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Physically based prediction of earthquake induced landsliding

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Earthquakes are an important trigger of landslides and can contribute significantly to sedimentary or organic matter fluxes.
We present a new physically based expression for the prediction of total area and volume of populations of earthquake-induced landslides. This model implements essential seismic processes, linking key parameters such as ground acceleration, fault size, earthquake source depth and seismic moment. To assess the model we have compiled and normalized a database of landslide inventories for 40 earthquakes. We have found that low landscape steepness systematically leads to overprediction of the total area and volume of landslides. When this effect is accounted for, the model is able to predict within a factor of 2 the landslide areas and associated volumes for about two thirds of the cases in our databases. This is a significant improvement on a previously published empirical expression based only on earthquake moment, even though the prediction of total landslide area is more difficult than that of volume because it is affected by additional parameters such as the depth and continuity of soil cover. Some outliers in terms of observed landslide intensity are likely to be associated with exceptional rock mass properties in the epicentral area. Others may be related to seismic source complexities ignored by the model. However, most cases in our catalogue seem to be relatively unaffected by these two effects despite the variety of lithologies and tectonic settings they cover.
This makes the model suitable for integration into landscape evolution models, and application to the assessment of secondary hazards and risks associated with earthquakes.