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Erosion patterns in the Nepal Himalayas from river gauging, cosmogenic nuclides and precipitation data

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The distribution of erosion in the Himalayas is mainly controlled by the spatial distribution of relief and possibly precipitation intensity. However, both parameters might depend on each other. Today we do not have a good understanding of the effects of this controlling parameters on erosion in complex topographic settings and active mountain belts such as the Himalayas. The conjunction of independent erosion proxies can help to understand recent (today-10^4 years) erosion distribution and its eventual dependency on topography, precipitation and uplift.

For our analysis we have validated the precipitation dataset APHRO_MA_V1003R1 (Asian Precipitation Highly Resolved Observational Data Integration Towards Evaluation of Water Resources, Monsoon Asia, Version 10, hereafter referred to as APHRO), which is interpolated from rain gauging stations. It was evaluated to be the best dataset of precipitation estimates at the scale of the Himalayas. APHRO data, with a daily temporal resolution and 0.25° spatial resolution, is available since 1951.

Here, we present a compiled analysis of spatio-temporal erosion evaluation from suspended river discharge fluxes, its relation with precipitation and rainfall induced landsliding. The analysis is based on data from 14 hydrological stations in Nepal, which cover nearly all major rivers, spanning a rainfall gradient from East to West along the Himalayan front. The annual hydrograph of the Himalayan rivers is controlled by the South Asian summer monsoon. The average increase of discharge during monsoon is one to two orders of magnitude with respect to winter base-flow. Considerable suspended concentrations (10^2-10^3 mg/l) are observable during monsoon season. Short lasting events, however, can catapult concentrations for few short periods above 10^3 mg/l. In general, few above 95 % quantile events account for more than the half of all suspended material transported in one year. These above threshold events are generated by precipitation driven landslides. A direct linkage between annual suspended fluxes and precipitation intensity distribution is also observed. Denudation rates calculated from suspended sediment fluxes are in the range of 2.1 to 5.6•10^3 t km^{-2} a^{-1}.

We will present cosmogenic erosion rates, deduced from ^{10}Be analyses from quartz, for several small and associated large catchments across the Himalayan range. Sample locations for large river basins correspond with the hydrological station location mentioned above. Our cosmogenic erosion rates are in the same range as the ones derived from suspended sediment fluxes, 1-4 mm/a. In general, erosion rates are higher within the Himalayan range close to the Himalayan ride crest.

The combination of these methods gives a good overview on the erosion processes and its distribution across the Himalayan mountain belt. Mass wasting is indeed the dominant process driving erosion and shaping topography. Furthermore, the source and transport pathways can be determined, which is a first step to understand the linkage between topography and precipitation distribution on a large scale.

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