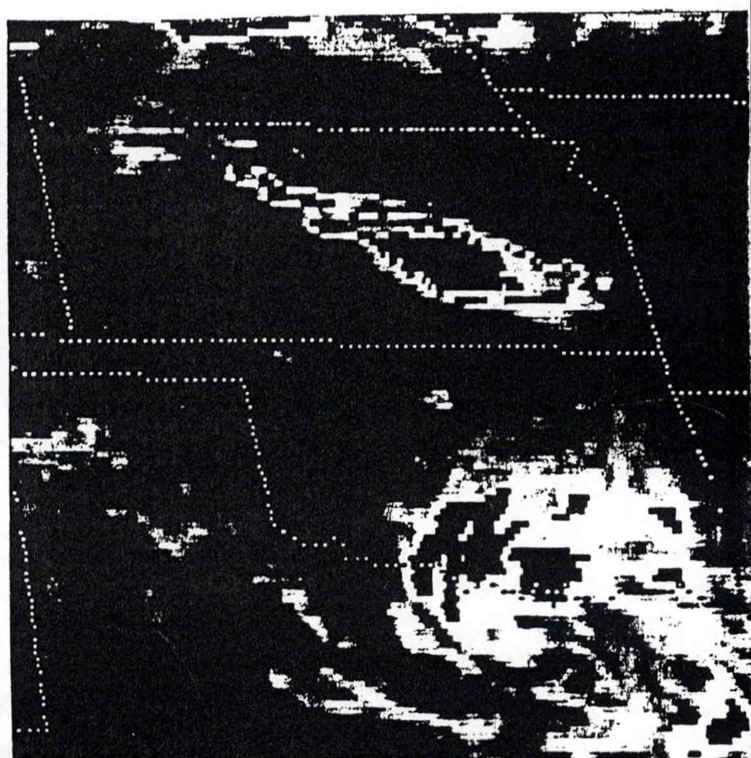

Figure 12
1000 UTC 19 June 1992
Satellite imagery

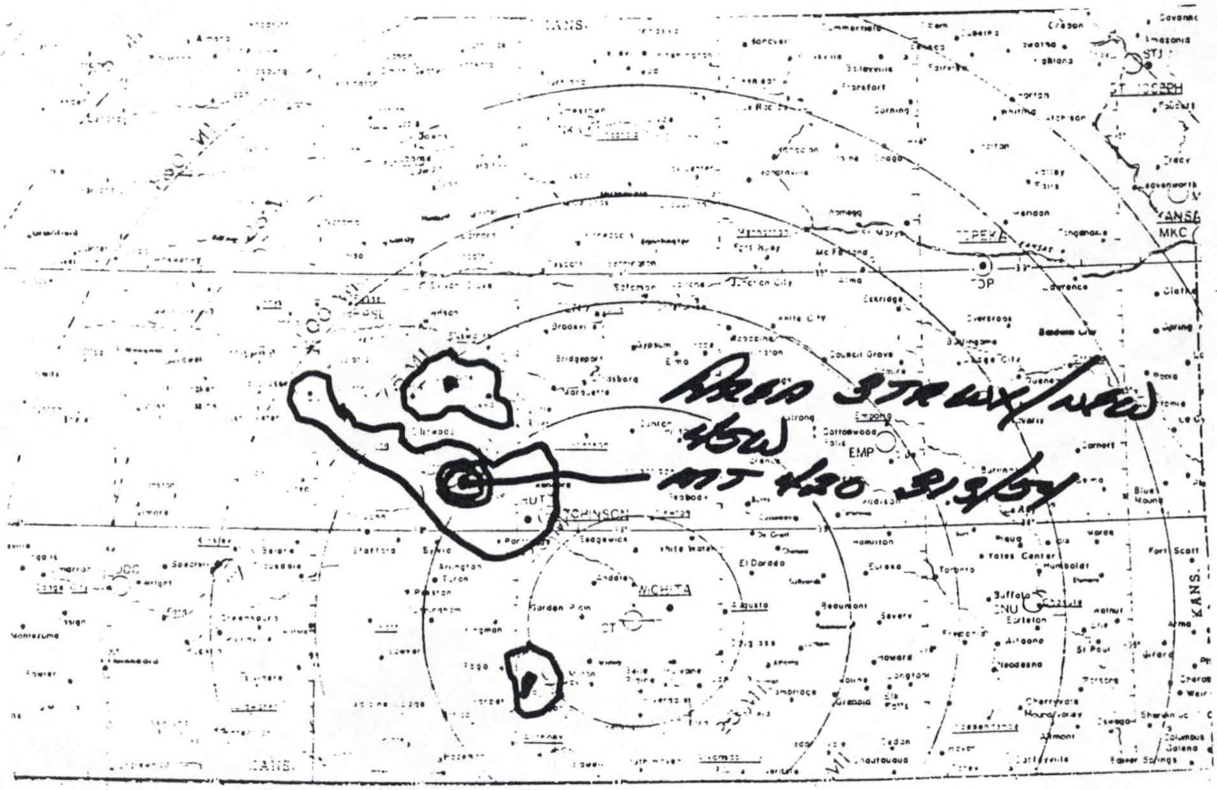

Figure 13
0825 UTC 19 June 1992 Radar overlay.