Title:	Numerical Simulation of Winter Precipitation over the Western Himalayas Using a Weather Research and Forecasting Model during 2001–2016
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Abstract:	In the present study, dynamically downscaled Weather Research and Forecasting (WRF) model simulations of winter (DJF) seasonal precipitation were evaluated over the Western Himalayas (WH) at grey zone configurations (at horizontal resolutions of 15 km (D01) and 5 km (D02)) and further validated using satellite-based (IMERG; 0.1°), observational (IMD; 0.25°), and reanalysis (ERA5; 0.25° and IMDAA; 0.108°) gridded datasets during 2001–2016. The findings demonstrate that both model resolutions (D01 and D02) are effective at representing precipitation characteristics over the Himalayan foothills. Precipitation features over the region, on the other hand, are much clearer and more detailed, with a significant improvement in D02, emphasizing the advantages of higher model grid resolution. Strong correlations and the lowest biases and root mean square errors indicate a closer agreement between model simulations and reanalyses IMDAA and ERA5. Vertical structures of various dynamical and thermodynamical features further confirm the improved and more realistic in WRF simulations with D02. Moreover, the seasonal patterns of upper tropospheric circulation, vertically integrated moisture transport, surface temperature and cloud cover show more realistic simulation in D02 compared to coarser domain D01. The categorical statistics reveal the efficiency of both D01 and D02 in simulating moderate and heavy precipitation events. Overall, our study emphasizes the significance of high-resolution data for simulating precipitation features specifically over complex terrains like WH.
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