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Abstract title
FRACTALS IN LANDSLIDE HAZARDS AND RISK ASSESSMENT

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Abstract
Fractal (scale-invariant) distributions are common in the Earth Sciences, both temporally and spatially. In the last couple of decades, a number of studies have investigated scale-invariant frequency-size distributions of landslides. These studies have helped to foster our understanding of mass movements, and can help in determining landslide hazards and the associated risk. This presentation discusses the results of three recent landslide investigations which involve "fractals". The first example describes attempts aimed at determining the frequency-size distribution of landslide areas. Large populations of landslides triggered by different mechanisms, including high intensity rainfall, earthquake shaking and rapid snow melting, are shown to exhibit the same characteristic behaviour. The noncumulative frequency-area distribution of medium and large landslides follows an inverse power-law with a scaling exponent of about -2.4. This value remains constant across geographical, lithological and physiographical boundaries. The small and very small landslide areas for each landslide inventory follows the same characteristic exponential roll-over. Combining these two behaviours results in the same 'general' probability distribution, which can be used to predict the statistics of landslide areas, help determine landslide hazards, and to test the quality of landslide inventory maps. The second example shows that the frequency-volume statistics of rock falls differ from the distribution of other landslide types, possibly indicating a different physical process; this information is used to propose methods to help determine the rock fall hazard. The final example discusses the frequency-magnitude statistics of landslide damage to the population in Italy. Using a catalogue of historical Italian landslides occurring 1279-2002, the number of fatalities and of fatal events exhibit power law ('fractal') frequency-size distributions, indicating a self-similar scaling behaviour of the losses. This, in principle, allows the use of more frequent, small intensity events to estimate the rate of occurrence of less frequent, larger events. This information is used to estimate the societal landslide risk to the people in Italy. The presentation ends with words of caution on the mathematical methods and tools commonly used to estimate the fractal distribution of landslide-related phenomena.

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