

A proposal for intercomparison experiments of global storm-resolving models: One-year long simulation and evaluation and Improvement by EarthCARE Satellite Observations

*Masaki Satoh¹, Daisuke Takasuka¹, Woosub Roh¹, Shuhei Matsugishi¹

1. Atmosphere and Ocean Research Institute, The University of Tokyo

This talk presents a proposal for intercomparison experiments of global storm-resolving models. 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, targeting for evaluation by the EarthCARE satellite, the new satellite scheduled to be launched in May 2024.

The EarthCARE satellite will enable the world's first observations of Doppler velocities from space using radar. This capability allows for the observational understanding of falling velocities of ice particles and raindrops. In numerical climate and weather forecasting models, falling velocities of hydrometeors have traditionally relied on empirical formulas based on limited 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 changes in cloud amount. The raindrops' falling speed influences their evaporation and the formation of cold pools, thus convective aggregation. After obtaining Doppler velocity observations from EarthCARE, reliance on these falling velocities as tuning parameters becomes obsolete, introducing observational constraints. Conversely, altering these falling velocities from prescribed values in numerical models leads to deviations in model climatology and equilibrium states from observations, necessitating refinement of other processes, which require resolving compensation 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.

Keywords: global storm-resolving model, EarthCARE, falling speed of rain and snow