Evaluations of cloud cluster properties in cloud-resolving model simulations using satellite simulators over the tropical open ocean

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1. Introduction

The cloud cluster is one of the main sources of rain and cloudiness over the Tropics. Cloud resolving models (CRMs) could explicitly resolve convective cloud systems with a horizontal grid spacing of a few kilometers for the simulation of cloud clusters. Satellite observations are also used to study tropical cloud systems such as TRMM and geostationary satellite data and compare with numerical simulations. It is preferable to compare satellite radiances with calculated radiances from numerical simulations using satellite simulators, because retrieved physical products from satellite data have different estimation methods and microphysics assumption in comparison with CRMs. Matsui et al. (2009) proposed the TRMM Triple Sensor ThreeStep Evaluation Framework (T3EF) for the systematic evaluation of precipitating cloud types and microphysics in CRMs. However, it is difficult to investigate relationship between the high clouds and each cloud types. Split window techniques based on difference between the 11 and 12 μm could classify optically thin cirrus clouds and optically thick clouds. In this study, we evaluate precipitating clouds of cloud cluster in NICAM (Satoh et al. 2008) using T3EF and investigate the relationship between precipitating clouds and high cloud using spilt window technique.

2. DATA

2.1 NICAM

NICAM simulations are performed from 00 UTC 1 January to 00 UTC 6 January 2007. The actual analysis was made for the period of from 00 UTC 2 to 00 UTC 6 January. The central point of the simulation is 180E on the equator and analysis domain is 20S-20N and 160E-160S. We used the stretched grid system, and the minimum horizontal grid is set to 3.5 and 7 km.

2.2 Satellite data and satellite simulator

TRMM PR 13.8 Ghz attenuation corrected reflectivity, TMI 85.5 Ghz dual-polarization microwave brightness temperature, and 12μm infrared brightness temperature are used for analysis for T3EF methods. Hourly 11μm and 12μm data acquired by MTSAT was used for the life cycle of cloud clusters and cloud classification by the split window. We simulated corresponding microwave brightness temperature, radar reflectivity, and visible/infrared radiances of NICAM using the Satellite Data Simulation Unit (SDSU, Masunaga et al. 2010).

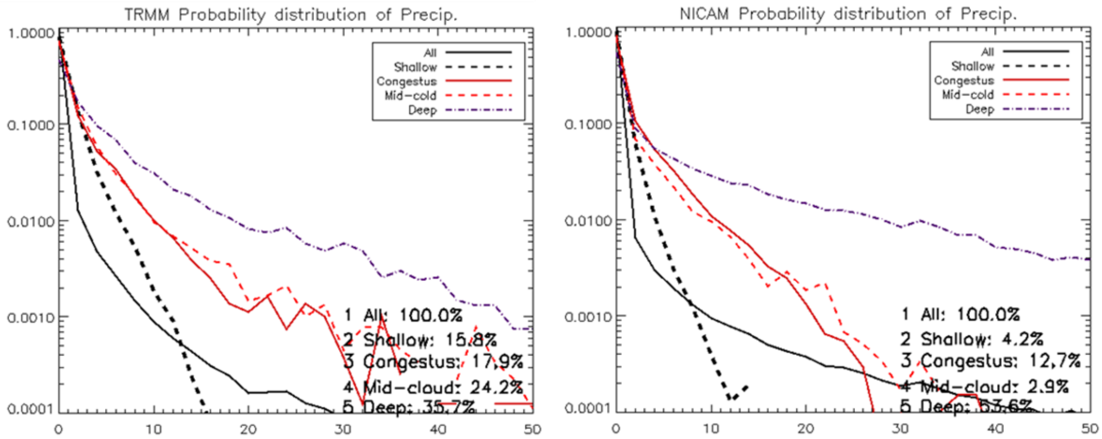

Fig1. Probability distributions of precipatatin rates for each category in T3EF.

3. Results

NICAM reproduces two convective cluster bands corresponding to infrared brightness temperatures (TBB) and 85 Ghz polarization corrected brightness temperatures in TRMM. The simulated probability distribution of precipitation rate has similar patterns with TRMM's orbital precipitation rate (Fig.1). NICAM has a good agreement with frequency precipitation rates of shallow and deep category. However, the more than 50% of rainfall amount in NICAM occurs in deep cloud category (35.7% in TRMM). Midcold category in NICAM underestimates the precipitation (2.9% in NICAM, 24.2% in TRMM). We would have sensitivity tests to improve disagreements of simulation results. Furthermore, we would investigate life cycles of a tracking method using 11 μm TBB using a satellite simulator and factors related to the life cycle of cloud clusters.

References

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