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# Assessing the sensitivity of small catchments to an extreme event in the North-west Himalayas

**Arkaprabha Sarkar**[1] and Vimal Singh[2]
[1]University of Delhi, Department of Geology, New Delhi, India (arkaprabha.geo@hotmail.co.uk)
[2]University of Delhi, Department of Geology, New Delhi, India (vimalgeo@gmail.com)

Smaller systems have thresholds lower than those of larger ones. Therefore, the response of a small change can be easily observed in small catchments where a larger system might not respond.

In this study, we investigated sub-catchments of a small 4$^{th}$ order Pranmati River Catchment, located in the North-west Himalayas; it is the part of the Ganga River System. We selected eight sub-catchments of 1$^{st}$ to 3$^{rd}$ order with area not more than 16 km$^2$ and analyzed their response to high-intensity rainfall. We calculated drainage density, length of overland flow, infiltration number, and constant of channel maintenance to analyze their behavior in terms of infiltration and surface runoff. The results show that two of the sub-catchments show tendency of low infiltration and higher surface runoff compared to the other sub-catchments. To validate our results, we compared them with the observations and available data of a highly localized high-intensity precipitation event that occurred in July 2018 within the catchment. During this event, there was focused rainfall in one of the sub-catchments that initiated a flash flood. The flood propagated from that sub-catchment along the trunk channel while all other sub-catchments suffered negligible impact. A significant increase in channel width has been observed along the path of the flood. We ran simulations of storm events in HEC-RAS for various rainfall patterns within the given time interval to replicate the event.

The hydrological simulation of basin-wide uniform rainfall with a Gaussian temporal distribution shows high overland sheet flow in these basins whereas the rest of the basin showed channel flow and low surface runoff. One of these two catchments was the initiation point of the flood event. The results indicate the high sensitivity of the basins and their contrasting responses under similar forces. Minor differences in the values of geomorphic parameters which are inconsequential in the case of large catchments become significant for smaller catchments. It also highlights the degree of spatial heterogeneity of rainfall and the inconsistency of the presently available precipitation datasets.