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SATELLITE VIEW OF AN APPALACHIAN SQUALL LINE

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On Friday afternoon, 11 May 1979, a line of thunderstorms, commonly referred to as an Appalachian squall line, formed along the Blue Ridge Mountains of Virginia and North Carolina. This line moved east into the Piedmont, causing hail, 40-mile an hour winds, and downpours. Intense lightning knocked out a communications center at Kannapolis, North Carolina. It also produced a hazard for pre-weekend air traffic across North Carolina.

Indications that a squall line might form could be seen in data the night before. At 300 MB (Figure 1), a cyclonic circulation is implied over eastern Tennessee with a cold pocket of air (-39°C) above Nashville. In an otherwise nondescript flow, where westerlies are displaced far to the north, this feature would lend support to the formation of an organized thunderstorm pattern given an unstable atmosphere below.

The cold pocket of air over Tennessee is also evident at 500 MB (Figure 2). Combined with warm moist air in the lower levels (Figure 3 - 850 MB), an unstable lapse rate capable of sustaining convection existed.

Even without the upper-level charts, one could deduce from satellite pictures that significant atmospheric instability existed that night over the Appalachian Mountains. Using the MB-infrared enhancement curve, Figures 4 and 5 clearly show convective cells in the Appalachian Mountain region at 0300Z and 0700Z.

The potential for convection existed that night. It could be reasoned then, that with little change in the flow pattern (no large-scale thermal advection aloft), the convective potential would still be there when maximum surface heating occurred the next day.

From 1700Z (Figure 6) on, satellite pictures show the development of thunderstorms along the blue ridge, likely triggered by differential heating. With knowledge of a cyclonic circulation pattern at 300 MB, it is interesting to note the direction of cirrus blow-off from thunderstorms at 1900Z (Figure 7). Over Virginia and West Virginia, cirrus filament is drifting to the northwest; over Kentucky, it's toward the southwest; in western North Carolina, nondescript; and in the central Carolinas, to the northeast.

During the afternoon, the most intense activity shifts from the northern part of the Blue Ridge in Virginia to the southern part in North Carolina. An arc line is evident at 2030Z (Figure 8) in the Virginia-North Carolina border region, indicating the likelihood of strong gusty winds with the system. By 2130Z (Figure 9), the squall line has become rather solid, moving east of the Blue Ridge into the Piedmont. During the early afternoon, WSFO Raleigh issued a Special Weather Statement describing the development of heavy thunderstorms and the likelihood of strong surface winds and hail.

This study suggests that nighttime satellite pictures can be used to focus in on convective potential for the following day. With detailed information from upper-level charts, the threat of an organized convective pattern, such as an Appalachian squall line, can then be assessed in the morning forecast package.

Also during mid-day and afternoon, half-mile resolution visible photos are valuable tools, to be used along with enhanced infrared pictures to "follow the action." This information should then be incorporated into the nowcating scheme of warnings and special statements.

Reference

George, Joseph J., "Weather Forecasting for Aeronautics," Academic Press, New York, N.Y., 1960, pp. 419-32.

