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Examining the Added Value in Downscaling Precipitation Characteristics over India using a Regional Climate Model

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In the COordinated Regional Downscaling Experiment (CORDEX) framework, it is aimed to provide high resolution regional climate projections using several regional climate models (RCMs) over different regions across the globe. Within this framework, we evaluate the performance of International Centre for Theoretical Physics (ICTP)- Regional Climate Model – version 4 (RegCM4) in simulating the precipitation characteristics over the South Asia CORDEX Domain, which encompasses the Indian subcontinent. It is very well known that the Indian subcontinent exhibits large spatial and temporal variability in precipitation especially during the Indian summer monsoon (June to September). In this study, the model evaluation is based on spatial patterns of seasonal mean precipitation, daily precipitation intensity and extremes over the five homogenous subregions (northwest India, central northeast India, northeast India, west central India and peninsular India) as well as all over India. Two simultaneous simulations have been carried out at 50 km (∼0.44 °) and 25 km (∼0.22 °) horizontal resolution using ERA-Interim (0.75 °) lateral boundary conditions for the period of 1999-2012. Comparison against the available high resolution observational datasets (e.g. TRMM and IMD, both at 25 km resolution) over all the homogenous regions shows that the model is well able to capture the seasonal mean cycle of precipitation both at 50 km and 25 km resolutions with respect to driving ERA-Interim reanalysis data. In addition, upscaling the simulated precipitation (both 50 km and 25 km) to the ERA-Interim resolution show better representation of spatial distribution of precipitation. Further analysis suggests that the precipitation at 25 km resolution shows consistent improvement both in mean and extremes over all the homogenous regions except overestimation in the west central and northeast India, that are both complex topographical regions. Here the associated probability distribution function (PDF) tails indicate more intense extreme events over the regions compared to the observations. Overall, it is seen that the characteristics of precipitation are sensitive towards the model grid resolution. These results would have implications while using RegCM4 for downscaling CMIP5 and/or CMIP6 GCMs (which are more coarser than ERA-Interim) for climate projections over India.