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# A CASE STUDY OF A MESOSCALE VORITICITY CENTER

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*Editor's Note: Numerous geographical locations are mentioned in this attachment. A map, Figure 0, is included that shows some of these locations.*

## 1. Introduction

On the afternoon of July 11,1987 a weak short wave moved east through the Ottawa valley of Quebec and Ontario. It appeared to be the triggering mechanism for a convective cluster, that moved through the Ottawa Valley, and into the St. Lawrence Valley of New York during the late evening. The convective cluster then moved south into the Adirondack region. This cluster produced a " Mesoscale Vorticity Center" (MVC) (Johnston,E.C.-1982), which appeared to be the triggering mechanism for a convective outbreak and 2 severe storms over eastern New York the afternoon of July 12th. This paper is a case study of the event, and how satellite interpretation was used in locating the MVC, and outflow boundaries in real time at the WSFO.

## 2. Events, Upper Air and Stability July 11, 1987.

The airmass across Upstate New York and adjacent areas of Canada was quite moist and unstable. The lifted index (LI) at 12z at Buffalo was -5, the K index was 35 , and the total totals was 47. The precipitable water was 1.88 inches. At Albany the LI was -5, the K index 32, and total totals was 45. The precipitable water was 1.81 inches (70% above normal). By afternoon temperatures were in the lower 90s and dewpoints were in the lower 70s from New York to southern Ontario, including the Ottawa Valley. The surface flow was light southwest with a very weak pressure gradient across the region. The 1701z satellite imagery (figure 1) had a weak short wave trough moving east, just north of the Ottawa valley. A weak surface dewpoint front was moving east across the Ottawa valley. (figure 2)

Between 1731z and 1831z several thunderstorms developed in the Ottawa Valley (figure 3). This area of convection grew during the afternoon and became persistent. It drifted slowly southeast reaching the St. Lawrence Valley around 00z (figure 4). The area weakened between 00z and 0231z (figure 5).

3. Events, Upper Air and Stability 00z-12z July 12.

At 00z July 12, 1987 the airmass remained moderately unstable across New York and adjacent areas of Ontario and Quebec. Dewpoints were in the lower 70s, the LI was -2 at Albany, with a K index of 38 and precipitable water of 1.92 inches (80 % above normal). The (LI) was -3 at Buffalo, the K index 29 and the precipitable water 1.38 inches.

At 00z, July 12 there was little hint of the first short wave on satellite imagery, but it was still evident on the 500 mb meso-analysis. The short wave was from the St. Lawrence valley to Huntington, West Virginia. It was propagating east. The Manawaki Quebec 500 mb plot showed a patch of drier air at 500 mb, and the 500 mb temperature at Buffalo was 3 degrees C cooler than surrounding stations. (figure 6-500 mb at 00z July 12)

In this favorable environment, a convective complex redeveloped rapidly between 03z and 05z in the St. Lawrence Valley (figures 7,8). At 07z a flood watch was issued for the St. Lawrence Valley. The convective cluster persisted until 08z when the cloud tops with the system began to warm. 3.00 inches of rain fell in St. Lawrence County, producing minor flooding at Canton and Newton Falls.

Between 08z and 11z the system weakened, and by 12z only a few light showers remained (figure 9). Between 10z and 12z the cirrus shield diverged away from the clouds remaining with the system.

4. Events, Upper air and Stability 12z to 23z July 12, 1987

The 1230z satellite imagery revealed the thunderstorm complex left behind a MVC, located just north of Glens Falls, New York (figure 10). These have rarely occurred in the northeast part of the United States. The MVC appeared as mainly middle clouds on the satellite imagery. Glens Falls, the closest observation point to the MVC, had ceilings of 8000 to 10000 feet from 10z to 15z. The MVC's appearance and chacteristics fit the Johnston model of MVCs well. The MVC was not noticable at 500 mb (figure 11)

At 12z on the 12th, the stability situation across eastern New York and western New England had changed little. At Albany, the LI was -5, and the precipitable water was 1.40 inches (30 % above normal). Dew points were in the lower 70s across the region. The steering winds were light up through 300 mb, and were under 15 knots.

The surface flow (figure 12), remained light southwest, and the airmass was rather uniform across New York and western New England. A weak surface trof was noticable with the MVC. The trough drifted slowly east to western New England by 18z. The forcasters at WSFO Albany were expecting another day of active convection. The area to the south of the MVC, was the prime area initial development was expected. Cumulus development in this area, showed several converging lines spiraling toward the MVC center. (figure 10).

The first few hours of heating produced rapid redevelopment of cumulus in MVC area, and just south of it from 12z-14z (figure 13). On the MVC's periphery, also the area of differential heating due to cloud cover, an arc of thunderstorms developed by 1531z from Herkimer County to Fulton and Saratoga Counties. (figure 14). Other convection developed quickly just west of the Connecticut River Valley in southern Vermont ahead of the MVC (figure 15).

The MVC appears to have initiated the convection in the favorable environment that existed over eastern New York and Vermont the 12th. Careful attention to the interaction of outflow boundaries that followed was operationally useful in predicting new convection.

The most rapid convective development occurred over southeast Hamilton County. These thunderstorms moved into Saratoga County. Albany radar detected a vip 5 core of 27 thousand feet, and small hail fell at Speculator, in Hamilton County between 1605z and 1625z. At 1626z a severe thunderstorm warning was issued for Saratoga County. From 1610 to 1630z several thunderstorms developed across the county. Trees and power lines were blown down between 1620z and 1700z.

The thunderstorm complex over Saratoga County produced an outflow boundary on the 1631z imagery (figure 15). Two other features were noticeable on this image. Cumulus development was extensive in two areas, the first was west of the Hudson valley through the Catskills, and the other area of extensive cumulus development was from southern Vermont through the Berkshire mountains. The Mohawk and Hudson valleys were almost devoid of cumulus development.

The Saratoga County storm's outflow propagated south across the Mohawk valley from 17z-18z (figure 16), being very noticeable on the 1801z (figure 17) imagery. Thunderstorm development did not occur in the Mohawk Valley itself as the outflow boundary went south through it.

The outflow boundary passed directly over WSFO Albany on its way south. The arc line of towering cumulus was easily seen looking south from the office. The surface wind went from SSE at 6 knots to N at 13 knots when this line passed, and remained north for a little over an hour at Albany.

The 1731z imagery (figure 16), also shows a thunderstorm developing near the Helderburg escarpment in the northern Catskills. It was intersected by the outflow boundry and developed rapidly by the 18z imagery (figure 17).

Between 1800 and 2100z thunderstorms formed adjacent to each other, in the two areas where cumulus development was extensive (figure 18). Each development of thunderstorms was south of the previous, as new convection formed on the previous convections outflow. Radar indicated most of these cells moved little during their lifetimes.

The 2101z imagery (figure 19), and Albany radar observation (figure 20), show a large thunderstorm in western Connecticut, and another in Orange County New York. Between these two thunderstorms on satellite imagery a developing cell can be seen. The Albany radar showed this cell as a rapidly developing thunderstorm over Putnam County, drifting slowly west.

By 2145z this storm between them, had developed rapidly, with its top reaching 47 thousand feet, the vip 6 core reaching 20 thousand feet and the vip 5 core reaching 30 thousand feet. The Maximum top was also over the reflectivity gradient, tilting into the inflow. A severe thunderstorm warning was issued for Putnam County at 2200z. Wind damage occurred in several Putnam County towns with this storm. Figures 21 & 22 are of this storm.

