Understanding and Constraining Global Storm-Resolving Simulations Using EarthCARE and ORCESTRA Observations

Woosub Roh[1] and Masaki Satoh[1, 2]

（1:AORI, the university of Tokyo 2:Typhoon Science and Technology Research Center, Yokohama National University, ）

Abstract

Global storm-resolving models (GSRMs) simulate mesoscale convective systems at kilometer-scale resolution, allowing more direct comparisons with active satellite observations that have similar spatial sampling. This capability reduces reliance on subgrid-scale assumptions and enables physically consistent model–observation evaluation.

The EarthCARE satellite, equipped with a Doppler cloud profiling radar (CPR), provides a new benchmark for testing both cloud microphysics and atmospheric dynamics in GSRMs. Its Doppler velocity measurements make it possible to simultaneously assess hydrometeor fall speeds and vertical air motions, offering valuable constraints on convective updrafts and cloud structure. Satellite simulators enable quantitative comparisons by converting model output into synthetic radar signals.

The ORCESTRA field campaign (August–September 2024) provides complementary multi-platform observations of organized convection in the tropical Atlantic ITCZ, combining measurements from research aircraft, a research vessel, and ground-based systems.

We use EarthCARE and ORCESTRA observations to constrain a 3.5-km-resolution NICAM simulation. We compare vertical cross-sections and contoured frequency by altitude diagrams (CFADs) of radar reflectivity and Doppler velocity between NICAM and observations from EarthCARE and the HALO aircraft. These comparisons demonstrate how combined satellite and field observations can directly constrain cloud microphysical and dynamical processes, providing guidance for improving global storm-resolving models.