Bridging EarthCARE Cloud Radar Observations with NICAM Simulations

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Abtract

Global storm-resolving models (GSRMs, Satoh et al. 2019; Stevens et al. 2019) have been used to generate detailed simulations of mesoscale convective systems using a kilometer-scale horizontal grid. The resolution of GSRMs closely matches the along-track sampling of active satellite sensors, typically less than 5 km, enabling direct comparisons between satellite observations and GSRM outputs without relying on subgrid-scale assumptions. Several studies have utilized satellite active sensor data to evaluate and refine the accuracy of microphysical representations within these models (e.g., Roh and Satoh, 2014; Roh et al., 2017; Ikuta et al., 2021).

The EarthCARE cloud radar, with its capability to observe Doppler velocity, provides a valuable opportunity to evaluate and improve GSRMs. Doppler velocity measurements capture downward motions linked to the terminal velocity of hydrometeors and upward motions associated with convective processes, offering insights into the microphysical and dynamical properties of convective systems.

Satellite simulators, which integrate comprehensive radiative transfer models to replicate satellite signals from atmospheric model outputs, play a crucial role in bridging the gap between simulations and observations. These tools enable robust assessments of GSRMs by facilitating direct comparisons between simulated and observed satellite signals, thereby enhancing model accuracy and alignment with observational data.

In this study, we evaluate GSRM simulations conducted at 3.5 km and 870 m horizontal resolutions using NICAM (Satoh et al., 2014) and EarthCARE data. Radar reflectivity and Doppler velocity were simulated with the Joint Simulator (Hashino et al., 2013; Roh et al., 2020), a satellite simulator. We investigate the utility of radar reflectivity and Doppler velocity as metrics for assessing microphysical processes and interpreting convective dynamics in both observations and simulations.