PICTURE OF THE MONTH

Further Examples of Low-Precipitation Severe Thunderstorms

HOWARD B. BLUESTEIN

University of Oklahoma, School of Meteorology, Norman, OK 73019

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ABSTRACT

The characteristics and environment of low-precipitation severe thunderstorms in the Southern Plains have been summarized by Bluestein and Parks in 1983. Photographic documentation is given here of several storms not previously shown.

1. Introduction

Donaldson et al. (1965), Davies-Jones et al. (1976), and Burgess and Davies-Jones (1979) have described cases of a type of severe storm found near the dryline that does not have a strong, precipitating downdraft at the surface and is characterized by a symmetrical, bell-shaped cloud tower at low and midlevels. Bluestein and Parks (1983) summarized the characteristics of this type of storm on the basis of the previously documented cases and others reported by storm-intercept crews in the Southern Plains. This type of storm is called the low-precipitation (LP) severe storm. Bluestein and Parks confirmed that LP storms form near the dryline. The LP storm’s environment is like that of a typical supercell in Oklahoma. However, the LP environment is drier; furthermore, the speed of the mean tropospheric wind, the magnitude of the mean tropospheric shear, the magnitude of the mean subcloud shear, and the mean subcloud hodograph curvature are smaller.

Sequences of high-quality 35-mm photographs of storm-related features taken by storm-intercept teams can be used to document phenomena not resolved by radar, satellite, fixed instruments or current numerical model simulations.

The purpose of this note is to provide additional photographic documentation of LP storms not shown in Bluestein and Parks (1983).

2. Description of cloud features

The dissipating stage of an LP storm in the Texas Panhandle is depicted in Fig. 1. The lower part of the cyclonically rotating cloud is bell-shaped (Fig. 1a), and is horizontally striated on its eastern side (right, front side of the picture). Successive pulses of convection occur next to the southern edge of the cloud (left, front side of the picture); evidence of three discrete cloud masses is seen in Fig. 1b. Anvil material and precipitation are present to the northeast (right, rear side of the picture). The tower leans toward the northeast (Figs. 1c–1d), becomes narrower, and eventually becomes disconnected from the remains of earlier convection and the anvil material. A short-lived funnel cloud (not visible in the photograph) formed under the ragged cloud base at midlevels to the northeast of the cumuliform tower (Fig. 1d).

A panoramic view of an LP storm is shown in Fig. 2. The anvil (left portion of Fig. 2) and the midsection (middle portion of Fig. 2) of the storm have horizontal striations. The base of the storm appears to be circular and hollow. Precipitation is visible off to the far right (north and northeast). The southern edge of the cloud is flared out at its base, and looks similar to the storm described by Davies-Jones et al. (1976). [The bright areas seen in the anvil (to the left) and under cloud base are due to diffuse sunlight, not in-cloud lightning.]

An anticyclonically rotating LP storm (Bluestein, 1983) is shown in Fig. 3. The top of the bell-shaped, circular tower is leaning toward the southeast (upper-left, front of photograph). Striations are visible on the east side of the cloud (front of picture). Note the similar appearance of Fig. 3 to Fig. 1a (even though they are taken from different perspectives). A cyclonically rotating storm was observed to the south of this one (E. Rasmussen, personal communication, 1983). On 19 May 1982 we filmed a similar anticyclonically rotating tower in the Texas Panhandle, which was also on the north side of a cyclonically rotating storm. As we approached the east side of the cloud seen in Fig. 3, we encountered hail, but no rain. As the tower dissipated, a high-based funnel cloud appeared to the east of the tower.
Fig. 1. Dissipating stage of a storm near Conway, TX (about 50 km east of Amarillo) on 24 May 1978; looking to the north-northeast: (a) 1945 CDT, (b) 1954 CDT, (c) 1958 CDT, (d) 2008 CDT (NSSL photos by Howard B. Bluestein).
3. Discussion

The photographs document features which appear repeatedly. They represent classes of phenomena and not isolated occurrences.

The striations and laminar features have also been observed by the author and others in supercells; these features are also seen in altocumulus lenticularis (Scoer, 1972; Takle and Brown, 1982) clouds and along the edge of gust fronts, which mark regions of strong stability. It is therefore surmised that the laminar and striated appearance is due to lifting of stable, moist air.

The appearance of high-based funnel clouds under ragged cloud bases as the storm dissipates is intriguing. Cumulus elements lose their buoyancy as the cloud material evaporates and generate clear-air, negatively buoyant elements. At the top of these elements there should be strong horizontal convergence and a production of the vertical component of vorticity from the ambient vorticity. An airborne Doppler lidar system (Bilbro et al., 1984) could be used to test this hypothesis.

The hollow structure under cloud bases seen in Fig. 2 could be due to the ingestion of dry air into the updraft (Fankhauser et al., 1983) or to downdrafts in which cloud particles had evaporated. In situ measurements were not available to investigate this problem.

Finally, it is not known why some bell-shaped towers rotate anticyclonically. Not enough of them have been observed to speculate whether or not they only occur on the north side of cyclonically rotating LP storms, as they did in two cases. If in fact they do only occur on the north side of cyclonically rotating storms, they may represent the left-moving part of a splitting storm (Klemp and Wilhelmson, 1978).

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REFERENCES