## 5. Summary and Conclusions

In this case the MVC met all 5 of Johnston's criteria for active MVCs. It also appears that the vorticity in the weakening short wave may have been concentrated by the convection into a smaller area, the MVC. The MVC was too small a feature for the numerical models to detect.

MVCs can occur in the northeast states, but are not as common as in the central United States. In a moderately unstable case, the presence of an MVC probably results in more vigorous thunderstorm development than would have otherwise occurred, and the MVC acts as the triggering mechanism.

MVCs can be produced by convective complexes that are not large enough to meet the definition of a MCC. (Maddox,R.C.-1980)

## References

Doswell, C.A. 1982: The Operational Meteorology of Convective Weather Volume I: Operational Mesoanalysis. NOAA Technical Memorandum NWS NSSFC-5. National Severe Storms Forecast Center-Kansas City, Mo. III58-III-66.

Johnston, E.C. 1982: Mesoscale Vorticity Centers Induced by Mesoscale Convective Complexes. Weather Service Forecasting Handbook No. 6 Satellite Imagery Interpretation for Forecasters, National Weather Service Headquarters, May 1986, 4K1-4K5.

Maddox, R.C. 1980: Mesoscale Convective Complexes. Bull. Amer. Mereor. Soc., 61, 1374-1387.

## Acknowledgements

I would like to thank, Roland Loffredo, MIC/AM WSFO Albany, Glen Wiley, Fred Zuckerburg and Hugh Stone, SSD ERH, and Ed Johnson for their assistance in preparing this paper, as well as Bob Thomas for use of his meso analysis material.

Scientific Services Division, ERH
November 10, 1987

Attachments (Figures 0 through 22)

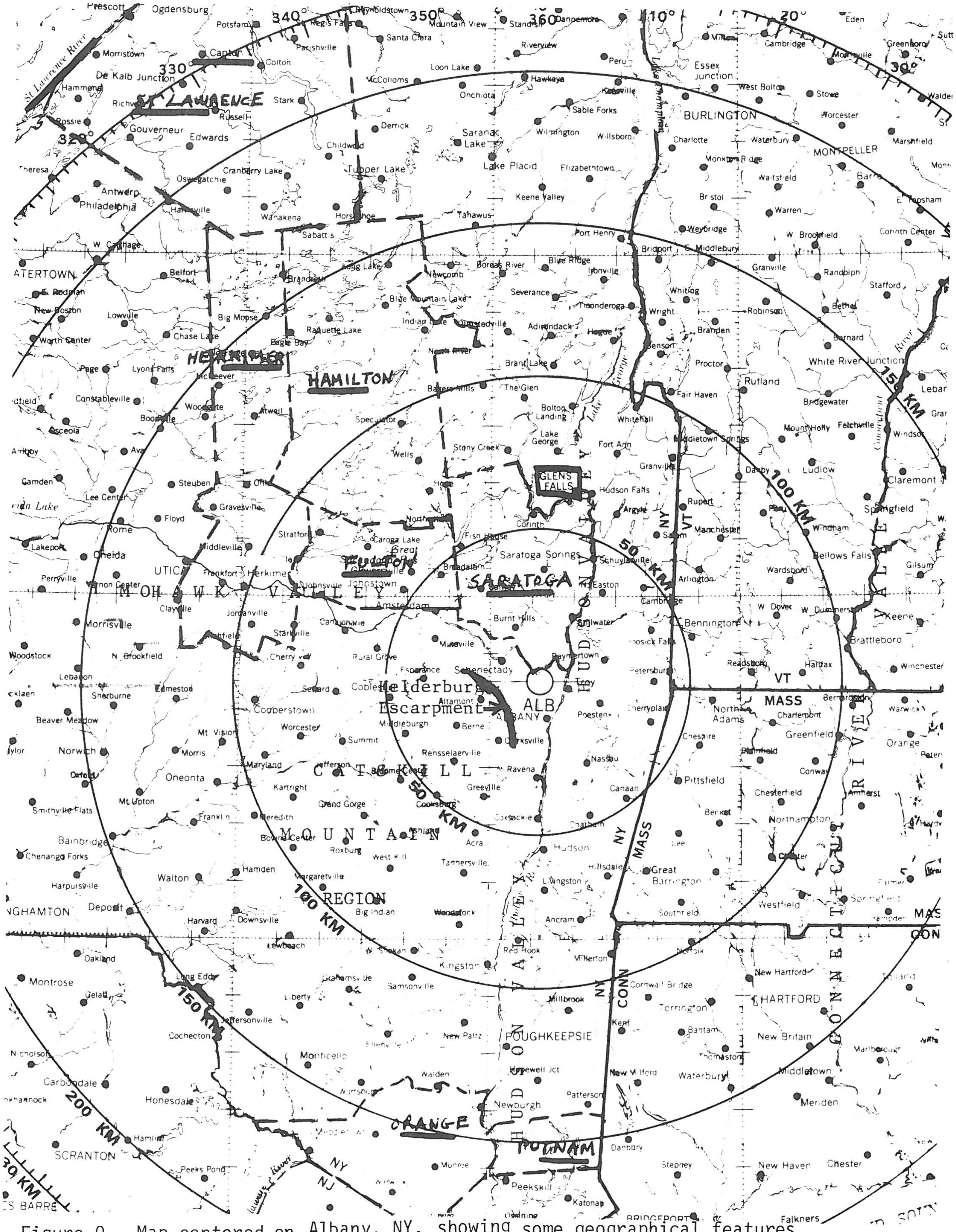


Figure 0. Map centered on Albany, NY, showing some geographical features mentioned in the text.

