

Landslides, Earthquakes, Risk and Erosion

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A landslide event consists of single to tens of thousands of landslides associated with a trigger, such as an earthquake, sudden snowmelt, or extended precipitation. Using four well-documented landslide events, from Italy, Guatemala and the USA, each with a different triggering mechanism, we find that the frequency of landslide areas for all four are well approximated by the same three-parameter inverse-gamma distribution. For small areas this distribution has an exponential 'roll-over' and for medium and large landslide areas decays as a power-law with exponent -2.40 . Implications of this distribution include: (i) we can introduce a landslide-event magnitude scale based on the log of the total number of landslides associated with a trigger; (ii) if a landslide-event inventory is incomplete (smaller landslides not included), the partial inventory can be compared with our landslide probability distribution, and the corresponding landslide-event magnitude inferred; (iii) this technique can be applied to inventories of historical landslides, inferring the total number of landslides that occurred over geologic time, and how many of these have been erased by erosion, vegetation, and human activity; (iv) using Gutenberg-Richter frequency-magnitude statistics for regional seismicity, we can relate the intensity of seismicity in an area and the magnitude of the largest regional earthquakes to erosion rates.