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SATELLITE SIGNATURES FROM MAY 9, 1988

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1. Introduction

A severe weather outbreak occurred over the Ohio Valley and Great Lakes areas on May 9, 1988. The system depicted numerous satellite signatures that are typical of cold core outbreaks. In addition, several mesoscale thunderstorm signatures were also observed. This paper briefly describes these signatures in an attempt to emphasize how satellite data can greatly aid duty forecasters in determining the potential for severe storms.

2. Discussion

The typical satellite pattern for a cold core severe outbreak is illustrated in Figures 1 and 2. The vertically stacked low pressure center is located at Point A in both figures, defined by a pattern of mid and high level clouds swirling into the low center (Goetsch, 1988a). At Point B, a secondary vorticity trough is identified rotating east around the center. This feature will often act as the trigger to fire afternoon convective activity, and can usually be tracked through the day (from Figure 1 through 3). Also essential for a cold core outbreak is the dry slot (Point C in Figures 1 and 2). This relatively clear area ahead of the upper low is caused by mid level dry air being wrapped around the deepening system, as it becomes closed off. The dry slot is very important for severe development (Miller, 1975). It allows diurnal heating of the low level atmosphere which, in turn, destabilizes the environment. Without this heating/destabilization associated with the clear air slot, severe storms often don't develop.

A case in point is shown in Figure 3 where a vorticity trough had moved over an area that had destabilized because of diurnal heating. A line of severe thunderstorms fired on the vorticity trough itself (Point C to D). Typically, convection in cold core outbreaks will have relatively warm tops. This is because the tropopause and equilibrium points are located at relatively low levels. Cloud top temperatures in this case were in the light grey enhancement of the MB curve (from -41 C to -52 C). Cold air advection at 500 mb also aided in destabilization, as the upper level cold core moved east toward the outbreak area. Severe reports associated with these storms consisted of large hail and wind damage.

Severe storms continued over Ohio ahead of the upper cold core through 2200Z (Figure 4). Farther south, over Kentucky, other storms had also strengthened (from B to C). However, these storms were not classified as "Cold Core" type. They did not form ahead of the low, in the cold advection pattern aloft and were located a large distance from the upper low center (Point A). These storms developed in response to a weak upper level jet over the area, plus low level convergence on the cold front.

The Kentucky thunderstorm became very strong by 2330Z (Figure 5). An overshooting top pattern was seen in the visible data at Points A and B. This satellite signature indicated the presence of very strong, high speed updrafts. Also notice the hard, well defined cloud edges on storm A. This also signifies a rapidly developing strong storm (Goetsch, 1988b).

Through 0100Z (Figure 6), cloud tops remain cool with apparent overshooting tops seen at A. Further intensification continued between 0100Z and 0200Z (Figure 7), depicted by rapid cooling. Note the small dot of black enhancement seen in the cirrus canopy of the storm at Point A in Figure 7 (blank enhancement temperature in the MB curve ranges from -58 C to -62 C). This feature is the signature in the IR imagery of an overshooting top. Also illustrated is a tight IR gradient on the outside of the southern portion or inflow side of the cell. This is again a signature of a storm with a strong, high speed updraft (Goetsch, 1988b). Severe weather will often occur with these types of satellite signatures, provided the correct synoptic situation exists. In this case, a tornado was produced which caused extensive damage to the town of Middleboro, Kentucky, near the dot (overshooting top) in Figure 8.

3. Conclusion

Satellite imagery can be an extremely valuable tool to use in forecasting severe local storms. Numerous signatures seen in satellite data can be used to help identify possible destructive storms. However, it should never be used by itself to issue warnings! Only by combining upper air, surface reports, real-time radar data, and spotter information with satellite data, can an accurate forecast and warning program be accomplished. "Satellite pictures" are just another tool that can provide a tremendous amount of additional information on storms that might possibly produce severe weather if conditions are right.

4. References

Goetsch, E. H., 1988a: Forecasting cold core severe weather outbreaks. Preprints, 15th Conf. on Severe Local Storms (Baltimore, MD), Amer. Meteor. Soc., Boston, 468-471.

__________, 1988b: Satellite interpretation techniques involving thunderstorms. Preprints, 3rd Conf. on Satellite Meteorology and Oceanography (Anaheim, CA), Amer. Meteor. Soc., Boston, 152-157.

Miller, R. C., 1975: Notes on analysis and severe storm forecasting procedures of the Air Force Global Weather Central. Air Weather Service Tech. Rpt. 200 (Rev.), HQ Air Weather Service, Scott AFB, IL, 190 pp.