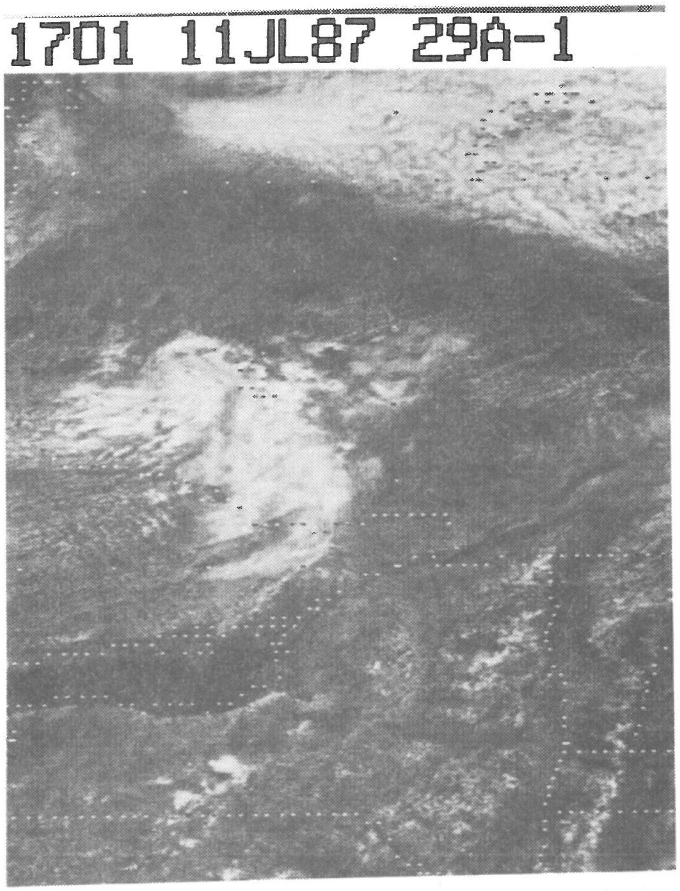


Figure 1. 1701z July 11,1987

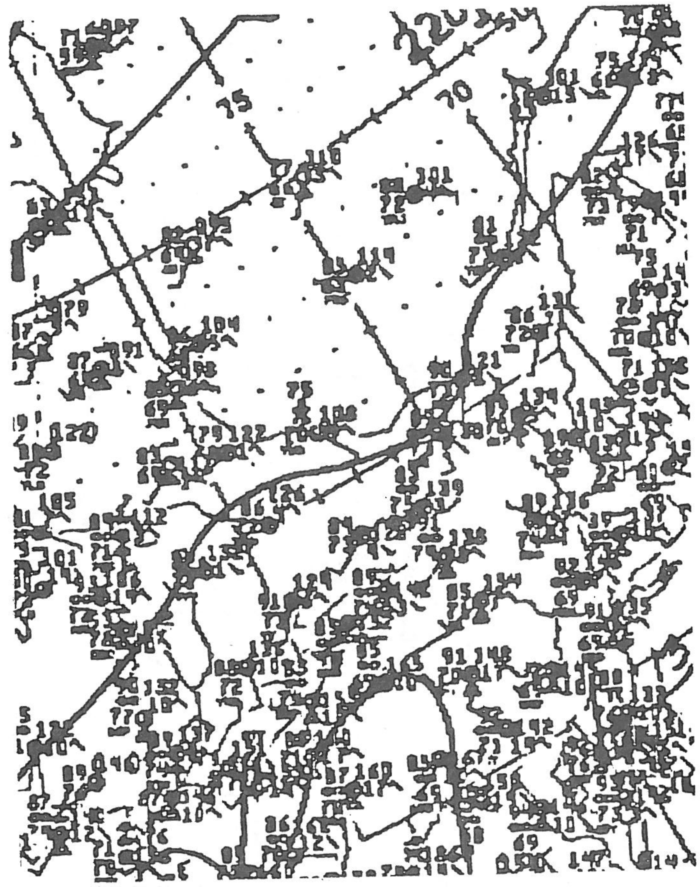

Figure 2. Surface 18z July 11,1987

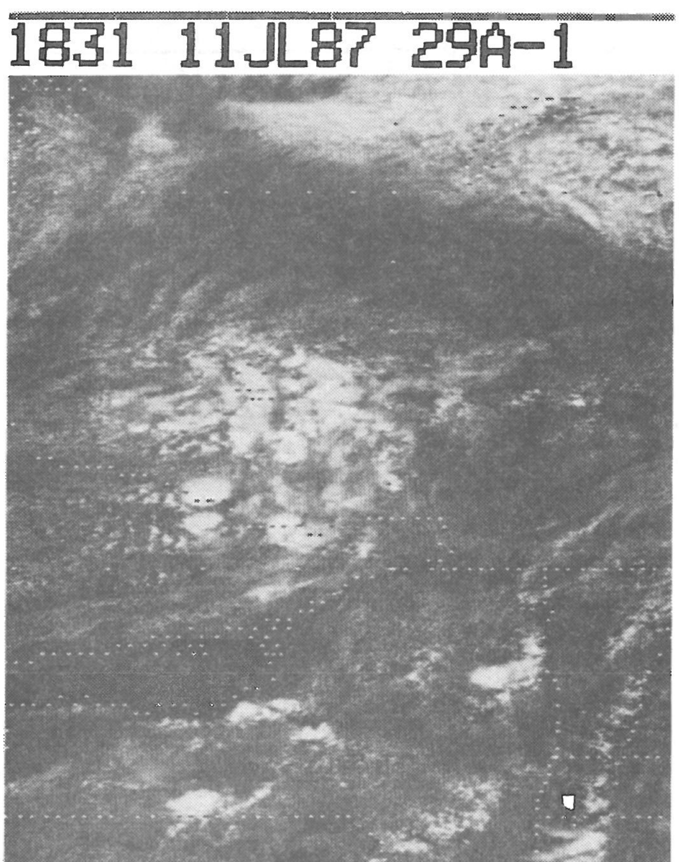


Figure 3. 1831z July 11,1987

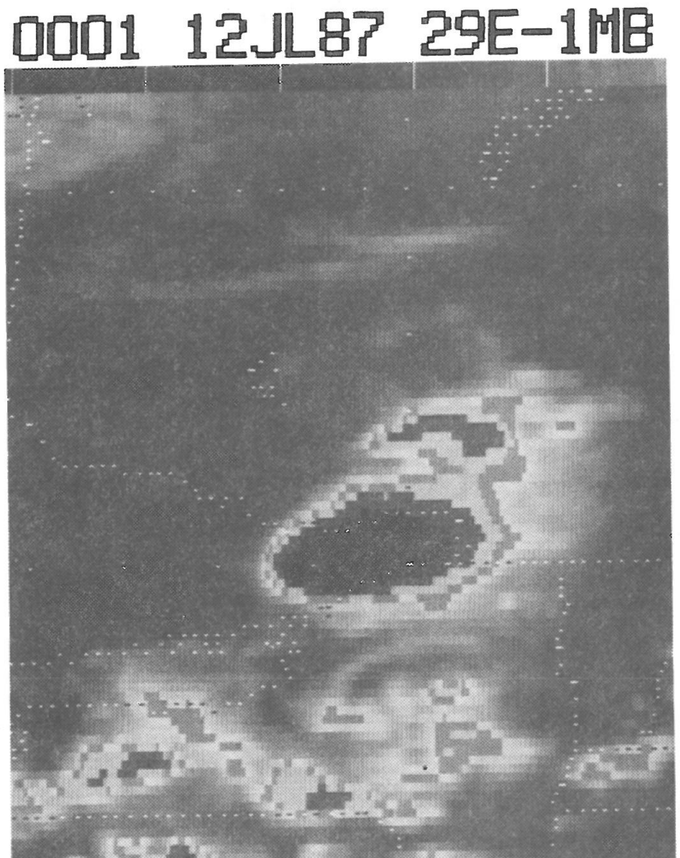


Figure 4. 0001z July 12,1987

