A new landslide area-to-volume relationship, and its application to the evaluation of landslide volumes and to the evaluation of landslide volume rates.

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Landslides are complex phenomena influenced by multiple factors. Knowing the number, area, and volume of landslides is important to determine landslide hazard and risk and to evaluate the long-term evolution of landscapes dominated by mass-wasting processes. The number and area of individual landslides and the total landslide area in a region can be computed from accurate digital landslide inventory maps. Determining the volume of a landslide is a more difficult task that requires information on the surface geometry of the slope failure. Determining the volume of slope failures for large populations of landslides is an even more difficult task that can be achieved adopting empirical relationships to link the volume of individual landslides to geometrical measures of the landslides. A catalogue of 677 mass movements of the slide type, from a global database of geometrical measurements of individual landslides, including landslide area (A_L) and volume (V_L), were used to determine a relationship linking landslide area to landslide volume. The relationship takes the form of a power law with a scaling exponent $\alpha = 1.450$.
We exploited the relationship to evaluate the volume of landslide material produced in the Collazzone area, Central Italy, in the period from about 1937 to 2005. The study area extends for 78.9 square kilometres, and a detailed multi-temporal landslide inventory map of the area, covering the period 1937-2005, shows 2543 landslides, for a total mapped landslide area of $10.43*10^6$ m^2. Using the landslide information and the area-to-volume relationship, we calculated the volume of the single landslides, we evaluated the total volume of landslide material and the average rate of landslide mobilization and we exploited the temporal information in the landslide inventory to estimate the volume of material produced during different periods by new and reactivated landslides.