

Three-dimensional climatological rainfall characteristics from operational radar and raingauge networks

M Steiner, R A Houze Jr and S E Yuter (Department of Atmospheric Sciences, AK-40, University of Washington, Seattle, WA 98195)

The manner in which precipitating cloud systems distribute latent heat in the atmosphere profoundly influences the general circulation and thus the climate system. The total rainfall at any one location is often composed of a combination of a small number of short-lived, very intense convective events and extended periods of lighter rainfall from stratiform clouds. The overall rainfall amounts from the two kinds of precipitation are often comparable. However, convective and stratiform precipitation regions are characterized by two distinctly different vertical profiles of latent heat release to the atmosphere.

Climatological characteristics of precipitation therefore need to be described not only in terms of the overall rainfall amount, but also by the relative contributions resulting from convective and stratiform precipitation regions. In addition, the vertical structure of the precipitating cloud systems is as important as the horizontal structure.

A methodology has been developed for determining the three-dimensional climatological characteristics of precipitation from operational radar and raingauge networks. The foundation of the data processing is an objective separation of convective and stratiform rainfall based on Cartesian-gridded radar echo patterns. This separation technique was applied to one month of radar data from an operational site in Darwin, Australia, and tested objectively by making use of the vertical precipitation structure (i.e., the radar bright band), which is not part of the separation algorithm. The convective and stratiform precipitation elements of radar echo patterns were separated with an accuracy of 5-10% (within the accuracy required by modeling studies of atmospheric heating).

Experimentation with various radar reflectivity-rainfall intensity conversions revealed that as long as a radar-raingauge adjustment is made, the results are not sensitive to the initial choice of a climatic Z-R relationship. It is important that the raingauge adjustment is based on radar information only in the vicinity of the raingauges.

Based on the February 1988 raingauge data from Darwin, Australia, it was found that a sampling strategy of at least 8 radar volume scans per day (3-hour time resolution) will produce monthly areal rainfall amounts accurate to within 10-15%.

In the near future, this methodology will be applied to data from NEXRAD sites in Florida and Texas.