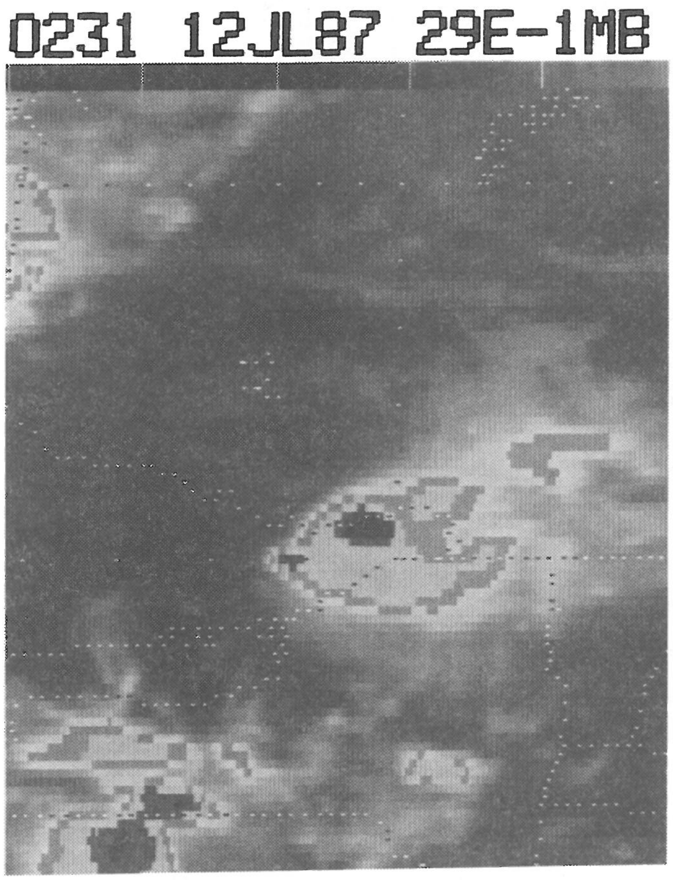


Figure 5. 0231z July 12,1987

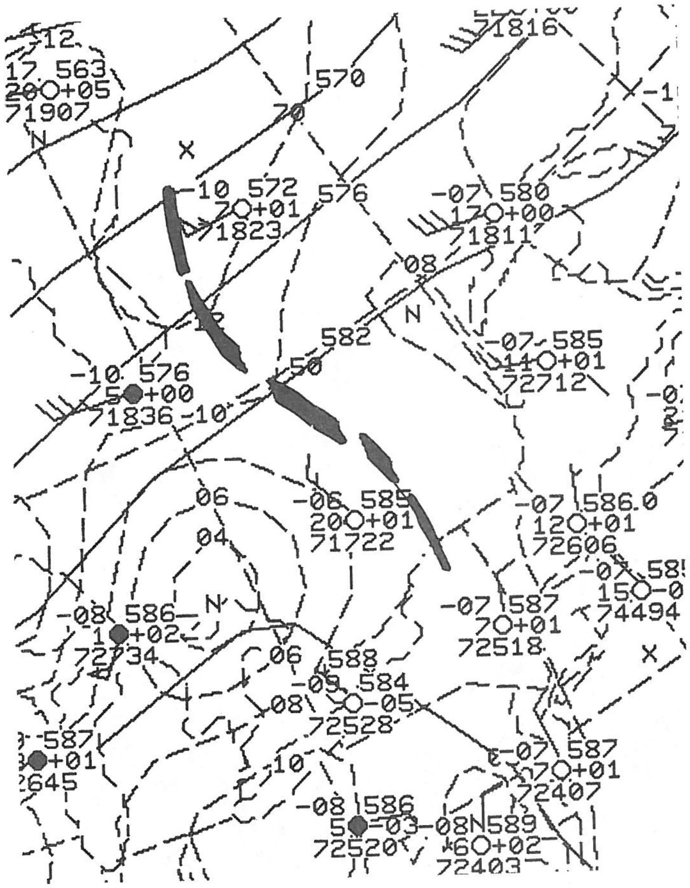


Figure 6. 500 mb 00z July 12,1987

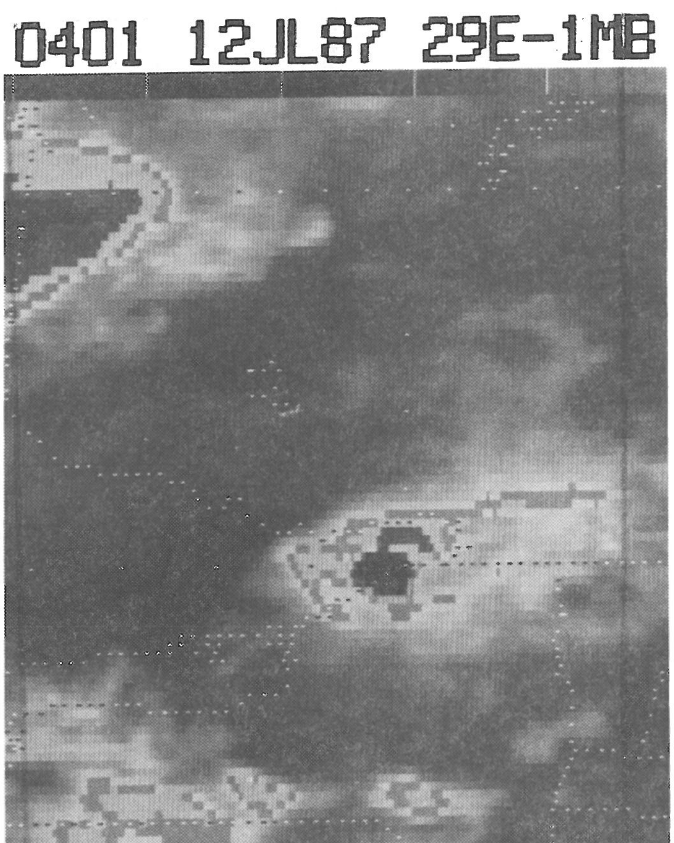


Figure 7. 0401z July 12,1987

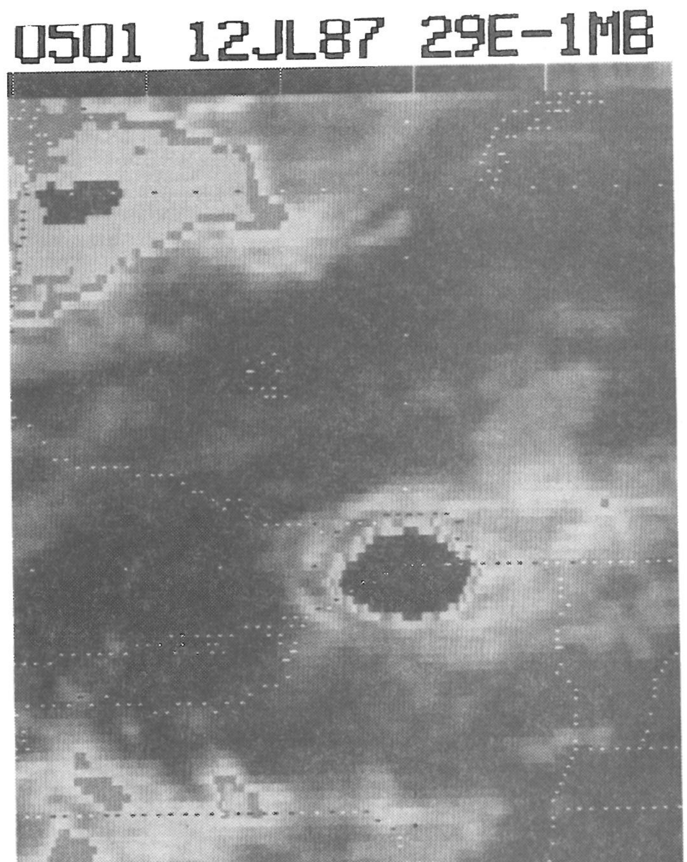