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Attachments: Figures 1-9

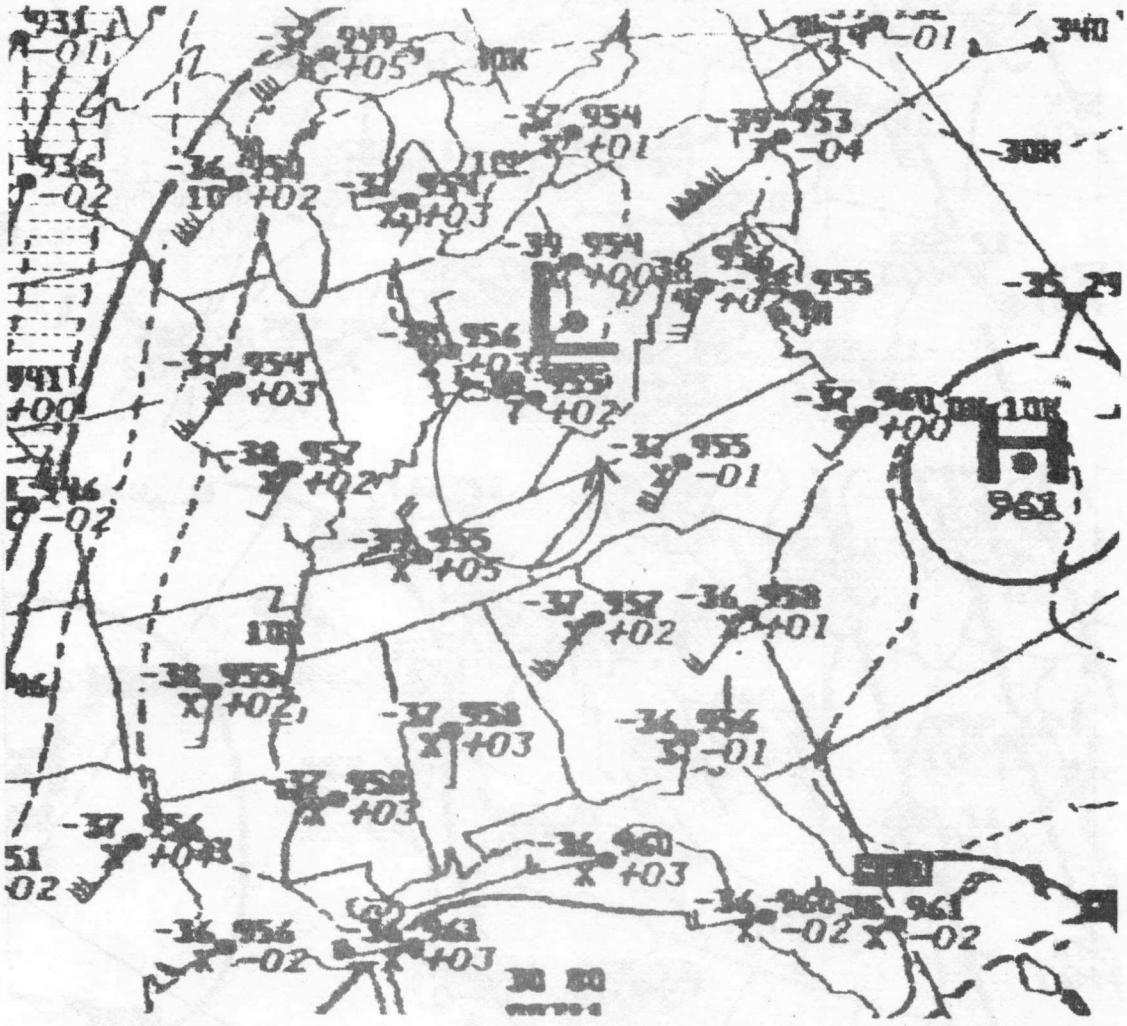

Figure 1 -
300 MB Chart -
