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1 The role of Cloud Microphysics Data Assimilation System (CMDAS) in the Numerical Weather Prediction (NWP) Model

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Reliable weather forecast by Numerical Weather Prediction (NWP) models depends on appropriate representation of cloud microphysical processes as well as reliable initial conditions of observations of atmospheric variables. Therefore, in order to improve the initial conditions of non-hydrostatic Advanced Regional Prediction System (ARPS) model and its precipitation predictability (especially over the oceans where no direct rainfall measurements are available), 1D-VAR Cloud Microphysics Data Assimilation Scheme (CMDAS) has been applied over the ocean to retrieve reasonable cloud distributions for warm cloud processes which can yield liquid hydrometeors at subfreezing temperatures whenever too few ice nuclei are available to create solid hydrometeors. The CMDAS general framework includes the Kessler warm-rain cloud microphysics scheme having three water categories of water vapor, cloud droplet and rain drop; a 4-stream fast microwave radiative transfer model (RTM) in the atmosphere; and a heuristic minimization approach called Shuffled Complex Evolution (SCE). The CMDAS assimilates the satellite microwave radiometer data set of Advanced Microwave Scanning Radiometer (AMSR-E) at channels of 89.0H GHz and 23.0H GHz and retrieves integrated cloud liquid water content (ICLWC) & integrated water vapor (IWV). The results reveal that CMDAS identify clearly their effects on the cloud distribution mapping by using observations of Wakasa Bay Experiment 2003 in Japan and shows the comparable structure of cloud system with Moderate-resolution Imaging Spectroradiometer (MODIS) image for cloud top. It has improved the perfor-

mance of cloud microphysics scheme significantly by the intrusion of heterogeneity into the external Global Reanalysis (GANAL) data, which resultantly improved atmospheric initial conditions. Total precipitation rate derived by ARPS with improved initial conditions provided by CMDAS reveals a good agreement of the spatial distribution of the precipitation rate with precipitation rate derived by 3-D Doppler radar reflectivity data. But at few places, ARPS has over-predicted the precipitation along with some spatial displacement which needs to be explored in detail in the near future.