VALIDATION OF INTEGRATED CLOUD LIQUID WATER CONTENT RETRIEVAL OVER OCEANS BY DEVELOPING AN 1-D CLOUD MICROPHYSICS DATA ASSIMILATION SYSTEM (CMDAS)

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SYNOPSIS

Changes in cloud microphysical processes can modify the spatial extent, spatial distribution, lifetimes of clouds, the water vapor distribution outside of clouds and the fluxes of water and radiation through the atmosphere. Given the importance of the various influences clouds have in the evolution of both the atmosphere and the surface, the accurate parameterization of cloud microphysical processes is of fundamental importance in numerical simulations of tropical climate and their effects need to be included in the numerical weather prediction (NWP) models. For reliable NWP, an accurate description of the initial state of the atmosphere is required. However, current operational in-situ observation systems, which are used in NWPs to improve atmospheric state, can not observe the cloud liquid water content (CLWC). Therefore, the unavailability of CLWC in the conventional observation data may result into a poor initialization and an unreliable precipitation prediction of the atmospheric model.

Since 1998, there has been an ongoing studies to assimilate retrieved rain rates from the TMI and SSM/I instruments into the ECMWF model to correct the model initialization by assimilating brightness temperatures directly through the use of a radiative transfer operator in a 1D variational (1D-Var) context. Keeping in mind the positive impact of variational satellite data assimilation in the NWP model analysis, 1D-VAR assimilation method is adopted in the current research for the development of a Cloud Microphysics Data Assimilation System (CMDAS). The general framework of CMDAS includes the Kessler warm-rain cloud microphysics scheme, a 4-stream fast microwave radiative transfer model (RTM) in the atmosphere, and a global minimization method known as Shuffled Complex Evolution (SCE). The main purpose of development of

CMDAS is to retrieve the reasonable cloud distribution and to investigate its potential regarding the cloud properties by considering integrated cloud liquid water content (ICLWC) as an assimilation parameter.

The domain area includes the field of the Wakasa Bay Experiment 2003, which is 240 km x 240 km x 11 km with vertical and horizontal resolutions of 0.375 km and 4 km respectively. The AMSR-E brightness temperature data is provided by Japan Aerospace Exploration Agency (JAXA) for the area of 131° E to 141° E and 31° N to 41° N. Rough estimate of cloud top of 2200 m is derived from available data from Moderate-resolution Imaging Spectroradiometer (MODIS) onboard of Aqua. The cloud bottom is arbitrarily assumed to be 1200 m below the cloud top, because no observation data are available.

The simulation results of CMDAS with the observed AMSR-E Tb 89.0H GHz values identify clearly their effects on the cloud distribution mapping and show a comparable spatial distribution of a cloud system with MODIS thermal infrared (TIR) image for cloud top. CMDAS has shown the potential to assimilate passive microwave remote sensing observations into the cloud microphysics scheme. It shows the ability to introduce the spatial heterogeneity of ICLWC into the downscaling for the global model to the regional one and whose output can be used to improve initial conditions of the atmospheric model.