5/11/79 - 0000Z

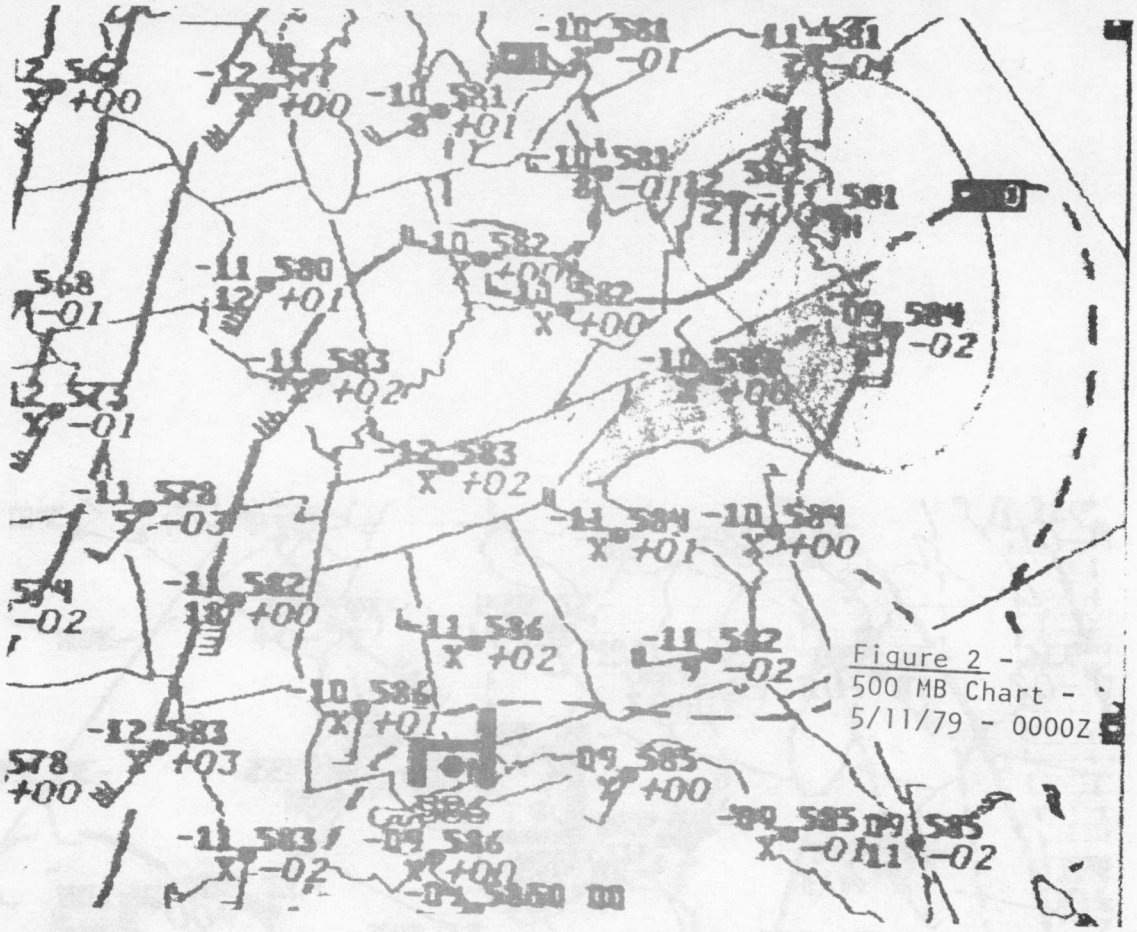

Figure 2 -
500 MB Chart -
5/11/79 - 0000Z

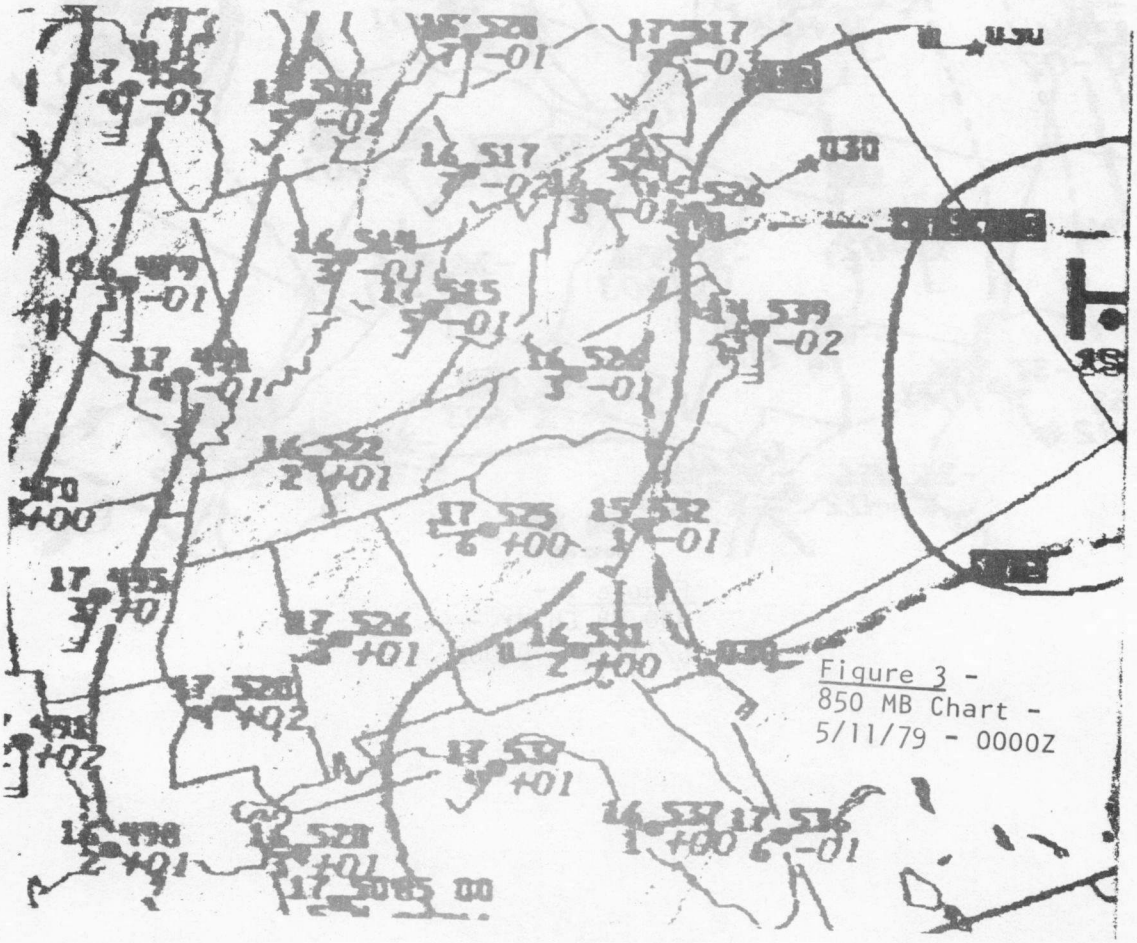

