Sensitivity Studies of Convective Schemes and Model Resolutions in Simulations of Wintertime Circulation and Precipitation over the Western Himalayas

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Abstract

The present study examines the performance of convective parameterization schemes at two different horizontal resolutions (90 and 30 km) in simulating winter (December–February; DJF) circulation and associated precipitation over the Western Himalayas using the regional climate model RegCM4. The model integrations are carried out in a one-way nested mode for three distinct precipitation years (excess, normal and deficit) using four combinations of cumulus schemes. The National Center for Environment Prediction—Department of Energy Reanalysis-2 project utilized gridded data, observed precipitation data from the India Meteorological Department and station data from the Snow and Avalanche Study Establishment were used to evaluate model performance. The seasonal mean circulation patterns and precipitation distribution are well demonstrated by all of the cumulus convection schemes. However, model performance varies using different schemes. Statistical analysis confirms that the root mean square error is reduced by about 2–3 times and the correlation coefficient (CC) increases in the fine resolution (30 km) simulations compared to coarse resolution (90 km) simulations. A statistically significant CC (at a 10 % significance level) is found only in the fine resolution simulations. The Grell cumulus model with a Fritsch–Chappell closure (Grell-FC) is better at simulating seasonal mean patterns and inter-annual variability of two contrasting winter seasons than the other scheme combinations.