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Investigating the microphysical characteristics of precipitation systems during the 2018 South-west Monsoon (SWM) season in South Luzon, Philippines

ABSTRACT

The Southwest Monsoon (SWM), which brings almost half of the Philippines' annual rainfall, has been extensively studied, however its rainfall microphysics remain largely unexplored. This study investigates the microphysical characteristics of rainfall in South Luzon, Philippines during the 2018 SWM season (June to September) using data from a PARSIVEL disdrometer and the Tagaytay C-band dual-polarization weather radar. Drop size distribution (DSD) and integral rain parameters such as normalized gamma number concentration ($log_{10}N_w$), mass-weighted mean diameter (D_m), rain rate (R), liquid water content (LWC), total number concentration (N_t), and mass spectrum standard deviation (σ_m) were analyzed. Using principal component analysis (PCA) on the DSD revealed groups corresponding to dominant microphysical processes. Averaged time-height plots and pseudo range-height indicator plots (PRHI) of radar parameters such as reflectivity (Z_H), differential reflectivity (Z_{DR}), specific differential phase (K_{DP}) and co-polar cross-correlation coefficient (ρ_{HV}) were used to reveal these processes. Four precipitation types are presented: strong widespread convection (SWC), strong isolated convection (SIC), weak shallow convection (WC) and weak stratiform (WS). Among the four, SIC recorded high concentrations of mid-to-large drops, while SWC has a wider range of drop diameters. High concentrations of small drops were usually observed in WC. Meanwhile, for WS, small to mid-sized drops dominate. Multiple PCA groups can be observed from SWC, showing the transitions within the system. For SWC, values of $log_{10}N_w$, D_m and LWC are comparable to that of SIC, but with relatively less R. SIC DSDs are clustered above the convection-stratiform (CS) separation line paired with high Z_H, $Z_{DR,}$ and K_{DP} values that reached heights up to 10 kms, typical for deep convective systems. DSD groups, including ice-based convective groups, were observed during the time of highest R. $LWC,$ and Z_H in the SIC case, thereby explaining the large drops observed at the surface. For WC, high reflectivity values (>35 dBZ) do not penetrate the 6 km height, hence the shallow classification. In contrast, the WS case has a low R with an evident bright band signature. DSDs in WS are tightly clustered below the CS separation line. These findings provide a more detailed perspective on these rainfall events which were not presented in previous studies in the context of the Philippines.

Keywords *rainfall microphysics, southwest monsoon, drop size distribution*