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Can Water Vapor Data Be Used to Estimate Precipitation Efficiency?

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Precipitation efficiency is an important physical parameter in convective systems and has been applied to determine the rainfall intensity in operational precipitation forecasts. The precipitation efficiencies have been defined can be defined as the ratio of rain rate to rainfall sources in the cloud microphysical budget (CMPE) and the surface rainfall budget (LSPE), respectively. In this study, we argue that the precipitation efficiency can be defined only in the primitive budget where precipitation rate is a diagnostic term. An example of such a primitive budget is the rain microphysical budget in the tropics. Thus, the rain microphysical budget is used to define rain microphysics precipitation efficiency (RMPE) and its estimate from grid-scale simulation data serves as the "true" precipitation efficiency. LSPE and CMPE may deviate from RMPE because only rainfall sources are used to estimate precipitation efficiency. Do CMPE and LSPE deviate from RMPE? What causes the differences? Can water vapor data be used to estimate precipitation efficiency? These questions will be discussed by analyzing a 21-day two-dimensional (2D) cloud-resolving model simulation that is forced by the large-scale forcing derived from the Tropical Ocean Global Atmosphere Coupled Ocean-Atmosphere Response Experiment (TOGA COARE). The results show that the root-mean-squared (RMS) difference between RMPE and CMPE is smaller than the standard deviation of RMPE whereas the RMS difference between RMPE and LSPE is larger than the standard deviation of RMPE. Thus, water vapor data cannot be used to estimate precipitation efficiency.