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Regional flood reconstruction in Kullu District (Himachal Pradesh, India): implication for Disaster Risk Management

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Floods are a common natural hazard in the Western Indian Himalayas. They usually occur when humid monsoon airs are lifted along the Himalayan relief, thereby creating intense orographic rainfall and runoff, a process which is often enhanced by simultaneous snowmelt. Monsoon floods are considered a major threat in the region and frequently affect inhabited valleys, disturbing the status quo of communities, stressing the future welfare and condition of their economic development. Given the assumption that ongoing and future climatic changes may impact on monsoon patterns and extreme precipitation, the implementation of adaptation policies in this region is critically needed in order to improve local resilience of Himalayan communities. However, its success implementation is highly dependent on system knowledge and hence reliable baseline data of past disasters. In this communication, we demonstrate how newly gained knowledge on past flood incidents may improve flood hazard and risk assessments.

Based on growth-ring analysis of trees growing in the floodplains and other, more classical paleo-hydrology techniques, we reconstruct the regional flood activity for the last decades. This information is then included as non-systematic data into the regional flood frequency by using Bayesian Markov Monte Carlo Chain algorithms, so as to analyse the impact of the additional data on flood hazard assessments. Moreover, through a detailed analysis of three flood risk hotspots, we demonstrate how the newly gained knowledge on past flood disasters derived from indirect proxies can explain failures in the implementation of disaster risk management (DRM). Our methodology allowed identification of thirty-four unrecorded flood events at the study sites located in the upper reaches since the early 20th century, and thus completion of the existing flood history in the region based on flow measurements in the lower part of the catchment. We observe that 56% of the floods occurred simultaneously in more than two catchments, and that in 15% of the cases more than four catchments were affected. By contrast, 44% of event years were related with one specific catchment, corroborating the assumption that large-scale atmospheric conditions and specific weather and/or geomorphic conditions may operate as triggers of floods in Kullu district. The inclusion of peak discharge data related with these ungauged extreme flood events into the regional flood frequency evidenced that flood hazard was systematically underestimated. Our results allowed to highlight the potential causes of three paradigmatic cases of flood disaster incidents at Kullus district, suggesting that the lack of knowledge on past flood disaster could play an important role in Disaster Risk managment (DRM) at three actors-levels i.e. civil engineering, local authorities and inhabitants. These observations show that reliable DRM implementation is conditioned by lack of data to characterize the flood process, and therefore put in value the palaeohydrological approach used in this study.