Project name：Numerical Study on Cloud Systems using NICAM （NICAM による雲降水システムの研究）

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1. Research purpose

The evaluation of cloud and precipitation is important in high-resolution models such as NICAM. These models are generally defined as nonhydrostatic models with horizontal grid spacing sufficiently fine to be able to explicitly simulate individual cloud systems. For clouds, NICAM more realistically represents microphysical processes, such as the consistent treatment of precipitating hydrometeors, compared with general circulation models (GCMs), and they calculate the time evolution, structure, and life cycle of cloud systems.

2. Research plan

We evaluate thermodynamic phases of clouds in a NICAM using Joint simulator and a Cloud-Aerosol Lidar and Infrared Pathfinder Satellite Observation (CALIPSO) lidar. For the evaluation, we developed the simulator of depolarization ratio in Joint simulator (J-simulator). We compare and analyze two simulations using two microphysics schemes such as NICAM Single-moment Water 6 (NSW6, Tomita 2008b) and the modified NSW6 (Roh and Satoh 2014). This year, we investigate the characteristics of ice clouds with 2D plate's shape (2D plates) such as effects of backscatters distribution and temperature dependencies. We evaluate the effects of 2D plates on cloud optical properties such as radar reflectivities and backscattering coefficients in NICAM and J-simulator.

3. Research progress

We investigated the effects of 2D plates on the vertical profiles of backscatters of CALIPSO using a merged dataset for CloudSat radar and CALIPSO lidar (Hagihara et al. 2010, hereafter, CSCA-MD) and DARDAR (Delanoë, J., and R. J. Hogan, 2010) data. We investigated the temperature dependency of 2D plates using CSCA-MD data. Figure 1 shows the temperature distribution of 2D plate and mixed 2D and 3D ices. The 2D plates exist above -20℃. The distribution of 2D plate has two peaks near -12℃ and 0℃. The peak near 0℃ is related to clouds over the southern hemisphere. We try to develop the parameterization of 2D plates using temperature and the possibility distribution of relative humidity for J-simulator and NICAM.

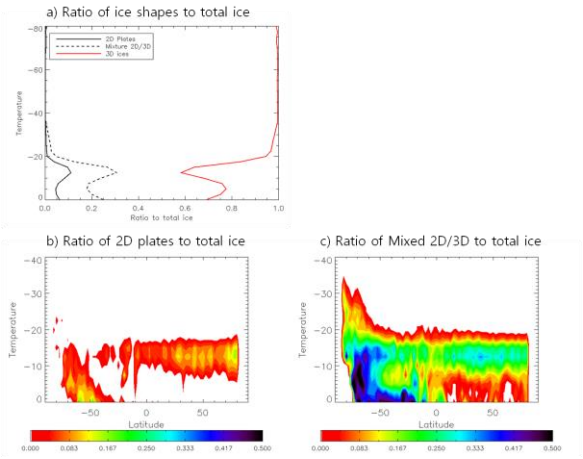

Fig. 1. Ratio of ice cloud shapes to total ices (a), and latitude-temperature distribution of 2D plate to total ices (b), and latitude-temperature distribution of mixed 2D/3D to total ices (c) for June 2008 using CSCA-MD data.

4. Future plan

We implement and test the parameterization of 2D plates in J-simulator. We investigate the effects microphysical properties related to ice shapes on the simulated signals of CloudSat and CALIPSO, and outgoing short wave radiations in NICAM.

5. Previous project name

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6. Record of supercomputer use （1st October 2015～31st October 2016）

Number of users: 3

CPU hours v_deb: 0.00 hours, v_32cpu: 0.00 hours, v_96cpu: 0.00 hours, v_160cpu: 0.00 hours, 計: 0.00 hours