Raindrop Size Distribution Characteristics of the Western Pacific Tropical Cyclones Measured in the Palau Islands

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Abstract

Due to the severe threat of tropical cyclones to human life, recent years have witnessed an increase in the investigations on raindrop size distributions of tropical cyclones to improve their quantitative precipitation estimation algorithms and modeling simulations. So far, the raindrop size distributions of tropical cyclones using disdrometer measurements have been conducted at coastal and inland stations, but such studies are still missing for oceanic locations. To the authors' knowledge, the current study examines—for the first time—the raindrop size distributions of fourteen tropical cyclones observed (during 2003–2007) at an oceanic station, Aimeliik, located in the Palau islands in the Western Pacific. The raindrop size distributions of Western Pacific tropical cyclones measured in the Palau islands showed unlike characteristics between stratiform and convective clusters, with a larger mass-weighted mean diameter and smaller normalized intercept parameter in the convective type. The contribution of the drop diameters to the total number concentration showed a gradual decrease with the increase in drop diameter size. Raindrop size distributions of Western Pacific tropical cyclones measured in the Palau islands differed slightly from Taiwan and Japan. The helpfulness of empirical relations in raindrop size distribution in rainfall estimation algorithms of ground-based (Z–R, μ–Λ, D_m–R, and N_w–R) and remote-sensing (σ_m–D_m, μ_o–D_m, D_m–Z_{ku}, and D_m–Z_{ka}) radars are evaluated. Furthermore, the present study also related the rainfall kinetic energy of fourteen tropical cyclones with rainfall rate and mass-weighted mean diameter (KE_{time}–R, KE_{mm}–R, and KE_{mm}–D_m). The raindrop size distribution empirical relations appraised in this study offer a chance to: (1) enhance the rain retrieval algorithms of ground-based, remote sensing radars; and (2) improve rainfall kinetic energy estimations using disdrometers and GPM DPR in rainfall erosivity studies.

Keywords: **raindrop size distributions**; **tropical cyclones**; **Western Pacific (WP)**; **rainfall rate**; **GPM DPR**; **and rainfall kinetic energy**