Geophysical Research Abstracts
Vol. 20, EGU2018-14723, 2018
EGU General Assembly 2018

Semi-automated mapping of landslide evolution following the 2015 Gorkha earthquake

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In the months that followed the 2015 Gorkha earthquake in Nepal, numerous efforts were undertaken to map coseismic landslides. These drew primarily upon very high resolution (sub-metre) imagery, yielding an upper estimate of > 25,000 coseismic landslides (Roback et al., 2017). An increasing body of research centres upon identifying rates of landsliding in the years after an earthquake. This of considerable importance for understanding subsequent patterns of sediment mobilisation, the role of coseismic damage accumulation in driving post-seismic slope failure, and the evolving nature, extent, and severity of landslide risk. The continued monitoring that is required becomes increasingly important in regions where landsliding is also driven by intense seasonal meteorological events, such as the South Asian Summer Monsoon. Following the Gorkha earthquake, extensive and pervasive cracking was observed on many hillslopes that had not undergone full failure. In the monsoons of 2015-2017, new failures and reactivations were observed in addition to many cracked slopes that remained stable. The case of the Gorkha earthquake therefore presents an important opportunity to increase our understanding of the decay in landslide rates in the years after an earthquake event.

Monitoring of post-earthquake landslide rates is more commonly undertaken by analysing fluvial sediment loads than by mapping of landslides, though alternative methods such as microseismic monitoring have also been employed. This is partly due to the fact that fluvial sediment loads exclusively relate to failures that intersect with the channel network, however, it is also the case that manual landslide mapping over large areas affected by shaking, over multiple epochs, is a time consuming task. Such a task becomes increasingly difficult when very high resolution imagery is sought. We evaluate the use of semi-automated mapping of medium-resolution imagery in order to track the time-evolution of landsliding across the 14 worst-affected districts in Nepal. An Object Based Image Analysis (OBIA)approach, described by Stumpf et al. (2017), is used, which draws here upon Sentinel-2 and Landsat 8 imagery collected pre- and post-monsoon from 2014-2017 as well as immediately after the earthquake. We describe the success of this approach relative to manually mapped data from the same imagery, in addition to statistics of landsliding through time, which include the number of landslides, their area, and the spatial density of landsliding across the affected districts. Its application has the potential to generate important datasets following future earthquake events.

Roback, K, Clark, MK, West, AJ, Zekkos, D and Li, G.: The size, distribution, and mobility of landslides caused by the 2015 Mw 7.8 Gorkha earthquake, Nepal, Geomorphology, doi: 10.1016/j.geomorph.2017.01.030, 2017.

Stumpf, A., Marc, O., Malet, J.P., and Michea, D.: Sentinel-2 for rapid operational landslide inventory mapping, EGU General Assembly Conference, 23-28 April, 19, 4449, 2017.