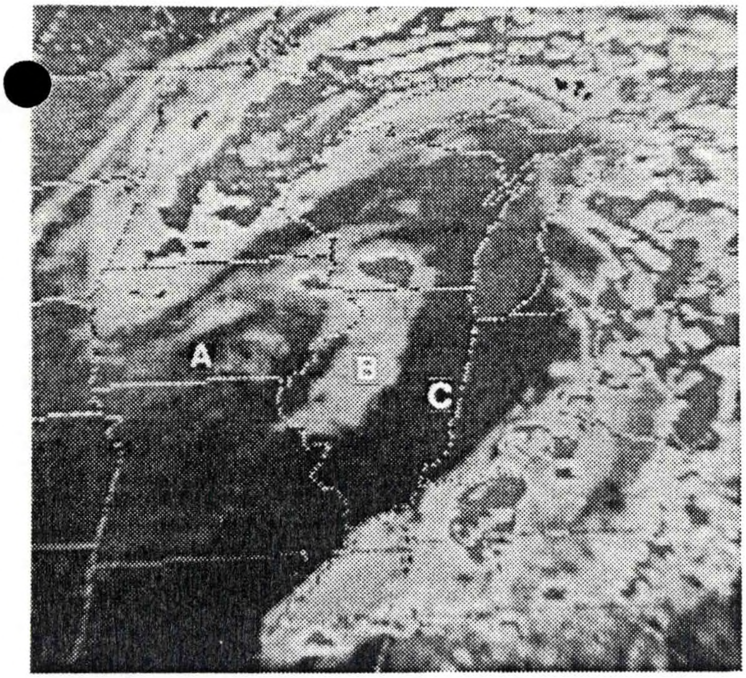

Figure 1. One mile 2 km infrared, MB enhancement curve, 0900Z, May 9, 1988.

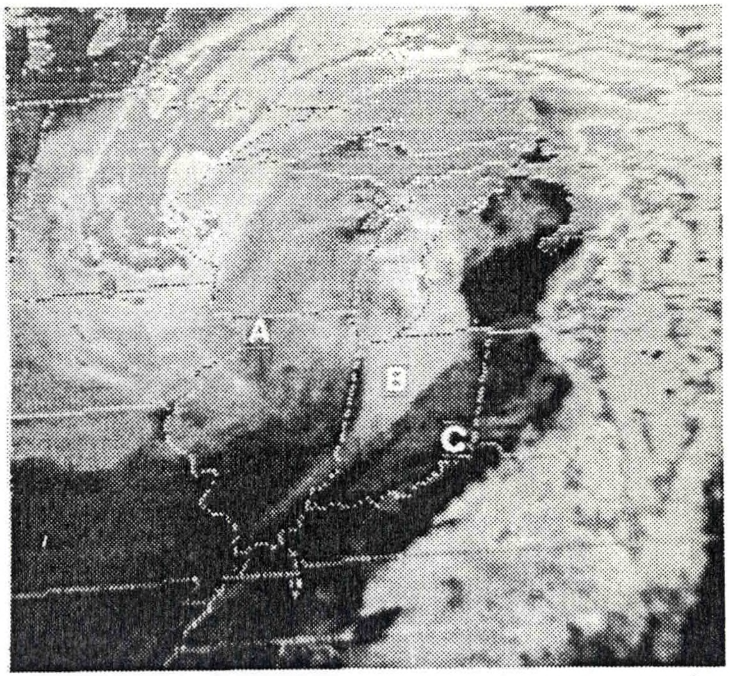

Figure 2. One mile 2 km infrared, MB enhancement curve, 1400Z, May 9, 1988.

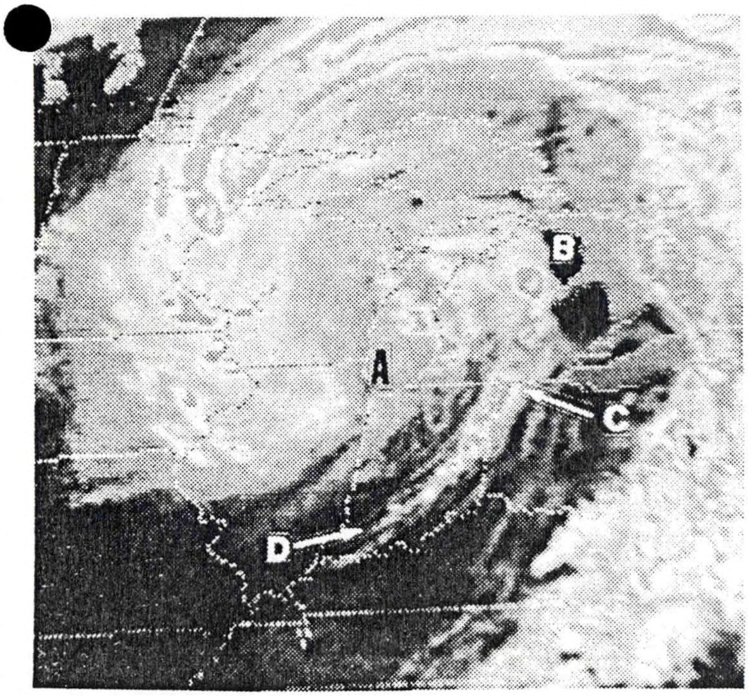

Figure 3. One mile 2 km infrared, MB enhancement curve, 1700Z, May 9, 1988.

