

A long term calibration of space-borne precipitation radar using natural target

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Precipitation observation by the Tropical Rainfall Measuring Mission's (TRMM's) Precipitation Radar (PR) has lasted for almost 17 years. On February 28, 2014, the core satellite of the Global Precipitation Measurement (GPM) mission was launched, and the GPM Dual-frequency Precipitation Radar (DPR) started providing precipitation data succeeding the TRMM PR observation. PR and DPR not only estimate precipitation accurately both over land and the oceans but also provide information to derive precipitation characteristics (e.g., rain top height and rain vertical profile). Homogeneity of long-term PR/DPR data will be essential to study the water cycle change related to the decadal climate variability. Then, a long-term stability of calibration accuracy for radars is an important factor to correctly obtain the nature variability. The radar algorithm for precipitation estimates converts from the observed radar reflectivity factor, Z , to the estimated rain rate, R , so that a Z bias of calibration error is a cause of absolute error of R . On the other hand, a temporal change of calibration bias causes an artificial trend of R . Therefore, the long term trend of calibration error (calibration drift) must be evaluated and compensated. In this study, we develop a method of calibration drift estimates. While the normalized radar cross section (NRCS or sigma-zero) over water surface is related with sea surface wind (SSW), sigma-zero at small incident angles is insensitive at moderate (8-10 m/s) wind speeds. Since a relationship between sigma-zero and SSW is invariant, a temporal change of sigma-zero filtered by moderate winds is obtained as the calibration drift of radars. In this study, calibration drift of the PR version 7 (V7) product is evaluated using SSW data by the TRMM microwave imager (TMI). The calibration drift of the PR is found for a 0.2 dB change during the entire TRMM mission. The long-term trend of unconditional rain by the PR V7 over the TRMM coverage is overall caused by the calibration drift. The calibration drift of the PR found in the current study will be compensated in future (version 8; V8) product.

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