Geophysical Research Abstracts
Vol. 14, EGU2012-3349, 2012
EGU General Assembly 2012

Simulated weekly variability of precipitation with the effect of aerosols on cloud microphysics

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Aerosols in the atmosphere play an important role in cloud formation as cloud condensation nuclei (CCN). Chemical composition and number size distribution of aerosols significantly modify cloud properties. In this work we improve the cloud microphysics simulation of the Weather Research Forecasting (WRF) model by including the modified CCN activation depending on aerosol number size distributions, and by providing spatially and temporally varying aerosol data from a regional atmospheric chemistry model, the Community Multiscale Air Quality (CMAQ) model. Simulated precipitation in WRF with CMAQ aerosols in East Asia shows small but significant spatial changes relative to the original WRF with fixed CCN concentrations. In particular the model shows different weekly variability of simulated precipitations in Korea such as increases during the weekdays and decreases during the weekends with the CMAQ aerosols. This simulated weekly variability is consistent with that of observed precipitation in Korea over the past decades. We find that weekly varying aerosols due to human activity affect cloud formation and the conversion from cloud droplets to rain drops that is particularly associated with cold rain processes in the model. This can be clearly attributed to the indirect effect of anthropogenic aerosols coined as "weekend effect", indicating the importance of an explicit consideration of aerosols for cloud microphysics simulations of regional meteorological models.