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Effect of Domain Size of a Regional Climate Model on the Indian Summer Monsoon Simulations

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Abstract

The characteristics of Indian Summer Monsoon circulation and rainfall simulated by Regional Climate Model version 4.2 (RegCM4.2) using two domains: the smaller domain over India and the larger one over South Asia (SA) CORDEX domain have been examined. This study is made over a period of 36 years starting from 1st January 1970 to 31st December 2005 at 50 km horizontal resolution of the model over both the domains. The UK Met Office Hadley Centre Global Circulation Model Version 2.0 (HadGEM2) outputs obtained from the Coupled Model Inter-comparison Project Phase 5 (CMIP5) for IPCC AR5 have been used for the initial and lateral boundary conditions. The model simulated precipitation has been compared with the Global Precipitation Climatology Project (GPCP) rainfall which is available over the entire domain of integration. Over the Indian land mass, the gridded rainfall values obtained from the India Meteorological Department (IMD) have been used for comparison. Results show that the total precipitation is reduced significantly when the domain size is reduced from SA to India. It is seen that the domain size has dominant impact on the convective precipitation simulated by the model whereas there is no change in non-convective precipitation. To understand this behavior of the simulated convective precipitation, different parameters such as latent heat flux, sensible heat flux and zonal moisture flux have been analyzed. The sensible heat flux simulated over the equatorial Indian Ocean and the latent heat flux over the Arabian Sea and Bay of Bengal are found to be more in SA domain than in the Indian domain. Simulated vertically integrated zonal moisture flux is also more over the Arabian Sea in case of SA domain and this contributes in a major way to the convective activity over India. Results show that the simulated climatological fields over India such as wind and rainfall in case of SA domain are closer to the respective observations as compared to those obtained using the Indian domain. It may be noted that when RegCM4.2 is integrated over the smaller Indian domain, the effects of the Himalayas and the moisture advection from the Indian seas are not included completely and hence the monsoon circulation and associated rainfall during the summer monsoon season are not adequately simulated.