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Onset and retreat of the Indian monsoon on the southern and northern slopes of the Himalayas as described by precipitation stable isotopes

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This project launched the first study to compare the stable isotopes (δ18O and δD) in daily precipitation at the Kathmandu and Tingri stations located on the southern and northern slopes of the central Himalayas, respectivily. Results show that low δ18O and δD values of summer precipitation at the two stations were closely related to intense convection of the Indian monsoon. However, summer δ18O and δD values at Tingri were lower than those at Kathmandu, a result of the lift effect of the Himalayas, coupled with convection disturbances and lower temperatures at Tingri. In winter, the relatively high δ18O and δD values of precipitation at the two stations appears to have resulted from the influence of the westerlies. Compared with those during the summer, the subsidence of the westerlies and northerly winds resulted in relatively high δ18O and δD values of the winter precipitation at Tingri. The δ18O and δD values in winter precipitation at Kathmandu far exceeded those at Tingri, due to more intense advection of the southern branch of the westerlies, and higher temperatures and relative humidity at Kathmandu. The detailed differences in stable isotopes between the two stations follow short-term variability in the onset date of the Indian monsoon and its retreat across the central Himalayas. During the entire sampling period, the Indian monsoon onset at Tingri occurred approximately one week later than that at Kathmandu. However, the retreat at Tingri began roughly three days earlier. Clearly, the duration of the Indian monsoon effects last longer at Kathmandu than that at Tingri. Our findings also indicate that the India monsoon travels slowly northward across the central Himalayas due to the blocking of the Himalayas, but retreats quickly from north to south.