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Statistical analyses of landslide geometries inferred from a global database of seismically and non-seismically triggered landslides

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The main focus of the database lies on the assessment of geometrical parameters characterizing the rupture masses of the concerned landslides in all their available details. With the objective of data creation for comparative statistical analyses and numerical modeling, a new chronological database of landslides with various kinds of triggers was built. It contains 277 globally distributed cases of which one third is seismically induced. The term “landslide” refers to proper sliding mechanisms as defined by the classification of Varnes (1978).
Several statistical analyses were carried out to test the database itself in terms of qualitative and quantitative features. According to the type of analysis, the dataset of interest might either be the totality of all landslides, the sub-set of all landslides in seismic regions or the sub-set of all seismically induced landslides.
The recurrence of distinct parameters in the database reveals that parameters related to maps and longitudinal cross sections are more frequently assessed, whereas parameters related to transversal cross sections are very rare to be reported. This fact is promising for 2D modeling, but limits accurate 3D modeling due to the lack of information about the lateral confinement of a landslide mass which is of particular interest for studying its response under seismic shaking. The completeness of assessed geometrical data per individual landslide shows that two thirds of all cases are complete to an extent of 50-70%.
In a next step the statistical behavior of values of distinct geometrical parameters was studied. After grouping values per parameter in histograms, normal, power and exponential distributions were fitted to them. Testing all parameters in the three (sub-)sets, histograms of dimension-related parameters manifest an exponential decrease whereas histograms of shape-related parameters reveal normal distributions.
The main aim of the database was to delineate geometries that represent averaged shapes of landslide masses. Therefore, and with respect to the three different (sub-)sets of data, landslides were united according to their calculated volumes into three groups of the orders of magnitude. This grouping approach resulted in nine series of mean values of distinct parameters. The comparison of mean value behavior with increasing order of magnitude confirmed a different behavior of dimension- and shape-related parameters.
Using those mean values finally nine mean longitudinal cross sections in 2D were derived which highlight well the three major findings of this study: (a) statistically, dimensions and shapes do not behave in the same way with increasing order of magnitude, (b) the shape is rather independent of the dataset, and (c) the shape is slightly dependent on the order of magnitude.