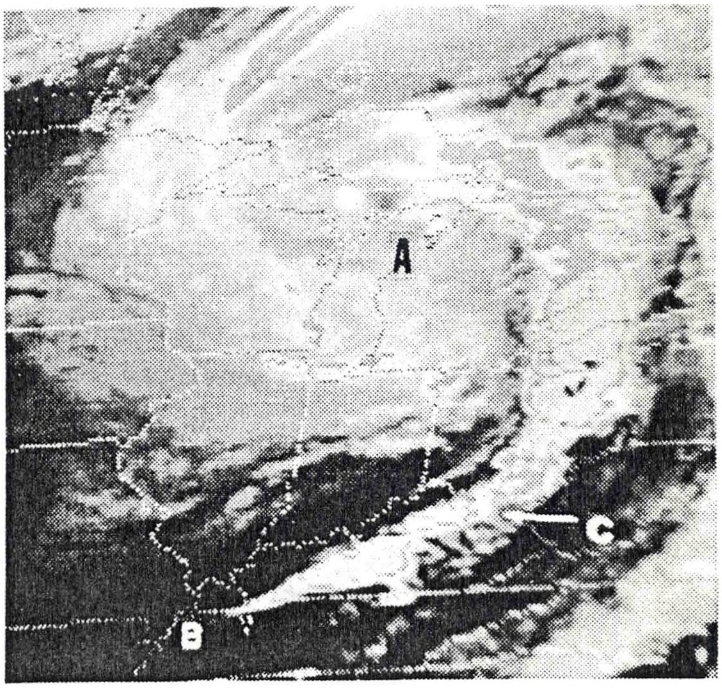

Figure 4. One mile 2 km infrared, MB enhancement curve, 2200Z, May 9, 1988.

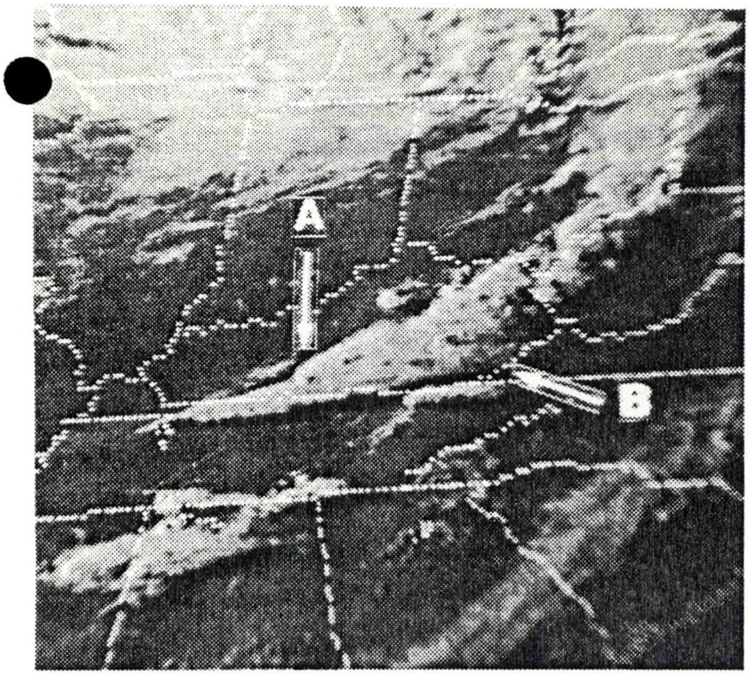

Figure 5. One mile 2 km visible, 2330Z, May 9, 1988.

