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2015 Nepal Earthquake: A regional landslide susceptibility analysis

Malcolm Billinge-Jones (1), Andrea Valagussa (2), Paolo Frattini (2), Elena Valbuzzi (2), and Giovanni Crosta (2)
(1) University of Portsmouth, School of Earth and Environmental Sciences, Portsmouth, United Kingdom, (2) University of Milano - Bicocca, Italy (andrea.valagussa@unimib.it)

Following the 7.8 Mw earthquake that struck Nepal on April 25, 2015, three landslide inventories have been prepared covering most of the area affected by coseismic landslides in Nepal. The first inventory contains more than 18,000 earthquake-induced landslides, which were mapped using Google Earth's historical imagery to compare images taken prior to the earthquake, with those taken after. Landslides were identified by visible changes in vegetation and the ground surface, or, by the appearance of characteristic geomorphological features such as a landslide toe or scarp. Where satellite imagery alone was insufficient to distinguish landslides due to distortion or cloud cover, helicopter footage (USGS, 2015) and Google Crisis were utilised. Most identified landslides were classified as debris flows or as shallow translational landslides. Some rotational landslides were identified, although the appearance of these was rare in comparison. The second inventory is a collection of pre-event shallow landslides showing those already active before the occurrence of the earthquake. This inventory includes more than 2,500 events. The third inventory includes almost 20,000 deep-seated landslides, consisting of mostly rock avalanches, slumps, rockslides, and deep-seated gravitational slope deformations (DSGSD). A multivariate statistical analysis, aimed at analysing the relative influence of the controlling parameters in the production of landslides, was performed. It was discovered that the parameters which contribute most to slope instability, and therefore the production of landslides, are: slope angle, relief in a 10,000m radius, the presence of deep-seated landslides, and high values of PGA (Peak Ground Acceleration). Zones with higher landslide susceptibility are primarily located at the convergence of the Lesser Himalayan Hills to the High Himalayan mountains in an east-west fashion, mimicking the fault rupture and PGA spread. A decrease of landslides at higher elevations was linked to the increased coverage of ice and snow, either reinforcing slopes, or removing any loose material from the slope entirely. Slopes that display a more northerly orientation were found to be less likely to fail than those facing east. This is likely due to the east-west propagation of the fault, and the amplification of seismic waves on slopes sharing an easterly orientation. Debris flow and rockfall propagation has been successively performed from areas with higher onset susceptibility, in order to assess the potential impact of these rapid landslides on roads and villages for the prioritization of mitigation strategies and further detailed studies.