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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Research period：April 2017 - March 2018

1. Research purpose

It is important to evaluate and improve the cloud properties in non-hydrostatic models such as NICAM (Satoh et al. 2014) using observation data. One of methods is a radiance-based evaluation using satellite data and a satellite simulator, which avoids making different settings of the microphysics between retrieval algorithms and NICAM.

One of challenging issues is an evaluation of mixed phase clouds, which consist of water vapor, ice particles, and supercooled water droplets. It is known one of the main reasons why climate models reveal large errors about the reflection of solar radiation over the Southern Ocean and Artic.

The purpose of this study is an evaluation and improvement of mixed phase clouds in NICAM using a Cloud-Aerosol Lidar and Infrared Pathfinder Satellite Observation (CALIPSO) and a satellite simulator.

2. Research plan

The case of mixed phase clouds is selected and evaluated. Several sensitivity tests are done to investigate the important parameters in microphysical processes related to supercooled water clouds. We improve the fraction of supercooled water clouds by introduction to new parameters or process in a microphysics scheme.

3. Research progress

This year, we evaluate thermodynamics phase of mixed phases clouds over the Southern Ocean between 45°S to 65°S and 170°E to 170°W following Yoshida et al. (2010) method. Two microphysics schemes, the original NICAM Single-Moment Water (NSW6) scheme (hereafter, CON; Tomita, 2008b) and the modified NSW6 scheme (hereafter, MODI) following Roh et al. (2017), were used and evaluated in this study. Figure 1 shows two-dimension frequency distributions of and x (a parameter estimated from two attenuated backscattering coefficients) and depolarization ratio for mixed phased clouds between -20℃ to 0℃ among the observation, CON, and MODI over the Southern Ocean. The observation shows frequencies of 2D plate ice clouds and super-cooled water clouds are dominant in the cloud particle diagram of Yoshida et al. 2010. The peak of frequencies located from 0% and 3% of depolarization ratio related to 2D plate ice clouds.

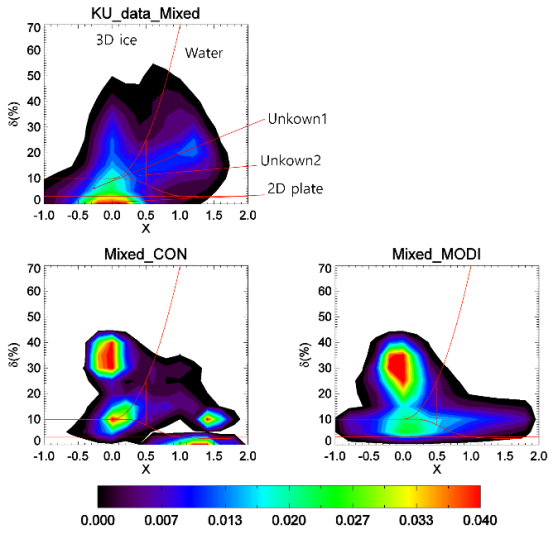

Fig. 1: Joint histograms of clouds in terms of x and depolarization ratio (δ) between -20℃ to 0℃ in January 2007. a) is from CALIPSO data. b) is from CON, and c) is from MODI. PDFs of cloud occurrences are shown on the below..

MODI underestimates super cooled water clouds comparing to observation and CON. We found snow deposition process is important to improve the supercooled water clouds.

4. Future plan

We will introduce new parameter of the snow deposition process in the microphysics to improve the fraction of super cooled clouds. We will investigate impact of supercooled clouds on of relative humidity in clouds and solar radiation budget.

5. Previous project name

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6. Record of supercomputer use （1st October 2016 - 30th November 2017）

Number of users: 3

CPU hours v_deb: 0.00 hours, v_32cpu: 1,067.87 hours, v_96cpu: 0.00 hours, v_160cpu: 0.00 hours, 計: 1,067.87 hours