Project name：Numerical study on cloud systems using NICAM

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1. Research purpose

It is important to evaluate and improve the cloud properties in global non-hydrostatic models like a Nonhydrostatic ICosahedral Atmospheric Model (NICAM, Satoh et al. 2014) using observation data. One of the methods is a radiance-based evaluation using satellite data and a satellite simulator (here Joint simulator, Hashino et al. 2013), which avoids making different settings of the microphysics between retrieval algorithms and NICAM.

The satellite data with active sensors has a limitation to observe the specific case of cloud and precipitation systems. And it is needed to validate satellite observations using in-situ observation. There are intensive observation stations over the Kanto region. The ULTIMATE (ULTra sIte for Measuring Atmosphere of Tokyo metropolitan Environment) is proposed to verify and improve high resolution numerical simulations based on these observation data.

In this presentation, we introduce the ULTIMATE project.

2. Research plan

There are several observation instruments over the Kanto region. Figure 1 shows the ultra-site observation networks in Kanto area. We investigated the availabilities of observation data and archived data.

The High Spectral Resolution Lidar (HSRL, 355 nm), Doppler lidar, and the Cloud Profiling Radar (CPR, 94 GHz) are located in NICT. HSRL and Doppler lidar can observe the aerosols and optically think clouds.

The Polarimetric radars are located in Haneda and Narita airports with 5.3 GHz wavelength. Polarimetric radar can observe the precipitation hydrometeors and retrieve the hydrometeor identification based on polarimetric variables.

The WInd profiler Network and Data Acquisition System (WINDAS) data is available in Kawaguchiko, Mito, and Kumagaya. WINDAS can observe 3D wind fields.

The second step of this project is the application and the development of Joint simulator. Joint simulator is developed for The EarthCARE satellite, which have CPR and HSRL.

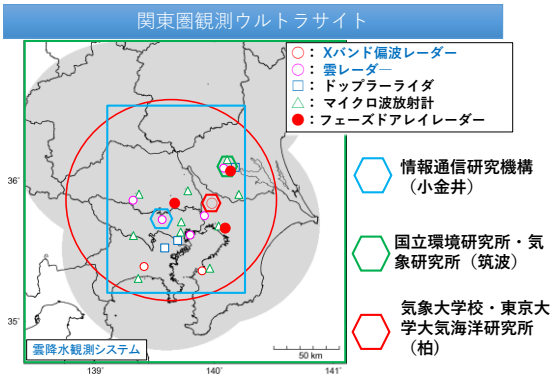

Fig. 1. Ultra-site observation networks in Kanto area.

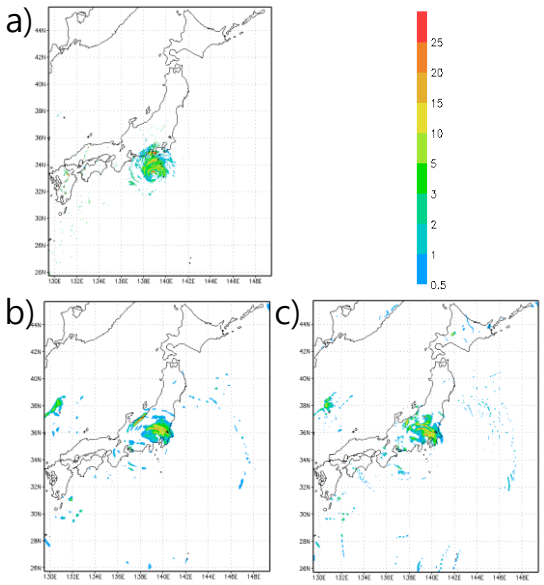

Fig. 2. Precipitation distributions on 17 UTC 8th Sep. 2019 among JMA-Radar observation (a), NICAM 2.8km experiment (b), and NICAM 1.4km experiment (c).

The EarthCARE Active Sensor Simulator (EASE, Okamoto et al. 2007, 2008; Nishizawa et al. 2008) in Joint simulator can simulate signals of CPR and HSRL in NICT. We need to develop the Joint simulator for in-situ observations like polarimetric radar.

The third step is to evaluate and improve NICAM using the intensive observations.

3. Research progress

This year, we achieved the observation data like C-band polarimetric radars in Narita and Haneda airport and WINDAS data. And we will get the HSRL data and CPR data in NICT.

POLArimetric Radar Retrieval and Instrument Simulator (POLARRIS, Matsui et. al. 2019) is implemented in Joint simulator. The POLARRIS can simulate differential reflectivity (Zdr), specific differential phase shift (Kdp), co-polar cross-correlation coefficient (ρhv), and Doppler velocity of a polarimetric radar using Mueller scattering matrix.

We used the stretched version of NICAM for test data of Joint simulator. We selected three cases for September 2019. Figure 2 shows the horizontal distribution of precipitation in one of the cases on 17 UTC 8th September 2019 by NICAM. NICAM reproduce the realistic precipitation of the tropical cyclone comparing to observation. We calculate the signals of polarimetric radar using Joint simulator.

4. Future plan

We will investigate the characteristics of signals in polarimetric radar. We will evaluate and improve the warm rain microphysics and riming process of graupel or hail.

We will consider the simulations of WINDAS using Joint simulator.

5. Previous project name

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

6. Record of supercomputer use （April 1, 2020 ～November 30, 2020）

Number of Users: 3
VE node time product v_debug: 0.10 hours, v_normal: 0.00 hours, Total: 0.10 hours,（Occupancy rate of the whole VE node time product: 0.0 %）