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Cloud base heights by ground based sky IR brightness temperature measurements compared with Cloud radar and Ceilometer in Shouxian

W. Zhang, D. Lu, and S. Duan

Key Laboratory of Middle Atmosphere and Global Environment Observation(LAGEO), Institute of Atmospheric Physics Chinese Academy of Sciences., Beijing, China, (zwx@mail.iap.ac.cn)

The ARM Mobile Facility (AMF) was deployed in Shouxian, Anhui Province, China from May to December 2008. ARM W-band (95 GHz) Cloud Radar (WACR) and Vaisala Ceilometer(VCEIL) are ground based instruments used to probe the vertical structure of clouds. The temporal resolution of reflectivity profile from WACR is 2s. VCEIL can give cloud base height and backscattered profile, with temporal resolution of 15s. Both of them make zenith-pointing measurements. During the AMF campaign, measurements of whole sky thermal infrared brightness temperature were conducted from Nov 27 to Dec 30,2008 at the same place, using an automatic scanning infrared thermometer(SIRIS-1)developed by the Key Laboratory of Middle Atmosphere and Global Environment Observation(LAGEO), Institute of Atmospheric Physics Chinese Academy of Sciences, the temporal resolution is 15 minutes. The three instruments made measurements in parallel for total 16 days, and the comparisons are made between the results from each two. The SIRIS-1effective cloud base height was calculated by using the data of sky brightness temperature and the surface weather data observed at the same time. The VCEIL cloud base heights were averaged over a 3 minutes interval centered at the time of each SIRIS-1 zenith-pointing measurement, and the WACR macro cloud properties were retrieved from the average reflectivity profile of 15 measurements around that time. A total of 1661 measurements the three instruments made synchronously, which including 428,287,225 times of cloud sensed by WACR, SIRIS-1 and VCEIL respectively. Three data sets of cloud base height were analyzed: all of the data, single-layered and two- or three-layered. For all data, the correlation coefficient between WACR and SIRIS-1(287 samples) is 0.82, and between WACR and VCEIL(225 samples) is 0.6. For single-layered, on the basis of a total of 75 samples, the standard deviations of the differences between WACR and SIRIS-1 ,and between WACR and VCEIL are 0.88 and 1.61km, while the corresponding correlation coefficients are 0.85 and 0.53 respectively. For two- or three-layered, the SIRIS-1 cloud base heights are, on average, within the WCAR top and bottom cloud boundaries, the results from VCEIL is more agreeable with WACR than in the other two cases because the bottom cloud base height in this case is relatively lower. The comparison reveals that the cloud base heights by SIRIS-1 demonstrate the clear superiority of stability, reliability and economy, though there is a systematic bias relative to the results from WACR. A preliminary method for improving cloud base height from SIRIS-1 is suggested