Evolution in Cloud Population Statistics of the MJO: From AMIE Field Observations to Global-Cloud Permitting Models Final Report

Version 1

Methods of convective/stratiform precipitation classification and surface rain rate estimation based on the Atmospheric Radiation Measurement (ARM) program cloud radar measurements were developed and evaluated. Simultaneous and collocated observations of the Ka-band ARM zenith radar (KAZR), two scanning precipitation radars (NCAR S-PolKa and Texas A&M University SMART-R), and surface precipitation during the DYNAMO/AMIE field campaign were used. The motivation of this study is to apply the unique long-term ARM cloud radar observations without accompanying precipitation radars to the study of cloud lifecycle and precipitation features under different weather and climate regimes.

The resulting convective/stratiform classification from KAZR was evaluated against precipitation radars. Precipitation occurrence and classified convective/stratiform rain fractions from KAZR compared favorably to the collocated SMART-R and S-PolKa observations. Both KAZR and S-PolKa radars observed about 5% precipitation occurrence. The convective (stratiform) precipitation fraction is about 18% (82%). Collocated disdrometer observations of two days showed an increased number concentration of small and large raindrops in convective rain compared to dominant small raindrops in stratiform rain. The composite distributions of KAZR reflectivity and Doppler velocity also showed distinct structures for convective and stratiform rain. These evidences indicate that the method produces physically consistent results for the two types of rain.

A new KAZR based two-parameter (the GAZ below 1km and near-surface Ze) rain rate estimation was developed for both convective and stratiform rain. This estimate was compared with the exponential *Z-R* relation. The relative difference between the estimated and surface measured rainfall rates showed that the two-parameter relation can improve rainfall estimation compared to the *Z-R* relation.

The classified convective/stratiform precipitation identifier and surface rain rates have been generated and analysis for MJO cycles observed during AMIE/DYNAMO project. Low level cloud evolutions seem lead the convective and stratiform rain, which then leads the middle and upper level clouds. The surface rain rates have beeb utilized in comparison with S-POL and SMART-R observed results in University of Miami and Colorado State University. The ARM cloud radar observation is very important for clouds and precipitation observation in the AMIE/DYNAMO project.