Figure 3 -
850 MB Chart -
5/11/79 - 0000Z

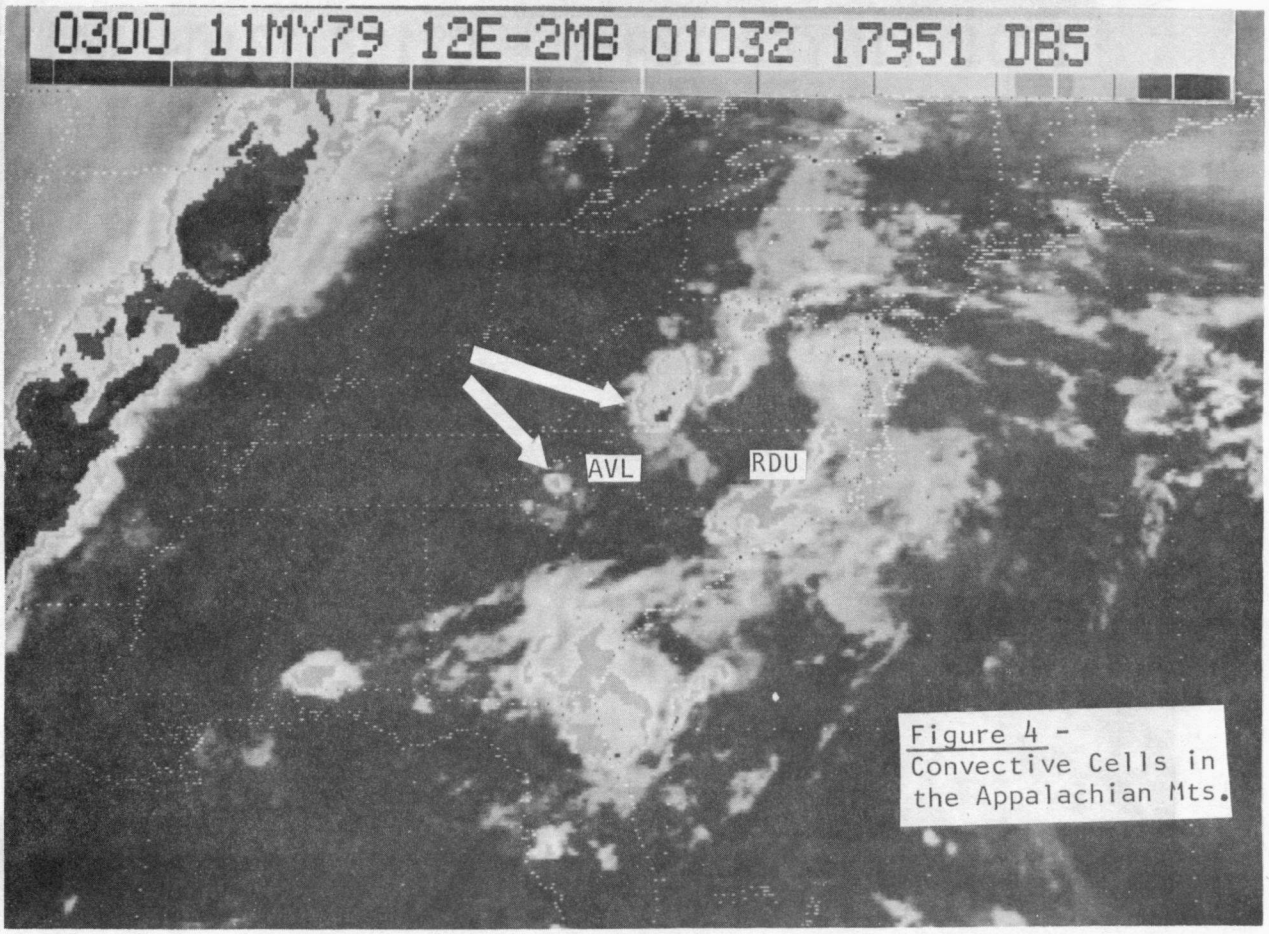

Figure 4 - Convective Cells in the Appalachian Mts.

