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Comparison of Large-scale Cloud Schemes in Single-column and Global Versions of a Numerical Weather Prediction Model

Hyun-Joo Choi, So-Young Kim, and Emilia Kyung Jin
Korea Institute of Atmospheric Prediction Systems, Seoul, Korea, Republic Of (hj.choi@kiaps.org)

Large-scale cloud parameterization has been used in the numerical models for weather forecasting and climate prediction in order to represent cloud generated from non-convective sources that partially occupies a grid box. We have developed the cloud parameterization for Korea's own global numerical weather prediction (NWP) model since 2012, and as the first step for the development, the performances of existing cloud schemes are compared in single-column and global versions of a NWP model. The Met Office Unified Model is used as the testbed model, and three cloud schemes are considered in the model separately. One is the diagnostic cloud fraction and diagnostic condensate scheme (DIAG scheme), another is the diagnostic cloud fraction and prognostic condensate scheme (DCPC scheme), and the other is the prognostic cloud fraction and prognostic condensate scheme (PC2 scheme). The single-column simulation with each cloud scheme is performed during the Tropical Warm Pool-International Cloud Experiment (TWP-ICE) period (18 January-13 February 2006), and the global simulation is performed during April 2012. The simulation results are also compared with the observation and reanalysis data. In both single-column and global simulations, the DIAG scheme underestimates low and medium clouds compared with the observations, which is mostly due to the underestimated humidity in the low-to-mid troposphere. The biases are aggravated in both single-column and global simulations with the DCPC scheme. The PC2 scheme produces larger cloud fraction compared with the DIAG scheme, which is mainly contributed by the detrainment from convection. The cloud fraction from the PC2 scheme is also larger compared with the observations. The difference in the cloud representation among the cloud schemes results in the difference in the radiation budget, which in turn affects the temperature. Besides, relative humidity and precipitation are changed through the interactions among other physical processes such as microphysics. More detailed results will be shown in the meeting.