Figure 8. 0501z July 12,1987

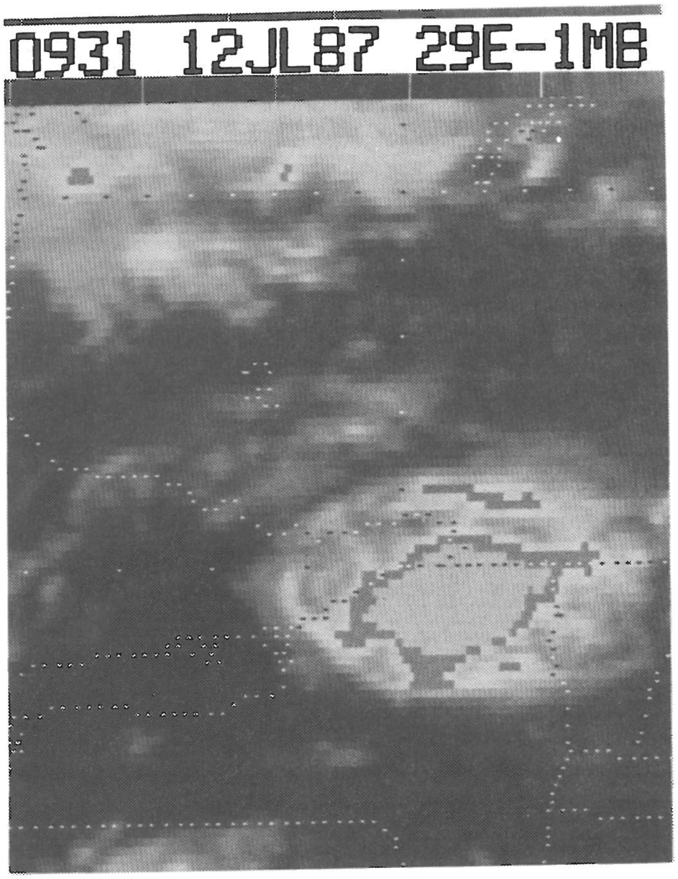


Figure 9. 0931z July 12,1987

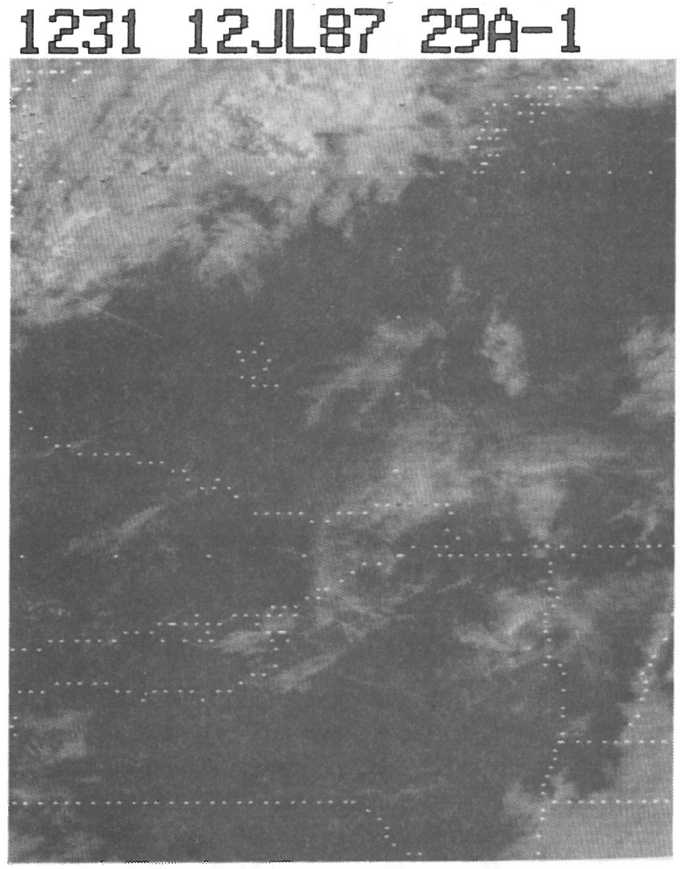


Figure 10. 1231z July 12,1987

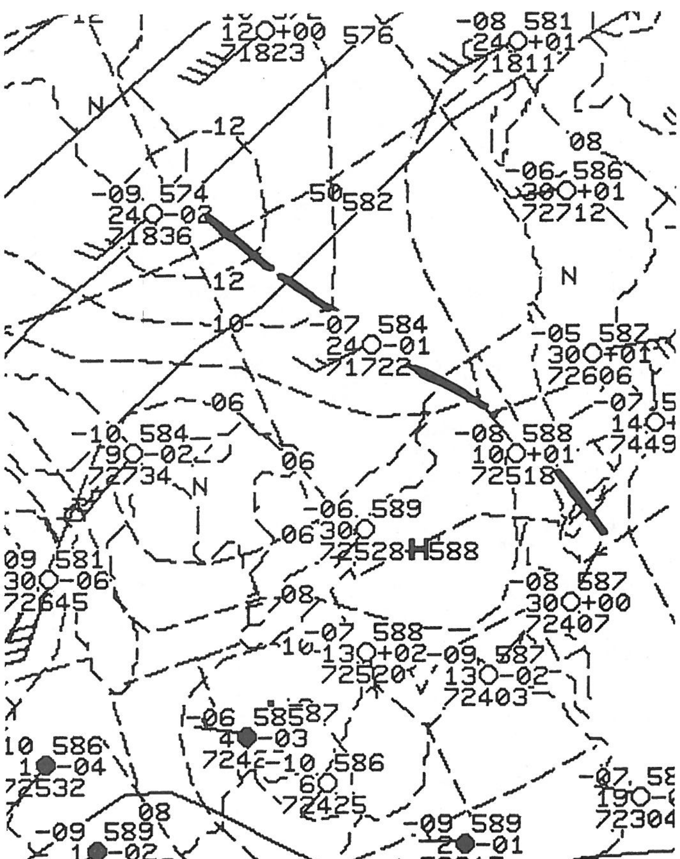

Figure 11. 500 mb 12z July 12,1987

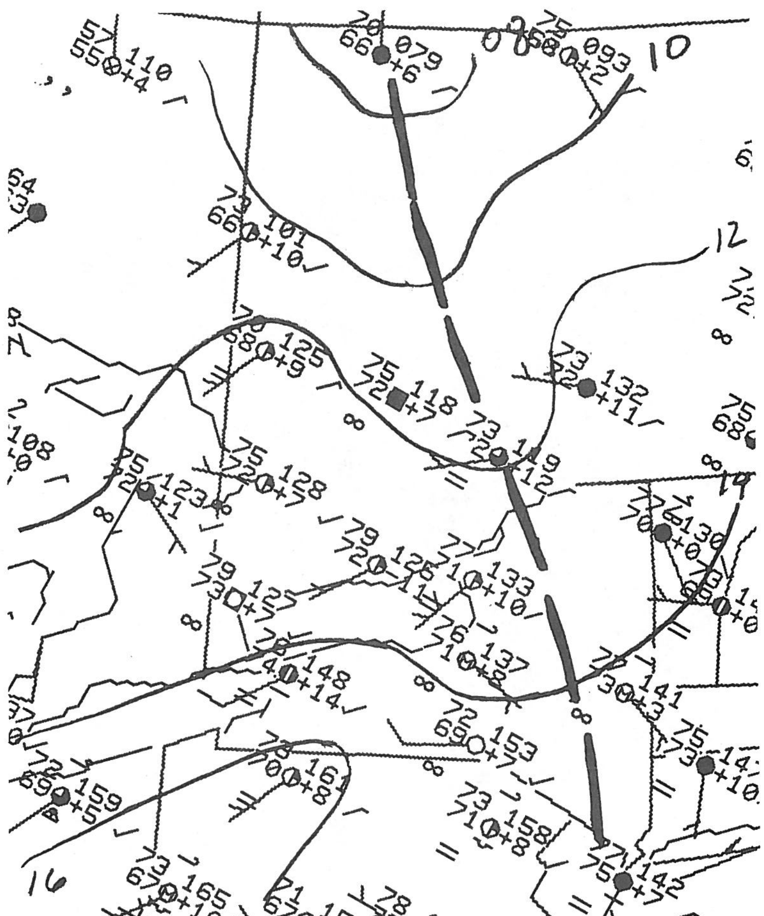