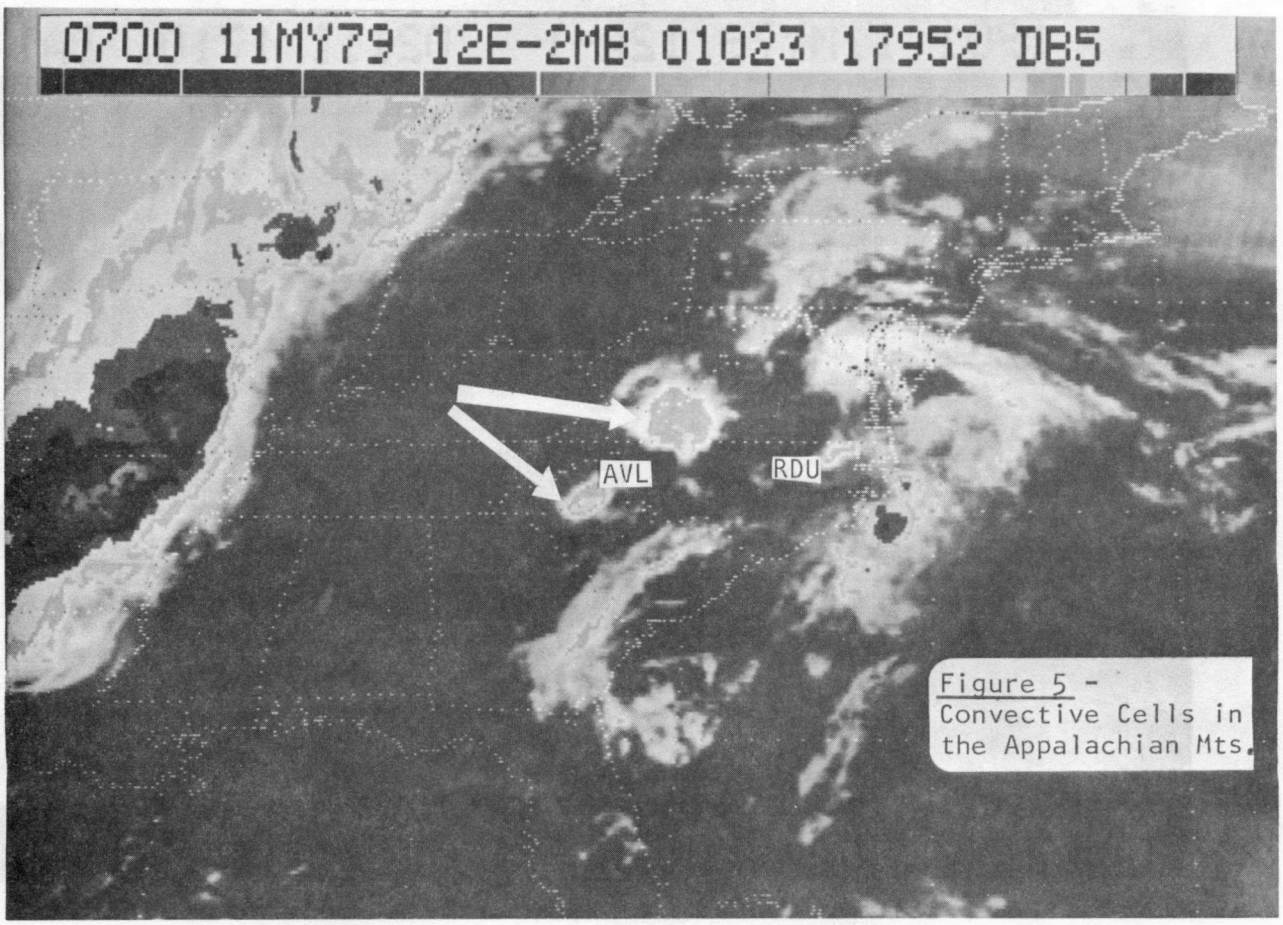

Figure 5 - Convective Cells in the Appalachian Mts.

