Comments on "Warm-Rain Initiation: An Overview of Microphysical Mechanisms"

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As Beard and Ochs (1993) have indicated in their excellent review, the mechanisms that trigger rain in warm clouds are also of importance in thunderclouds. Even in clouds that have regions well-below freezing temperatures, warm cloud processes may play a significant role.

An assumption made in this overview is that "Factors such as electric charge, turbulence, temperature, and pressure, will be neglected since they would usually play a secondary role during the initial stage of coalescence growth." In a warm cloud there can be little doubt that the variations in turbulence, temperature, and pressure are so small that they would be of little importance. It is questionable, however, whether the neglect of the effects of electricity can be justified.

It has long been assumed that the buildup of electric charge in a cloud is caused by falling precipitation (Vonnegut 1994). If this assumption is correct, there can be little doubt that the neglect of electrical effects in a nonprecipitating cloud is warranted. It must be recognized, however, that there are observations showing the intensity of the electric field in a cloud can increase in the absence of precipitation (Moore et al. 1958).

Furthermore, following the discovery of ionizing radiation early in this century, it has become apparent there are mechanisms of cloud electrification that do not require the presence of falling precipitation. Grenet (1947), Phillips (1967), and Wagner and Telford (1981) have shown how the transport of charged cloud particles by convection can lead to the buildup of electric fields in the complete absence of precipitation.

It is now well established that electric fields can accelerate the coalescence of water droplets (Rayleigh 1879; Czys and Ochs 1988). Therefore, if electrification can begin early in the cloud's development, it is possible that atmospheric electricity may be playing an unexpectedly important role in determining when and where precipitation first forms within clouds.

Future field investigations of precipitation formation should be accompanied by atmospheric electricity measurements, and computer models of cloud microphysical processes should include consideration of the action of electrical forces.

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