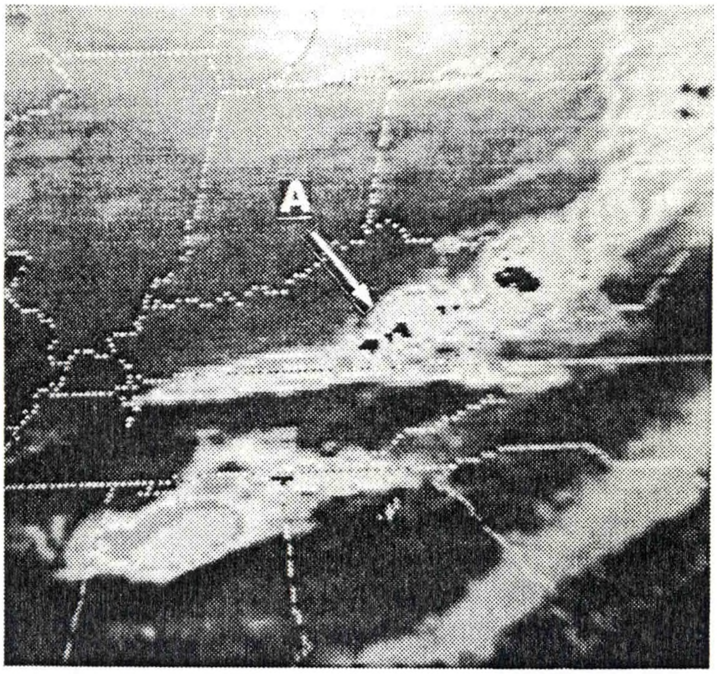

Figure 6. One mile 2 km infrared, MB enhancement curve, 0100Z, May 10, 1988.

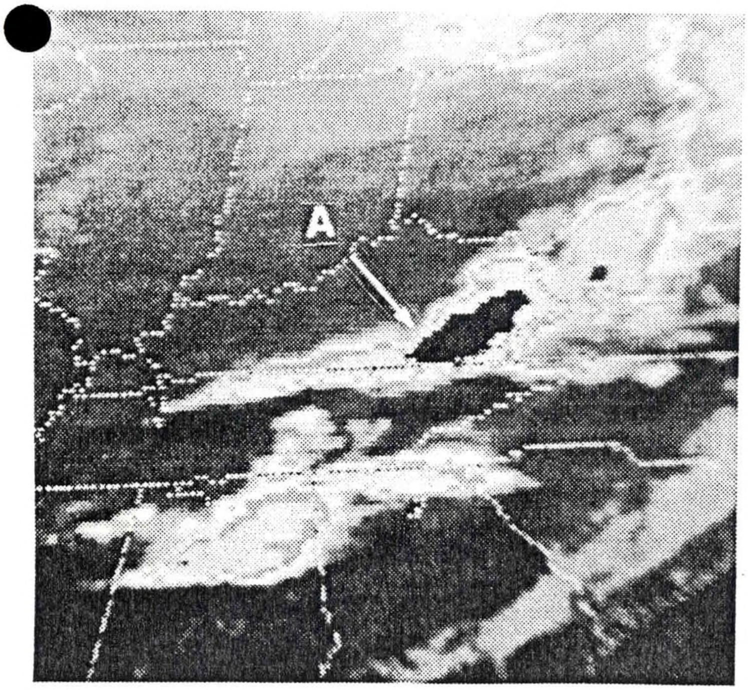

Figure 7. One mile 2 km infrared, MB enhancement curve, 0200Z, May 10, 1988.

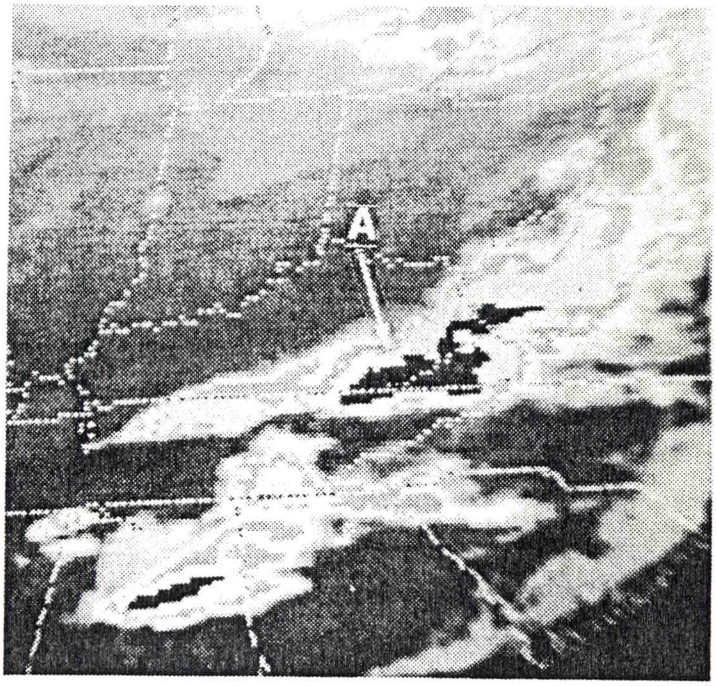

Figure 8. One mile 2 km infrared, MB enhancement curve, 0300Z, May 10, 1988.