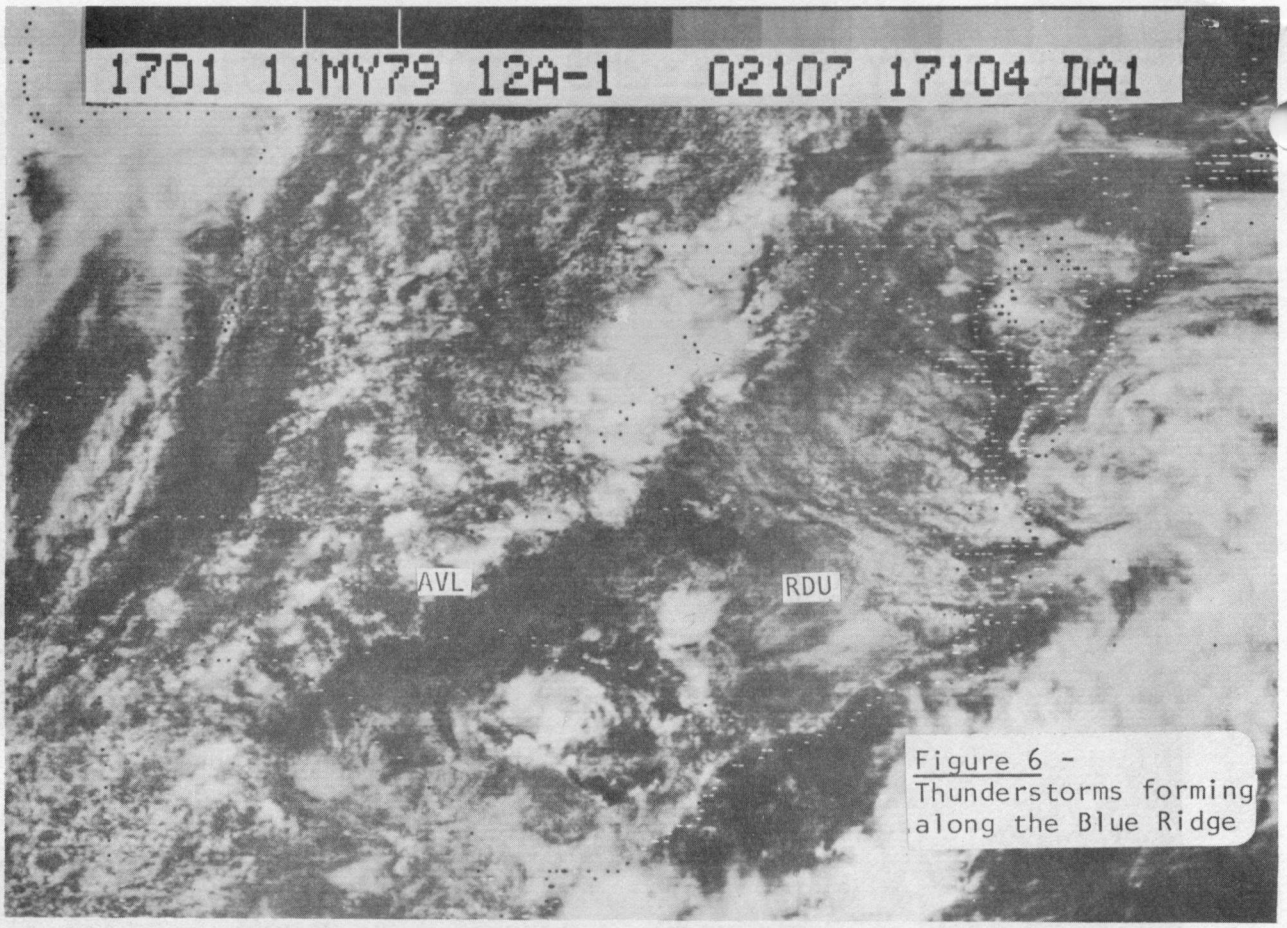

Figure 6 - Thunderstorms forming along the Blue Ridge

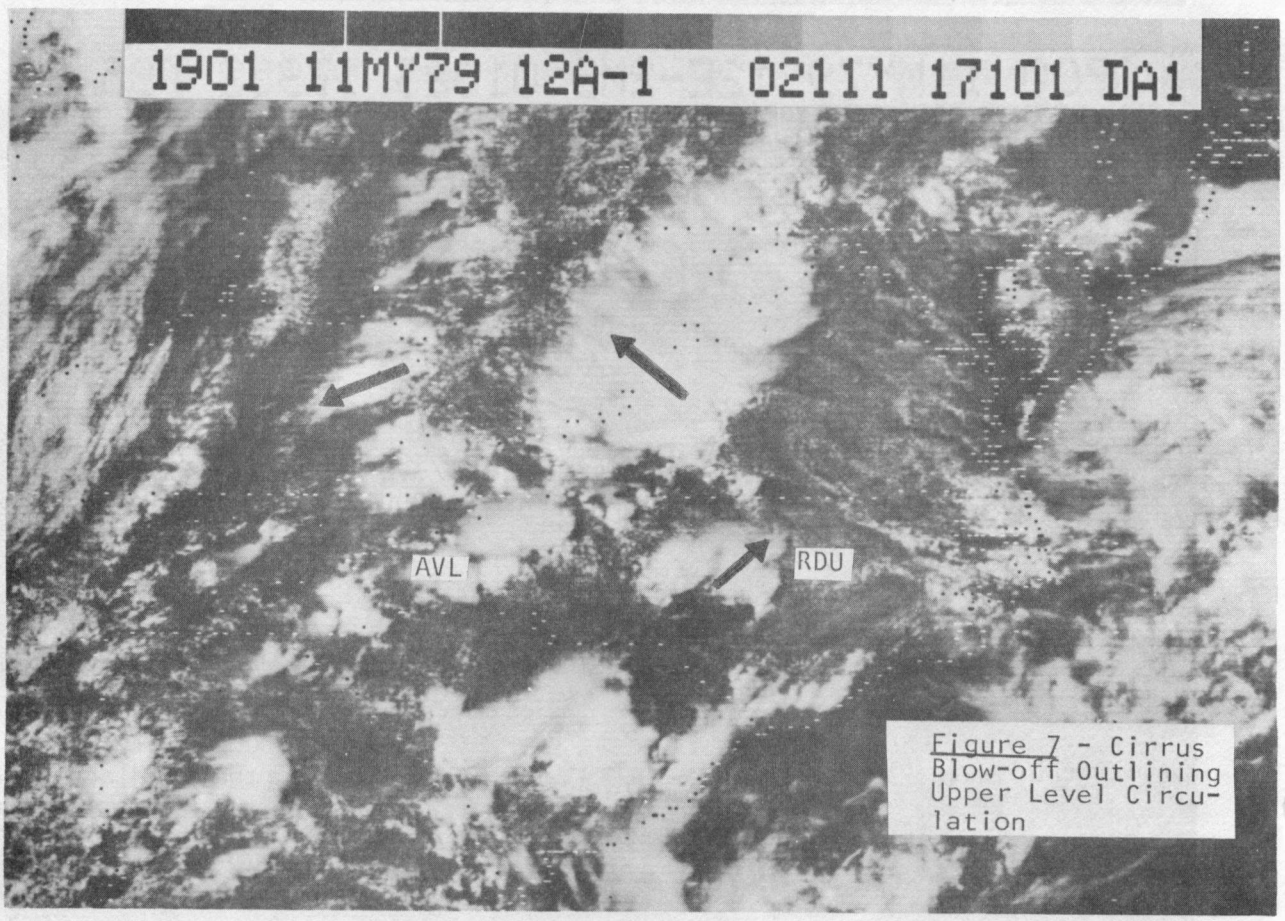

