Continental-scale simulation of diurnal variations in South Asian summer monsoon: Insights from the explicit and parameterized convection experiments

Konduru Rakesh Teja (konduru-rakeshteja@ed.tmu.ac.jp)
Tokyo Metropolitan University, Department of Geography

The most fundamental mode of variability in the convection during Asian summer monsoon is a diurnal cycle of precipitation. Exact representation of such diurnal cycle of precipitation especially over land and ocean is a significant problem in most of the sophisticated general circulation models (GCMs) and regional circulation models (RCMs). In this study, we simulate diurnal cycle of precipitation during south Asian summer monsoon using a suite of three ensemble experiments conducted at different spatial resolutions (25km, 12.5km, and 6.25km), with (convection on, CON) and without cumulus parameterization scheme (convection off, COFF). These continental scale simulations forced by Era-interim six hourly datasets for a period April 1 to October 31. The evaluation performed on peak south Asian summer monsoon season (July-August) and, compared with Tropical Rainfall Measuring Mission (TRMM) three hourly datasets. The analysis shows no much impact of spatial resolution on the phase and amplitude of diurnal cycle precipitation over both land and ocean. Instead, explicit simulations showed marked changes and remarkably reproduced phase and amplitude of diurnal cycle precipitation as compared to the convection-parameterized simulations. The explicit simulations well simulated both afternoons to late afternoon rainfall over land and early morning to afternoon rainfall over the Bay of Bengal. Besides, the southward propagation of the diurnal peak precipitation convincingly captured over the Bay of Bengal in the explicit simulations. However, in the convection-parameterized experiments, northward propagation of the diurnal peak precipitation over the Bay of Bengal is not realistic. This improvement in the explicit simulations regarding southward propagation of the diurnal peak over the ocean was due to the presence of a southward component of wind at the 600 hPa; this component is absent in the convection-parameterized experiments. Over land region, in explicit simulations, higher solar insolation increased the surface air temperature, which deepened the monsoon trough. As a result, moisture transport to the land from ocean amplified and availability of sufficiently higher convective available potential energy triggered convection in the late afternoon. Nevertheless, this late afternoon convection is absent in convection

parameterized simulations. These results outline the prominence of the explicit or modified convection schemes in the models to simulate realistic diurnal cycle of precipitation in South Asian monsoon