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Observation of Clouds characteristics over the Eastern Tibetan Plateau

Clouds not only play a crucial role in weather dynamics but are also a key factor influencing cosmic ray detection. The presence of clouds increases the absorption of Cherenkov light, thereby affecting cosmic ray observations. Moreover, the variation of clouds over the Tibetan Plateau(TP) has a significant impact on radiation balance and even the global water cycle. This study utilizes the Vaisala CL51 ceilometers at the Large High Altitude Air Shower Observatory(LHAASO), TP, from October 2020 to June 2022 and CloudSat-CALIPSO data from 2010 to 2019, to analyze cloud occurrence frequency(COF) and cloud vertical structure (CVS), including cloud base height(CBH) and the number of cloud layers. Additionally, the study assesses the suitability of MERRA-2 reanalysis data for characterizing cloud vertical structure in this region. During the observation period, the COF measured by the CL51 ceilometer and CloudSat-CALIPSO were 43.7% and 44.9%, respectively. During the LHAASO observation period (from October to May, 20:00–05:00 Beijing Time), the COF was 34.2%, with the lowest COF at midnight (24:00). The COF exhibits distinct seasonal and diurnal variations. The cloud structure in this region is predominantly single-layered, with the most complex cloud layers occurring in summer. The CVS shows a distinct single-peak feature in summer and autumn, while the vertical distribution is relatively uniform in spring and winter. MERRA-2 reanalysis data perform well in describing high-level clouds but significantly underestimate mid- and low-level clouds. Both the CL51 ceilometer and CloudSat-CALIPSO observed that clouds frequently occur around 1000 m, and CloudSat-CALIPSO data indicate another peak in the vertical cloud structure at around 5000 m. These observational results provide important data for studying cloud variations over the TP, offer parameterization references for accurately describing cloud vertical structures in climate models, and provide valuable insights for the operation of telescopes at the LHAASO.

Collaboration(s)

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