Geophysical Research Abstracts
Vol. 20, EGU2018-3952-1, 2018
EGU General Assembly 2018

The interaction of extreme floods and extreme erosion thresholds [U+0096] an example from the 2016 Bhote Koshi glacial lake outburst flood

Kristen Cook (1), Christoff Andermann (1), Florent Gimbert (2), Niels Hovius (1), and Basanta Adhikari (3)

(1) GFZ Potsdam, GFZ Section 5.1, Potsdam, Germany (klcook@gfz-potsdam.de), (2) University of Grenoble Alpes, CNRS, IRD, IGE, Grenoble, France, (3) Tribhuvan University, Civil Engineering Department, Kathmandu, Nepal

In a bedrock landslide dominated catchment, channels may receive sediment ranging from large boulders to fines. This wide range in grain sizes can result in extreme bed armoring if the largest grains are unable to be mobilized by typical discharges. In some cases, boulders may be completely immobile and must be eroded in place, a relatively slow process. In a system where the largest grains are not completely immobile, but are only mobilized during extremely large floods, these floods can become very important drivers of channel change, despite their rarity. We present an example of such a threshold-dominated system in the Bhote Koshi/Sun Koshi River in central Nepal, which is a rapidly eroding river with at least several meters of alluvium covering the bed. In July 2016, the Bhote Koshi was hit by a glacial lake outburst flood (GLOF) that passed through a seismic and hydrological observatory installed along the river in June 2015, providing a unique set of data on flood dynamics and impacts. The GLOF caused substantial changes to the channel bed, banks, and adjacent hillslopes, causing at least 26 landslides and an average of 11 m of channel widening. In contrast, the annual Indian Summer Monsoon appears to have little impact on the channel. During the monsoon, sediment delivered to the channel from hillslopes and tributaries is transported downstream, but boulders that armor the channel bed and banks are not mobilized and therefore little in-channel erosion takes place. Seismic data from the GLOF and the 2016 monsoon season confirm that bedload transport is supply-limited during the monsoon, and both suspended load and bedload flux were temporarily up to 30 times higher than usual following the disruption of the bed structure by the GLOF. The ability of extremely large floods such as GLOFs (and landslide lake outburst floods) to mobilize otherwise immobile sediment gives them the potential to have a disproportional impact on the river channel. As outburst floods occur regularly in the Himalaya, we suggest that they may play a major role in the dynamics of many Himalayan rivers, particularly in upstream reaches that are both more GLOF-susceptible and often contain very coarse alluvial cover. Fluvial erosion in these reaches may therefore be driven not by monsoon precipitation, but rather by outburst flood frequency and magnitude.