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New insights in the size distribution of recent and historical landslides in a populated hilly region

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Despite the availability of studies on the frequency density of landslide areas in mountainous regions, frequency-area distributions of historical landslide inventories in populated hilly regions are absent. This study revealed that the frequency-area distribution derived from a detailed landslide inventory of the Flemish Ardennes (Belgium) is significantly different from distributions usually obtained in mountainous areas where landslides are triggered by large-scale natural causal factors such as rainfall, earthquakes or rapid snowmelt. Instead, the landslide inventory consists of the superposition of two populations, i.e. (i) small (< 1 - 2 10^{-2} km^2), shallow complex earth slides that are at most 30 years old, and (ii) large (> 1 - 2 10^{-2} km^2), deep-seated landslides that are older than 100 years. Both subpopulations are best represented by a negative power-law relation with exponents of -0.58 and -2.31 respectively.

This study focused on the negative power-law relation obtained for recent, small landslides, and contributes to the understanding of frequency distributions of landslide areas by presenting a conceptual model explaining this negative power-law relation for small landslides in populated hilly regions. According to the model hilly regions can be relatively stable under the present-day environmental conditions, and landslides are mainly triggered by human activities that have only a local impact on slope stability (e.g. removal of lateral support at the landslide foot or overloading of the landslide depletion area for construction works, poor and insufficient sewerage systems, and the obstruction of springs). Therefore, landslides caused by anthropogenic triggers are

limited in size, and the number of landslides decreases with landslide area.

The frequency density of landslide areas for old landslides is similar to those obtained for historical inventories compiled in mountainous areas, as apart from the negative power-law relation with exponent -2.31 for large landslides, a positive power-law relation followed by a rollover is observed for smaller landslides. However, when analysing the old landslides together with the more recent ones, the present-day higher temporal frequency of small landslides compared to large landslides, obscures the positive power-law relation and rollover.