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Landslide scaling properties – at or beyond the limit?

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The increasing availability of landslide inventories has helped constrain a narrow range of parameter values for several scaling relationships between measures of landslide size and frequency, as well as landslide volume and area. The resulting capability of probabilistically predicting the magnitude and frequency of slope failures over several orders of magnitude within a given study area epitomizes the concept of quantitative landslide hazard assessment.

Recent comprehensive summaries on this topic indirectly highlight the scope of further exploring landslide scaling relationships. Undoubtedly, the search for a mechanistic explanation of the nonlinear scaling of landslide timing and geometry remains one of the principal challenges. Also, comparably little is known about the scaling behaviour at the tail of distributions, where fewer samples of larger landslides, especially those with length scales >1 km, compromise the robustness of fit. This is far from being a statistical triviality, as it raises the crucial (and frequently ignored) question on the spatial and temporal limits to applying empirical scaling properties. Neglecting, for example, to include the largest landslides in magnitude-frequency distributions causes considerable bias as to whether smaller or larger failures dominate hillslope denudation.

Moreover, there is uncharted potential in exploring scaling relationships of landslide-prone topography, especially in conjunction with existing magnitude-frequency models. Linking, for example, probability density functions of hillslope lengths with those of landslides provides insights into the geomorphic coupling and sediment delivery potential of slope failures. Finally, several scaling properties related to landslide density may pose viable links to current models of long-term landscape evolution in

landslide-dominated mountain belts.