Figure 12. Surface 12z July 12,1987

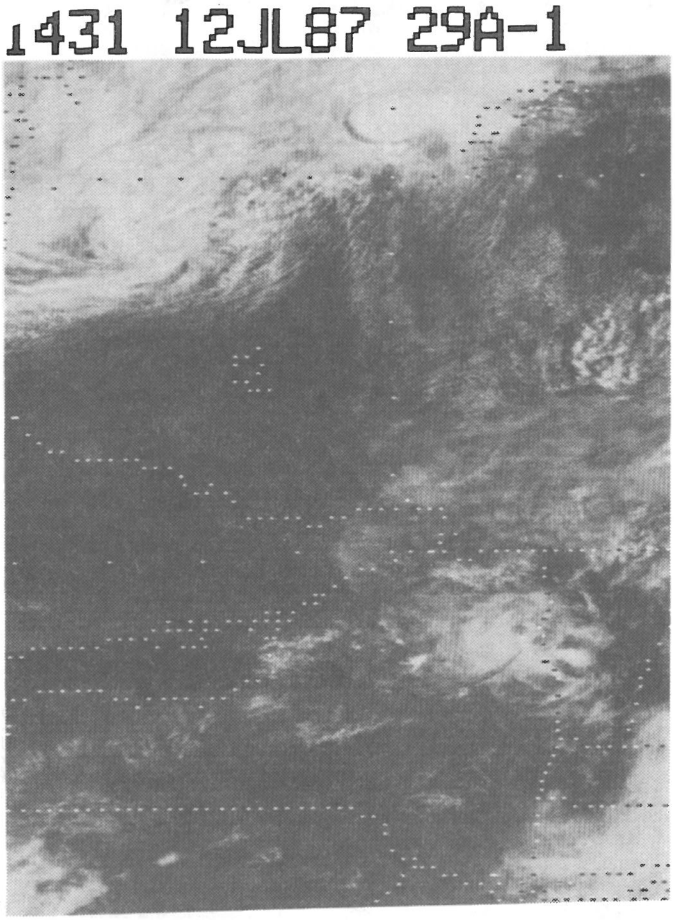


Figure 13. 1431z July 12,1987

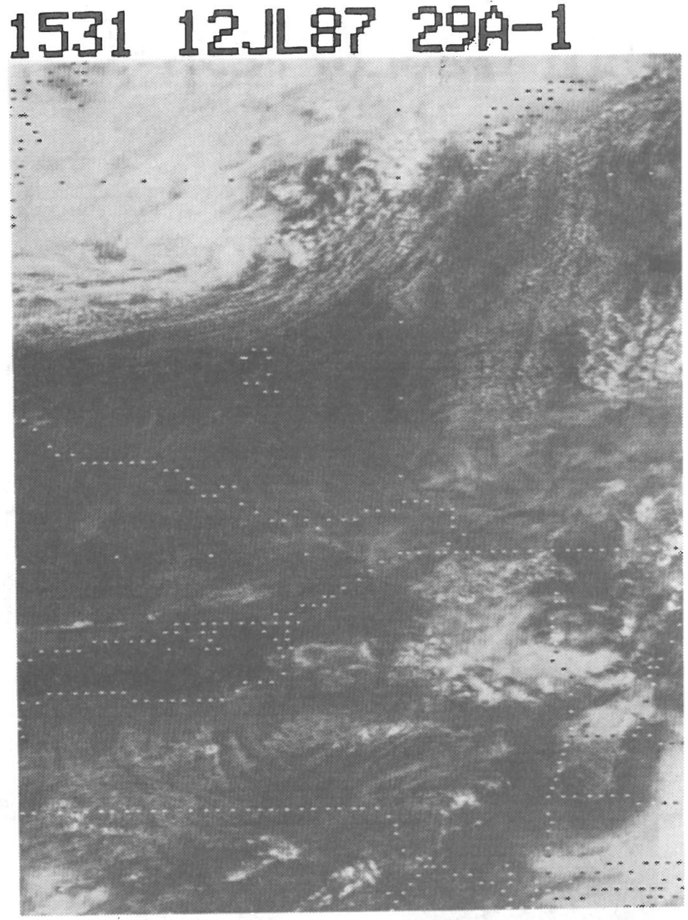


Figure 14. 1531z July 12,1987

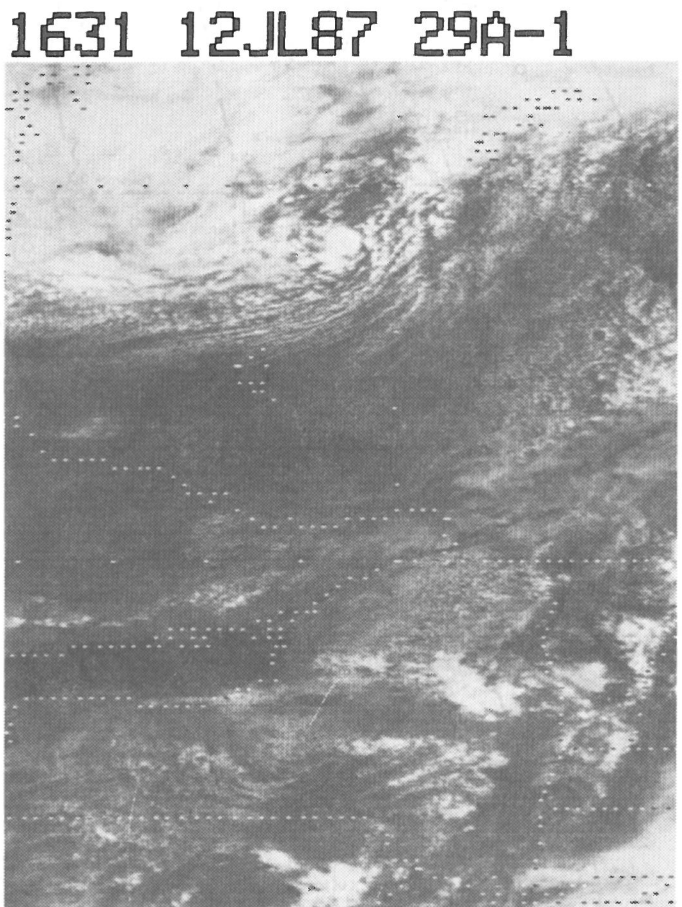


Figure 15. 1631z July 12,1987