Figure 7 - Cirrus Blow-off Outlining Upper Level Circulation

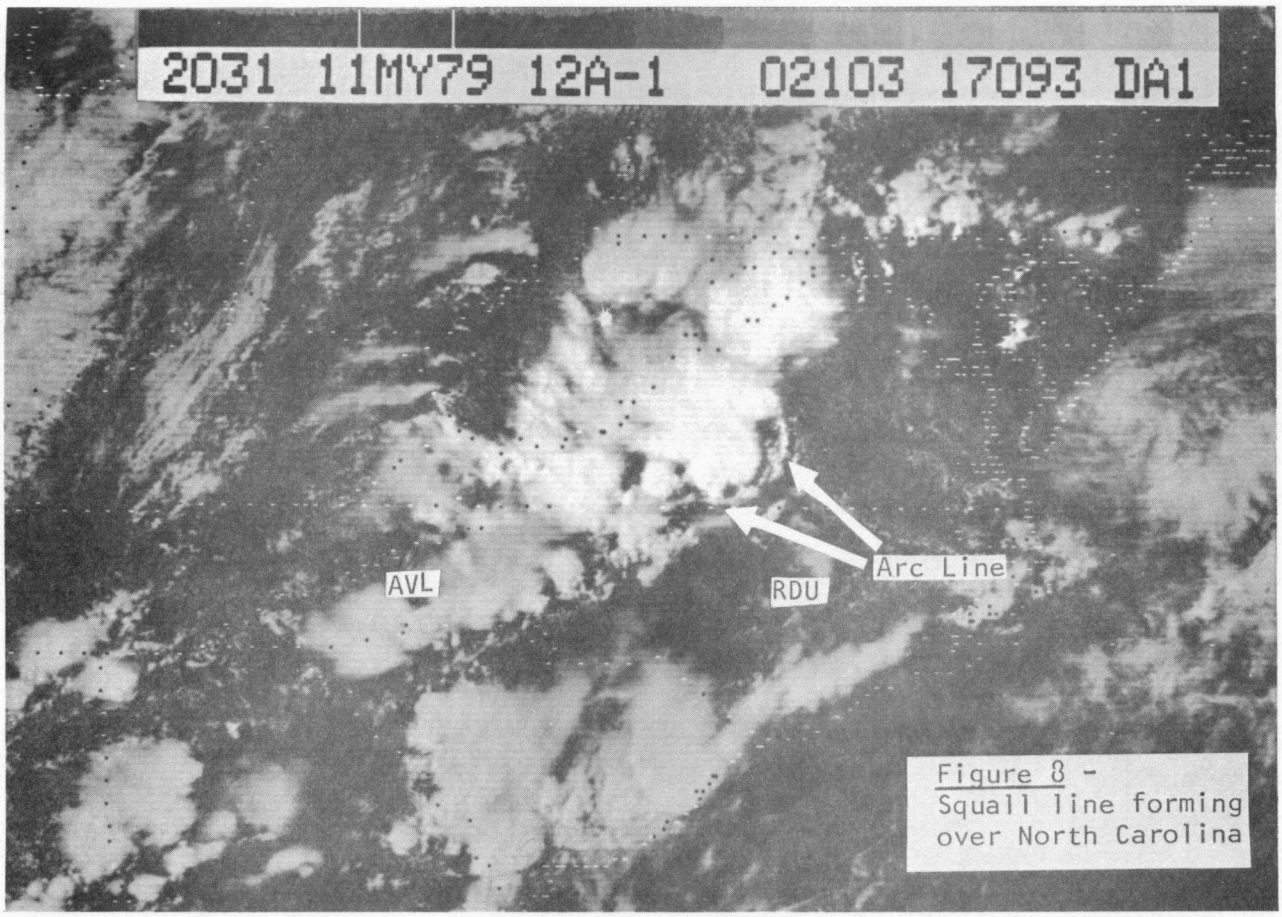

Figure 8 - Squall