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Real-time measurements and modelling of bedrock river erosion along two rivers of the Frontral Himalaya

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River incision is a key process in mountains evolution by setting base level and driving mass wasting of adjacent hillslopes. Most studies have been devoted to model mountain river incision by considering heuristic and simplified laws, or empirical relations derived from long term incision, and considering average flow or sediment flux values. In contrast, few studies have focused on the incision at the timescale of a flood, and tried to bridge the gap between experimental or theoretical approaches and long term river incision studies.
Here we present observations made during 5 monsoon seasons on fluvial bedrock incision in the Frontal Himalaya in Central Nepal. Two rivers, the Bakeya and Ratu Khola, characterized by Holocene incision rates larger than 10mm/yr, were monitored in order to mostly document incision of the lateral parts of their bedrock channel : one river is draining across poorly cemented sandstones, the other across alternation of indurated sandtone and less resistant claystone.
Measurements were twice. At the scale of the whole monsoon, six detailed microtopographic surveys of channel bedrock elevation at 5-cm intervals were conducted. In parallel, we developed and installed a new erosion sensor that brings the first real time study of fluvial bedrock wear with a recording time step of 5'.
Results for both measurements indicate that :
1. Erosion is highly dependent on rock resistance. Banks made of weak sandstone are eroded quickly by wear and detachment, meanwhile banks made of resistant sandstone are eroded partly by abrasion but at a much slower rate, and partly by block detachment following undermining of the claystone levels.
2. Erosion increases with flood discharge. Real time recording confirms that most of the bank erosion occurs each year during a few hours of the maximum flood, i.e. when a maximum of the sediment load is set in motion.
3. Experimental measurements on abrasion produced by gravels and coarse sand, combined with Rouse suspension model, permits, when using the flood history recorded by an automatic pressure gage, to predict both real-time and monsoon average erosion amplitude and profiles.