The observed properties of summer convective clouds and precipitation over the central Tibetan Plateau

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Macro- and micro-physical properties of summer convective clouds and precipitation over the central Tibetan Plateau (TP) were investigated using the in-situ observations during the Third Tibetan Plateau Atmospheric Sciences Experiment (TIPEX-Ⅲ) in 2014. The advanced aircraft and radar observational systems were employed during the experiment.

The results show that the convective activities mainly distributed in the central and southeast part of the TP. The average heights of cloud top and cloud base were 11.62 ±2.45 km and 6.89 ±1.58 km, respectively. The average rain rate was ≈1.2 mm/h, and most rain events lasted less than 1 hour. The raindrop size distribution spectra were wider than other of lower altitude, and compared to M-P distribution, the Γ distribution was more suitable in describing the raindrop size distribution of precipitation over the central TP. Due to the solar heating effect over the plateau, both convective clouds and precipitation processes had obvious daily variation. The convections began to develop in the afternoon, reached the maximum in the late afternoon, turned into stratiform-like at night, and decayed in the second half of the night, and vanished as the sun recurred.

The aircraft observations show that the summer clouds over the Tibetan Plateau were primarily characterized as mixed-phase cumulus clouds induced by strong solar radiation heating. The characteristic number concentration of cloud droplets (2~50 μm in diameter) in developing cumuli was around 10 cm^{-3}, which was about 1~2 orders of magnitudes lower than other continent and ocean regions, and that for large drops (>50 μm in diameter) was around 10–3 cm^{-3}, which was also lower than other regions. The droplet spectrum distributions (DSDs) of cloud drops were much wider than other regions, indicating that the cumulus clouds over the plateau could form precipitation easier than that in other regions. Ice microphysics was characterized as very active glaciation and riming processes with high supercooled water content, which caused the formation of high concentration of graupel particles in clouds.

Keywords: the Third Tibetan Plateau Atmospheric Sciences Experiment (TIPEX-Ⅲ), convective clouds and precipitation, cloud microphysical characteristics, aircraft observations