line forming over North Carolina

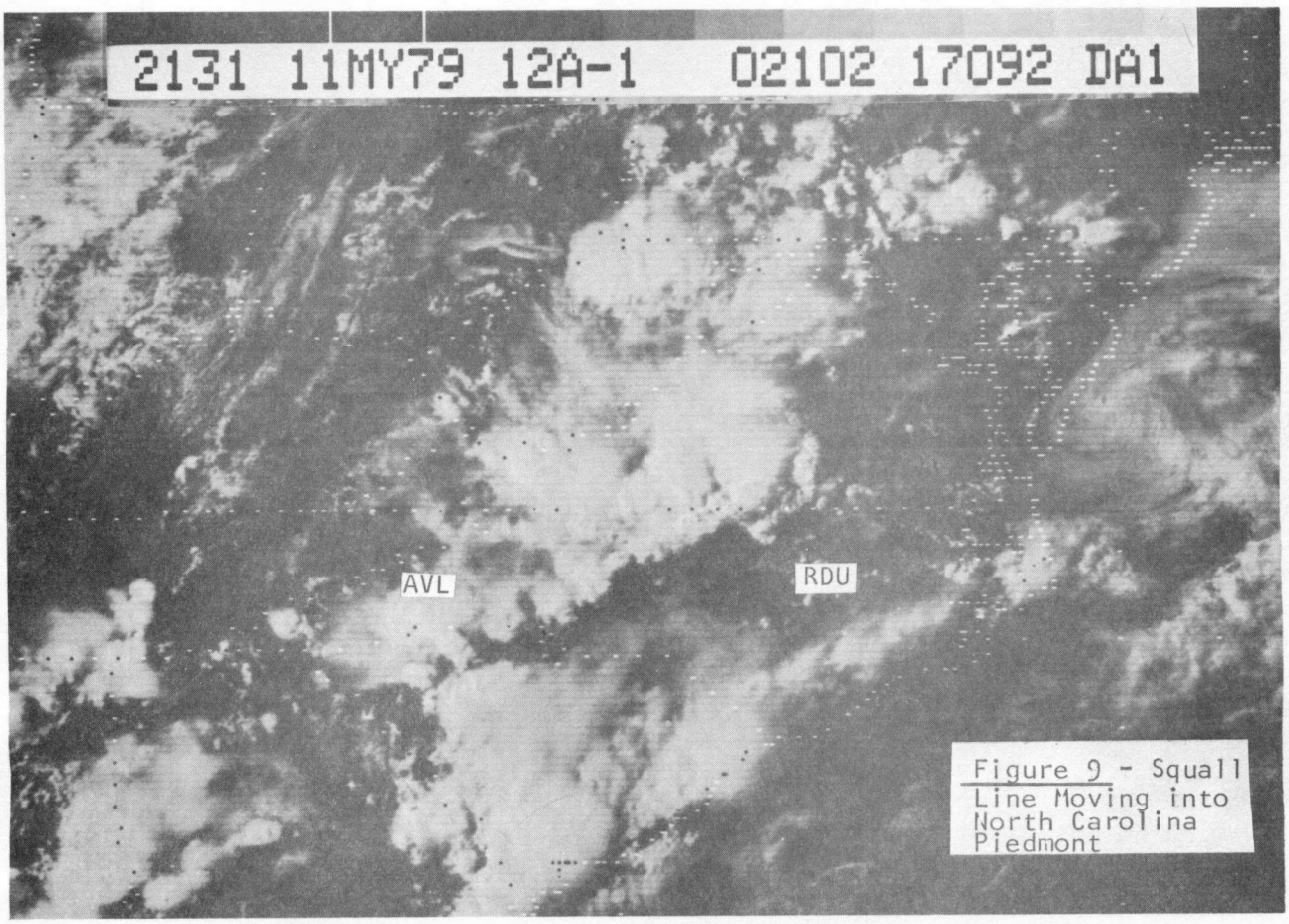

Figure 9 - Squall Line Moving into North Carolina Piedmont