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Microphysical transition in water clouds over the Amazon and China derived from space-borne radar and radiometer data

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This study examines the transitional processes and relationships among cloud droplets, drizzle, and precipitation in single-layer water clouds over the Amazon and China by synergistically analyzing products of active CloudSat and passive Moderate Resolution Imaging Spectroradiometer (MODIS) sensors. Cloud droplet number concentrations (Nc) are confirmed to generally be lower over the Amazon and higher over China, reflecting the difference in aerosol amount between these two regions at different seasons. Radar reflectivity (Ze) frequencies are consistent with the regional and seasonal differences in precipitation rate. Furthermore, the fractional occurrences of maximum Ze as a function of liquid water path (LWP) show an almost monotonic decline and increase for non-precipitating and precipitating categories, respectively, denoting differences in the precipitation rate. The behavior of cloud parameters such as the cloud optical depth, effective particle radius, Nc, and LWP among different Ze categories indicates the cloud development stage and reveals regional differences in the microphysical characteristics. Finally, a vertical cloud structure is examined to illustrate that water clouds tend to become optically thinner and to produce precipitation (shifting to larger Ze) through the coalescence of droplets as Nc decreases. Regionally, precipitation over the Amazon takes place in optically thicker parts than that over China.