The radiative impact of precipitating ice in a global nonhydrostatic model

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This study examines the impact of precipitating ice (snow and graupel) on the longwave (LW) radiative flux by evaluating the output data from a global cloud-system resolving model. An offline radiation model based on the radiation transfer code, MSTRNX (Sekiguchi and Nakajima 2008) is employed, and the precipitating ice data, simulation results from a nonhydrostatic icosahedral model (NICAM, Satoh et al. 2014) with a double-moment cloud microphysics scheme with six-water categories (rain, cloud waver, cloud ice, snow, and graupel; Seiki and Nakajima 2014), are used. The horizontal resolution of model output data is approximately 14-km, the cloud process is solved explicitly, and the analyzed period is one boreal summer. Results show that the LW radiative flux in the tropical region is sensitive to the ice hydrometeor properties, and the snow contributing impact reaches a maximum about 2 W m^{-2} in the Indian Ocean region, while the average is 1.2 W m^{-2} in the tropics. Though there is a gap between our estimation and satellite borne estimations (5-10 W m^{-2}; Waliser et al. 2011, Li et al. 2014), both suggest that the LW radiative impact by precipitating ice ignored in most general circulation models, is non-negligible. Specifically, the positive bias in the LW radiative flux in the tropical region appears in GCMs can be reduced by taking the interaction between the precipitating ice and the radiation field into account.

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