



## **A sensitivity study on the diurnal variation of simulated precipitation to cumulus parameterization schemes**

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This study aims at comparing the reproducibility of diurnal variation in precipitation simulated by various cumulus parameterization schemes during East Asian Summer Monsoon, and at investigating the sensitivity of the simulated results focusing on the timing and amount biases in diurnal variation of precipitation. The capability to simulate diurnal variation of precipitation over East Asia region during JJA 2011 is investigated from ensemble simulations using five different cumulus parameterization schemes in Weather Research and Forecasting model. Semi-diurnal cycle with 12-hour interval over the land and diurnal cycle with 24-hour interval over the ocean are commonly found in all of simulations. Observed two dominant peaks in the early morning and afternoon are reproduced in all simulations. However, the simulated afternoon peaks occur earlier than the observed (e.g., 2 h for Kain-Fritsch and Simplified Arakawa-Schubert, 3 h for Betts-Miller-Janjic and Tiedtke). The Kain-Fritsch scheme with alternative trigger function based on moisture advection provides slightly better results in that it alleviates the excessive precipitation rate and the overestimated precipitation frequency at the afternoon peak and delayed the afternoon peak later by 1-2 h. This results from the delayed initiation of convection by modified trigger function as well as the increase of non-convective precipitation. Sensitivity simulations with the change of temperature perturbation in the trigger function demonstrates the afternoon peak in total precipitation tends to be delayed later with reduced precipitation rate as the temperature perturbation decrease, implying a significant role of the frequency for convective initiation in determining diurnal variation of precipitation.