

Regional analysis of distribution of pre and post 2015 Nepal Earthquake landslides

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A magnitude 7.8 earthquake struck Nepal on April 25, 2015. Three landslide inventories have been prepared in four districts: Dhading (1885 km²), Sindhupalchok (2488 km²), Rasuwa (1522 km²) and Nuwakot (1194 km²), that are located north of Kathmandu. These inventories extend 14 to 138 km SE from the epicenter of the main shock (April 25, 2015), 4.5 to 143 km NW from the epicenter of the main aftershock (May 12, 2015), and 34 to 136 km from the Main Frontal Thrust.

The first inventory is a coseismic and post-seismic landslide inventory based on multi-temporal images (Google Earth, Google Crisis maps, Bing maps), and helicopter-based video. The second one is a pre-event shallow landslide inventory. In these two inventories the most abundant landslide types are: debris flows, shallow translational slides, and rockfalls. The third is a deep seated landslide inventory, in which the most represented landslide types are rock avalanches, slumps, rockslides and deep-seated gravitational slope deformations (DSGSD). All the landslides have been mapped as individual polygons. For the analysis we focus our attention on four districts:

First we studied how the landslide frequency density changes as a function of topographic parameters (i.e. slope gradient, slope aspect, and elevation). The analyses have been based on the ASTER Global Digital Elevation Model (ASTER GDEM). For coseismic and post-seismic landslides we observed that the mean slope gradient at which the landslide occurs is higher with respect to the two other inventories (50° and 30/40° respectively). The slope aspect of coseismic and post-seismic landslides is also different, with a larger frequency of landslides towards SW, whereas in pre-event landslides the most common slope aspect is SE. This could be related to the direction of the seismic wave. At least the coseismic and post-seismic landslides occur, in mean, at an elevation lower than the pre-event landslides. We also analyzed the relationship between the landslide frequency density and the lithology in which each landslide occurs to better understand if a particular geological suite is more prone to give landslides, both in seismic and non-seismic conditions. The landslide density for the Deep Seated Landslides and the Pre-Event Shallow landslides does not shows particular changes with the lithology in which the landslide occurred. The Deep Seated Landslides seem to be more abundant in marbles with respect the others lithologies. The pre-event landslides seem to be more abundant in gneiss and shale. Different observations could be done for the coseismic and post-seismic landslides, which show a high value of density (5.13 landslides per km²) for schist, limestone and quartzite. Instead, the granites have a lower number of landslides, as observed for the two other inventories.