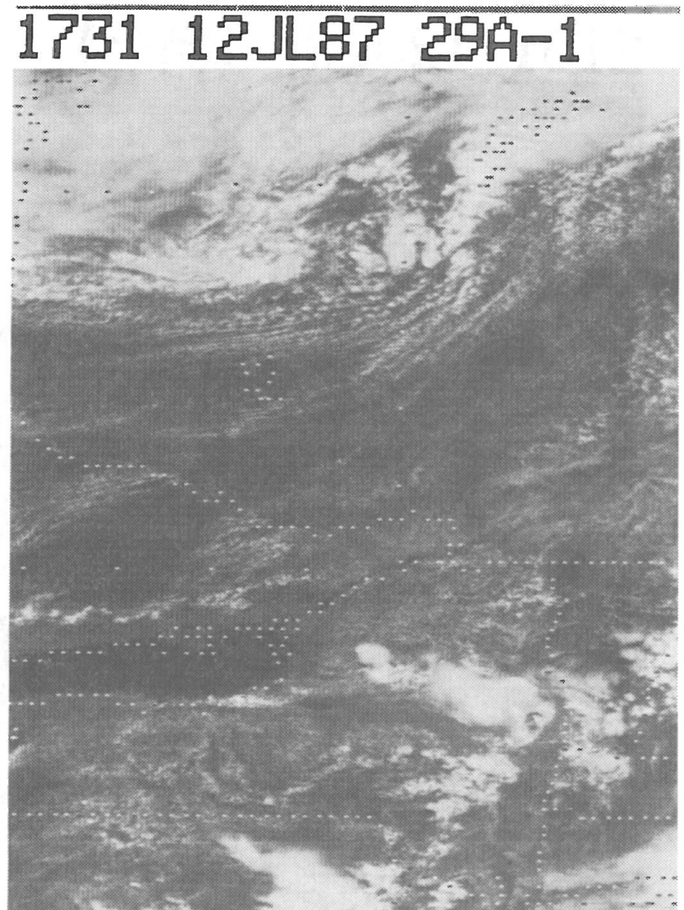


Figure 16. 1731z July 12,1987

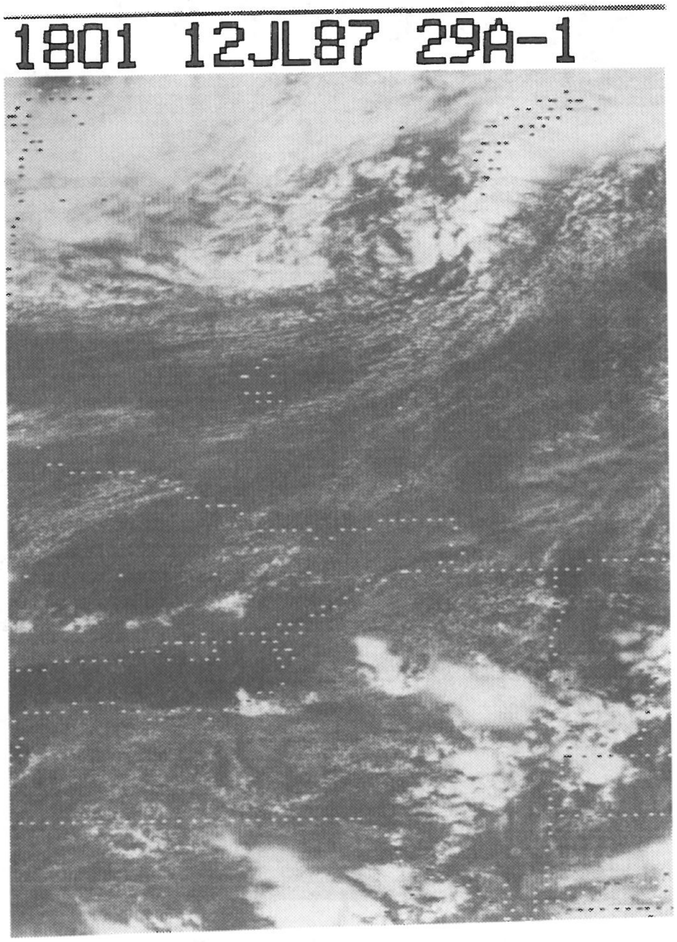


Figure 17. 1801z July 12,1987

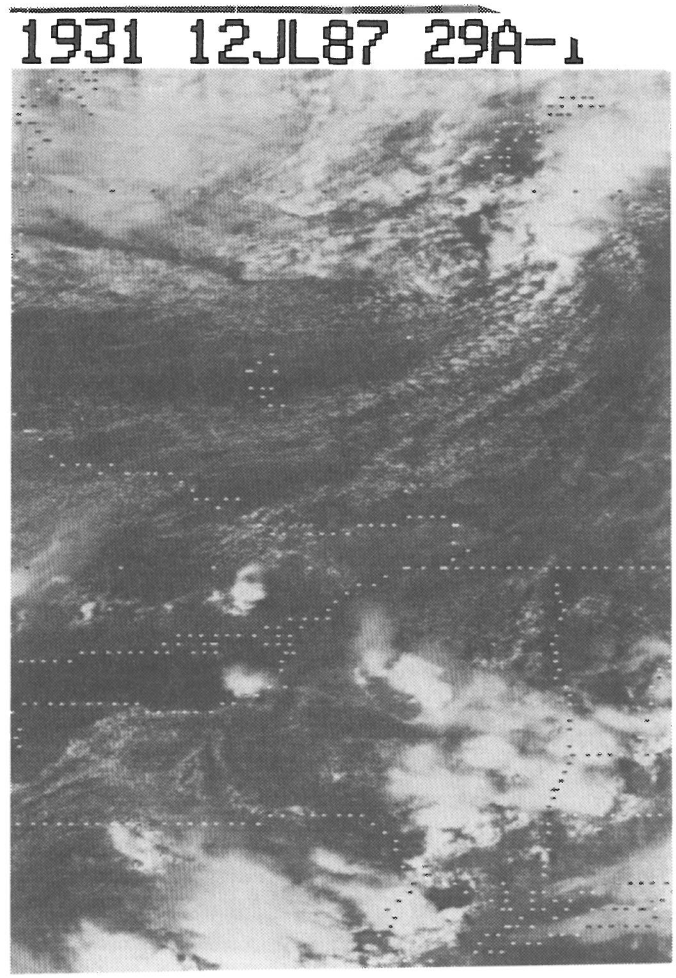


Figure 18. 1931z July 12,1987

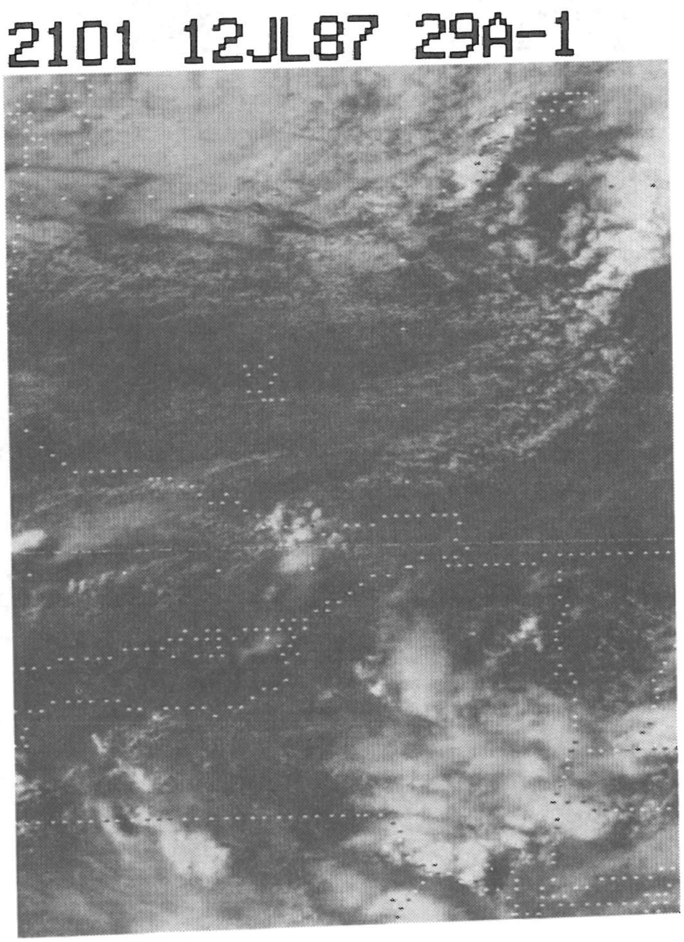


Figure 19. 2101z July 12,1987

