



Rainfall hazard in the Darjeeling-Bhutan Himalayan front

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The mountain front of the Darjeeling-Bhutan Himalaya is a transition zone between interior of Himalaya to the north and adjacent piedmont to the south. The area is located just north of the gap between the Deccan Plateau and the Meghalaya Plateau, and is open to advection of humid air masses from the Bay of Bengal. Thus the multiscale interaction of monsoonal circulation with the local topography cause that the Darjeeling-Bhutan Himalaya front experiences the highest annual rainfall (3,000-5,000 mm) and most frequent heavy rains (up to 800 mm/day) along the whole Himalayan margin.

A daily rainfall data analysis was carried out for 20 Indian and Bhutan stations for 30 years (1981-2010) in order to identify the rainfall aggressiveness. Four precipitation concentration indices, predisposition of a site to produce overland flow with potential erosive effects by calculating the conditional occurrence probability of daily events with a minimum of 50 mm rainfall amount, preceded by at least 28 mm during the previous five days as well as rainfall thresholds between 1 and 5 days for triggering shallow landslides were used.

The results show that the precipitation concentration values are lowest in the Himalayan foothills where annual total precipitation highest. Himalayan foothills are characterized by also increasing trends of precipitation concentration at the 0.05 significance level of the Mann-Kendall test. This is in contrast to areas located northward in the interior of Himalaya and southward in the piedmont where most of the stations revealed increasing precipitation concentration trends during investigated period. The probability of shallow landslides triggering increases from 0.2-1.4% for one day rainfall threshold of 144 mm to 4.8-12.7% for 5 days rainfall threshold of 202 mm. The spatial differentiation of the probability of the landslides triggering increases together with the number of days of the rainfall threshold. It is significantly higher in Bhutan Himalaya in comparison to Darjeeling Himalaya.