

Reproducibility of Indian summer monsoon rainfall in convection permitting Weather Research Forecasting model

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Dynamical downscaling of Indian summer monsoon rainfall (ISMR) by using regional climate models (RCMs) portrays the inability of the RCMs in simulating the ISMR, and certain systematic biases appear in the seasonal monsoon rainfall climatology. The inconsistency in RCMs simulation of ISMR can be due to the improper representation of convection by convective and/or microphysical parameterization schemes in different RCMs. In this study, we conducted convection permitting simulations in WRFv3.8.1 and compared with parameterized simulations, to understand the difference of reproducibilities of time-space patterns in the ISMR. Our experimental set-up consists of two sets of simulations with parameterized and explicit convection on a grid resolution of 25 km. The simulations are conducted for three different monsoon seasons: flood, drought, and normal years, to ascertain robustness in the analysis of the model output. These simulations are forced by using ERA-Interim reanalysis as the lateral boundary and large-scale forcing input. The mean large-scale circulation, the spatial distribution of rainfall, seasonal northward propagation of rain bands, and magnitude-phase of the Indian summer monsoon rainfall are verified against the JRA55 reanalysis and India Meteorological Department gridded rainfall datasets. The results show that regional simulations with explicit convection have benefited in the simulation of ISMR features. Simulated seasonal mean rainfall in parameterized convection shows positive bias over Gangetic plains and the Western Ghats. The same bias reduced in explicit simulations and seasonal mean ISMR behaves realistically concerning IMD observations. The added value in the simulation of ISMR in explicit experiments is found to be consistent during the flood, drought, and normal monsoon seasons. Further evaluation of the results reveals that over Indian region, explicit convection simulations of Indian summer monsoon are more realistic than parameterized convection simulations. Therefore, the current study tried to show up the uncertainties in ISMR simulation associated with parameterizations, and explicit convection experiments highlight the reduction of these uncertainties.

Keywords: Indian summer monsoon rainfall, Regional climate models, explicit convection, parameterization, JRA55 reanalysis, ERA-Interim reanalysis

