Use of low-level static stability for improvement of the heavy orographic rainfall estimates in the GSMaP algorithm for microwave radiometers

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An orographic–nonorographic rainfall classification scheme of the operational Global Satellite Mapping Precipitation (GSMaP) passive microwave radiometer (MWR) algorithm mitigated underestimation for heavy orographic rainfall with low precipitation-top heights (PTHs) over coastal mountain ranges of the Asian monsoon region. The scheme based on topographically forced upward motion and convergence of surface moisture flux, however, was switched off in high lightning regions, because of the precipitation profiles with high PTHs even for orographic rainfall conditions.

In this study, a low-level static stability is introduced to the scheme instead of convergence of surface moisture flux as a thermodynamic parameter to extend the orographic–nonorographic rainfall classification scheme to the high lightning regions. Lookup tables derived from precipitation profiles with topographically forced upward motion according to the lower level stabilities (stable, neutral and unstable) are selected to estimate rainfall. The revised scheme mitigates the underestimation of heavy orographic rainfall with low PTHs in stable conditions that occurs rarely in high lightning regions, such as July 2010 Pakistan rainstorms. The scheme also provides an adequate of the estimates of rainfall with topographically forced upward motion and high PTHs in unstable conditions that normally occurs in the regions.