Modeling of wet deposition process coupled with a double moment bulk cloud microphysics scheme

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Abstract

We elaborate modeling of wet deposition processes coupled with a double moment bulk cloud microphysics scheme named NDW6 (Seiki and Nakajima, 2012, submitted). The aerosol transport model used in this study is based on SPRINTARS (Takemura et al., 2000; 2002; 2005), and was incorporated in a global cloud resolving model (GCRM) named NICAM (Satoh et al., 2011). To evaluate scavenged aerosols explicitly, we newly predict in-cloud aerosols, which is a mass fraction of dissolved aerosols in cloud droplets. This approach enables us to isolate aerosols, which are transported within rain droplets and active in nucleation processes, from total aerosols in a grid box. We implemented the cloud nucleation scheme proposed by Abdul-Razzak and Ghan (2000; 2002; 2004), the immersion freezing scheme proposed by Khvorostyanov and Curry (2004; 2009), homogeneous ice nucleation scheme proposed by Khvorostyanov and Curry (1998; 2004a; 2004b; 2009), and inhomogeneous ice nucleation scheme proposed by Khvorostyanov and Curry (2000; 2004a; 2004b; 2009). Below cloud scavenging scheme is newly developed based on theoretical formulation by Seinfeld and Pandis (2006) to be consistent with droplet size distribution assumed in the NDW6. Aqueous chemical reaction of sulfuric acid is based on Takemura (2002) with pH diagnosis method by Goto et al. (2011).

An idealized simulation of tropical convective cloud system shows differences in the in-cloud ratio of aerosols to total aerosol in a grid box and wet depositional ratio to total depositional ratio depending on the developing stage of cloud systems.

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