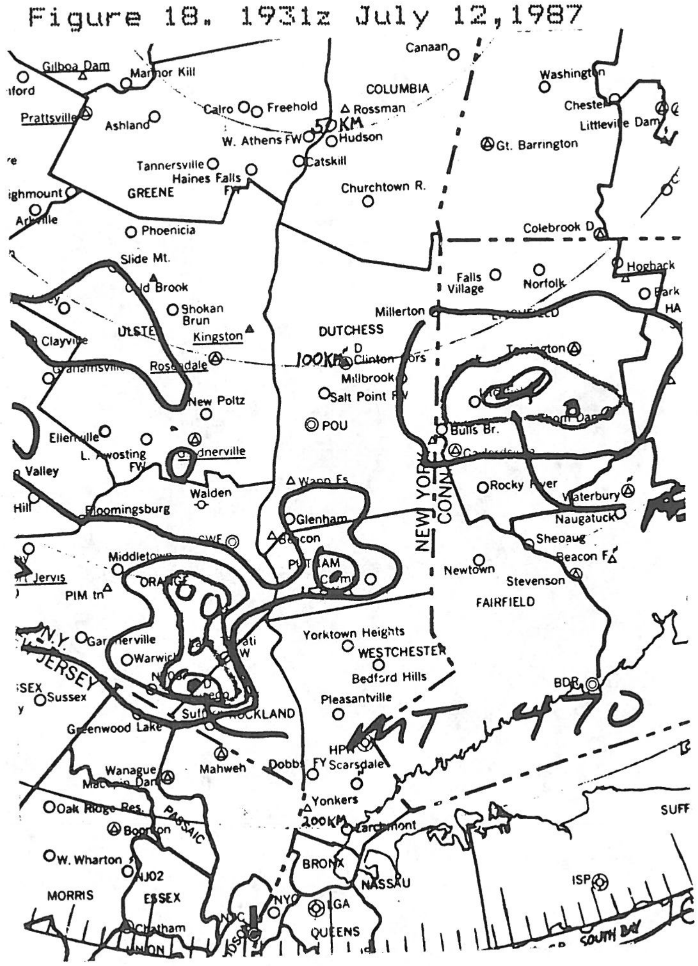


Figure 20. 2130 Albany radar each line represents a VIP level.

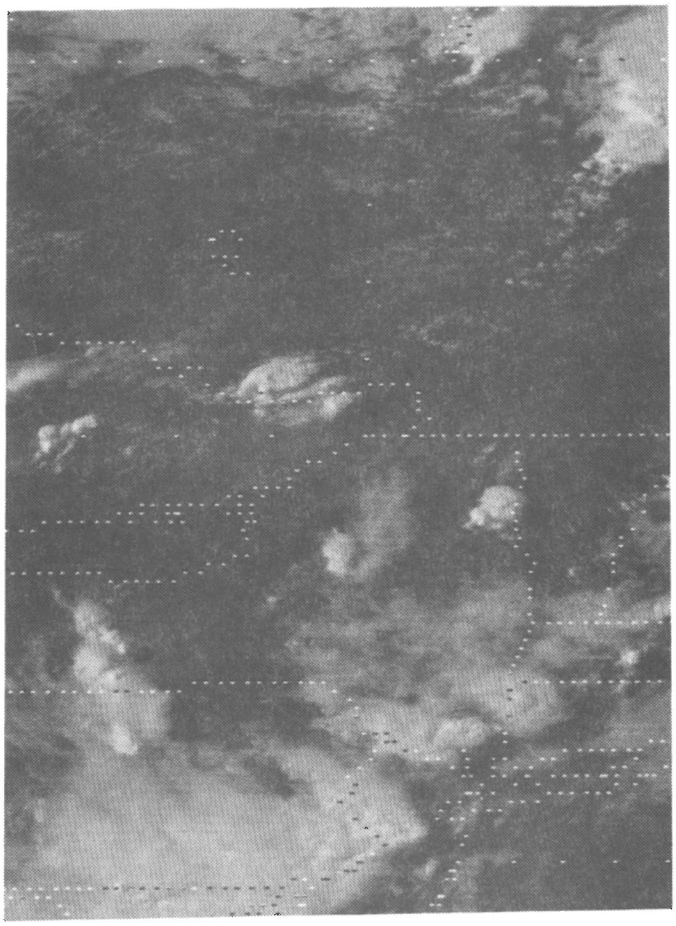

Figure 21. 2201z July 12,1987

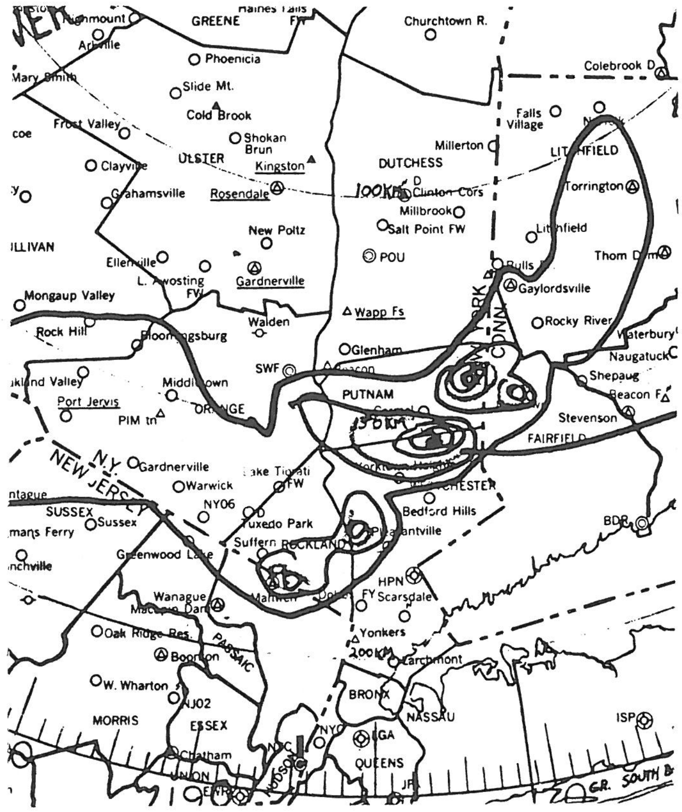


Figure 22. 2230z Albany Radar
each line represents a VIP level.