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Asian Monsoon Years (2007-2012): Spatiotemporal variability and uncertainty in rainfall observed by TRMM PR

Masafumi Hirose[†];
[†] Meijo University, Japan
Leading author: mhirose@meijo-u.ac.jp

The precipitation radar (PR) on board the Tropical Rainfall Measuring Mission (TRMM) satellite has been capturing global-scale rainfall (35°N-S) for the past 13 years. The first part of this study was conducted to extract coherent signals in the fine-scale (0.1o) precipitation variability over Asia on the basis of the long-term dataset. We focused on regional characteristics of the seasonal variation of means and some precipitation-system components. This study also exhibits the year-to-year variation and uncertainties in observing rainfall to understand current retrieval errors related to the observation property. Significant intrinsic defects of TRMM PR data are caused by the orbit boost in August 2001 and the angle-bin differences of near-surface rainfall at various bottom levels free from ground clutter. We examined the incidence-angle bias before and after the boost, and the impact of the correction on year-to-year variations in tropical rainfall. The total bias between incidence angles was 0.7% before the boost (1998-2000) and -4.6% after the boost (2002-2004). Over ocean (land), it accounted for 2.7% (-5.8%) before the boost and -3.2% (-9.5%) after the boost. With regard to the effect of the bias on temporal variations, this study indicated that contributions from the boost effects, such as the asymmetric bias, have a crucial impact on estimating the 10-year trend during 1997-2007. The original data indicates a misleading decreasing trend with a ratio of -5.5% for the decade. By the bias correction, the trend was changed to positive, i.e., 2.8% for the decade, which is coherent with the prior researches based on the Global Precipitation Climatology Project version 2 monthly analysis data. The ratio of the corrected data is almost equivalent to the GPCP data for the ocean and less over land. The study supports the view that rainfall in the last few years is relatively high, both from the TRMM PR and GPCP, in spite of the significant differences in the amplitude of variations. The internal consistency verification and the effects on the temporal variation were also checked on the basis of the upcoming algorithm (V7). The tentative results showed the following: 1) slight decreases in detecting shallow storms, 2) reduced bias between incidence angles due to increases in off-nadir severe rainfall over land, 3) remaining errors such as underestimates at the swath edge, and so on.