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Commentary

Himalayan Region Co-Seismic Landslide Hazard Evaluation

David T Long*

Department of Geological Sciences, Michigan State University, Michigan, USA

DESCRIPTION

The Himalayan region is regarded as one of the most seismically active regions in the world, and it has already been hit by a number of devastating earthquakes. In the mountainous area, earthquakes can cause secondary hazards such as rock falls, landslides, and debris flows. Of these secondary dangers, co-seismic landslides are by far the most frequent. The 1999 Chamoli earthquake in India (which caused 56 landslides), the 2005 Kashmir earthquake in India (which caused 1293 landslides), the 2013 Lushan earthquake in China (which caused 22,528 landslides), and the 2015 Gorkha earthquake in Nepal are just a few examples of large-magnitude earthquakes that have caused landslides in the Himalayas (triggered more than 25,000 landslides). One of the riskiest earthquake-related collateral hazards is these landslides. Sometimes, the damage brought on by strong shaking and fault rupture has been surpassed by the harm brought on by seismically generated landslides. The landslides brought on by earthquakes obstruct stream drainage, damage and destroy infrastructure, and block highways. It is crucial to understand the specifics of various earthquake shaking circumstances that can cause slope instability, as well as the probable location and size of the landslide's occurrence.

The Newmark model method and statistical analysis methods are currently the most widely used landslide hazard assessment techniques. The mathematical correlations between landslides and factors that generate landslides, such as topography, hydrology, human activity, and geology, are determined through statistical analysis methods using earthquake-induced landslide inventories. The landslide hazard evaluation is done using the derived models. Recent evaluations have relied heavily on mathematical-statistical analysis, particularly those that use Support Vector Machines (SVM) and Logic Regression (LR). These two statistical techniques have been successfully applied to assess the landslide hazard at the regional level. Both of these approaches have the benefit of creating models based on the actual distribution of landslides and producing findings for assessments that are comparatively objective. Most are unaware of the mechanisms that cause landslides, though.

The first basic model for determining co-seismic slope displacement was proposed by Newmark, and it makes the assumption that displacement takes place when seismic acceleration exceeds a Critical Acceleration (a_c). The Newmark's method has been applied by a number of researchers to estimate co-seismic slope displacement at specified places in conjunction with real strong-motion records. Two main methods are used to assess the risk of earthquake-induced landslides based on Newmark's model and ground motion data: (I) The probabilistic method, which computes Newmark displacement for the standard probability of exceedances using a ground motion parameter, typically Peak Ground Acceleration (PGA) or Arias Intensity (I_a), and (ii) the deterministic method, which takes into account a specific scenario of a high magnitude earthquake event, which is uncommon but possible. The probabilistic approach takes into account numerous uncertainties related to co-seismic landslide dangers in contrast to the deterministic approach, which is dependent on a single seismic scenario. In spite of the fact that many studies on the assessment of co-seismic landslide hazards use deterministic methods, there aren't many that do so. Incorporating seismic information obtained from probabilistically determined ground motion parameters has also not received much attention. The ground motion parameters obtained from PSHA are a more accurate representation of the seismic activity of a region because it takes into account all the seismic sources that are affecting the area under inquiry and the various spatiotemporal uncertainties associated with them. The evaluation of, which is reliant on the shear strength of rock joints, is necessary for the analysis of dynamic slope stability. In order to measure the shear strength of rock joints, the Barton model is frequently used. Static slopes that are statically stable typically resist earthquake loading. In the limit equilibrium condition, slope collapse is frequently caused by earthquakes. Therefore, it is crucial to properly define the slope shear strength. Therefore, co-seismic landslide hazard evaluation is crucial for planning for future land use, emergency preparedness, and lowering the risk of earthquake-induced landslides.

Correspondence to: David T Long, Department of Geological Sciences, Michigan State University, Michigan, USA, E-mail: long.david@msu.edu

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