Submitted Abstract

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Abstract

A numerical experiment with a 2-km horizontal resolution was conducted using the Weather Research and Forecasting (WRF) model to understand the physical processes controlling nocturnal precipitation occurrence over the Himalayas during the mature monsoon season from 2003 to 2010. The model experiments simulated a diurnal variation in the precipitation over the Himalayan slopes and foothills, i.e., the two daily peaks in the afternoon and in the midnight over the slopes and the single nocturnal peak over the foothills. When the nocturnal precipitation dominated over the Himalayan slopes, moisture supply associated with westward propagation of low pressure systems was found in the synoptic-scale. Meanwhile, moisture was directly transported by the monsoon westerlies when nocturnal precipitation occurred over the foothills. In the model experiment, afternoon precipitation was simulated on the mountain ridges in the Himalayas where the altitude was approximately 2000–2500 m, and precipitation area expanded to the lower-elevation regions during the night. In the midnight, downslope wind was formed by radiative cooling at the surface and was intensified by evaporative cooling by hydrometeors in the near-surface layer. This downslope wind converged with the synoptic-scale moisture flow, and then nocturnal precipitation was promoted over the Himalayan slopes and foothills. Importance of topographic resolution for the nocturnal precipitation simulation was confirmed in the sensitivity experiment as well as a number of vertical layers in the model. This work was published as Sugimoto et al. (2021; Journal of Hydrometeorology).