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Proposal for an Intensive Short-term Intercomparison Experiment of Global Storm Resolution Models for Evaluation by EarthCARE Satellite Observations

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We propose a protocol for observational intensive intercomparison experiments of global storm-resolving models, targeting for evaluation by the EarthCARE satellite, the new satellite scheduled to be launched in May 2024. Previously, a month-long or 40-day simulation of an intercomparison of global storm-resolving models was conducted under the DYAMOND (the DYnamics of the Atmospheric general circulation Modeled On Non-hydrostatic Domains) project. Global storm-resolving models can simulate meso-scale systems in the global domain, and it has been shown that the month-long simulations under the DYAMOND project reproduce the evolution of meso-scale convective systems comparable to nature in many aspects. As a next step of the feasibility of the global storm-resolving models, two directions of the intercomparison experiments are considered. One is to extend the simulation time to cover a longer period, such as a one-year experiment with a seasonal march (Takasuka et al. 2024, in preparation). The other is to evaluate with intensive observations. Here, we propose a possible protocol for the short-term (a few weeks to a month) intercomparison experiment to evaluate GSRM results with observation by the EarthCARE satellite and the coordinated grand observation campaign called ORCESTRA.

The EarthCARE satellite will enable the world's first observations of Doppler velocities from space using radar. This groundbreaking capability allows for the observational understanding of global snow and raindrop falling velocities. In numerical climate and weather forecasting models, falling velocities of snow and raindrops have traditionally relied on empirical formulas based on fragmented observations, lacking comprehensive validation through global observations. These falling velocities have frequently been used as tuning parameters for numerical models. The falling velocity of upper-level clouds directly impacts radiation balance through variations in cloud amount. In contrast, the raindrop velocity influences the formation of cold pools and the organization of convective clouds. After obtaining Doppler velocity observations from the EarthCARE satellite, reliance on these falling velocities as tuning parameters becomes obsolete, introducing observational constraints. Conversely, altering these falling velocities from traditional prescribed values in numerical models leads to deviations in model climatology and equilibrium states from observations, necessitating refinement of other processes, which require the resolution of new compensatory errors. This presentation analyzes the characteristics of Doppler velocities using the global non-hydrostatic model NICAM and discusses the impact of snow and

raindrops falling velocities. Specifically, utilizing the EarthCARE-like simulated data based on a global 220m mesh NICAM simulation, we aim to comprehend the global view of falling velocity characteristics and gain insights to analyze the EarthCARE satellite observational data.