STATISTICAL DISTRIBUTION OF ROCK FALL VOLUMES

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The analysis of the frequency-size distribution of past rock fall events has a high importance for the implications of modeling approaches and consequently also for land use planning. Statistics on rock fall size are difficult to determine and still remain poorly understood (Brunetti et al. 2009).

A common way to analyze volume data is the use of logarithmic scales. One of the main drawbacks of this method is due to the expert based distinction of class/bin boundaries, which may lead to wrong determination of dominant boulder sizes. Using a kernel density estimation (KDE), volume data can be displayed within a bandwidth (standard deviation) ranging from 0.3 and 0.5. This may enable a more accurate delineation of typical rock fall volumes for a given scenario.

We analyse 7 datasets with measurements of the landslide volumes for rock fall and rock slide events worldwide. Each dataset include from 25 to 549 landslides with individual landslide volumes ranging from 10^{-4} m^3 to $5 \cdot 10^8$ m^3. Datasets could be considered reasonably complete, in the sense that it is reasonable to assume that all landslides within the range of volume allowed by the adopted measuring technique were measured. The statistical analysis performed on the different landslide datasets was aimed to estimate the probability density distribution of the volumes (see Figure 1). The analysis confirms that these volumes follow a heavy-tailed distribution. In particular the analysis reveals a self-similar behaviour of the frequency-size distribution of the landslide volumes, which implies a power-law probability density function, linear in a log-log scale. The estimated power-law exponents obtained from the analysis range from -1.9 to -1.2 (see Figure 2).

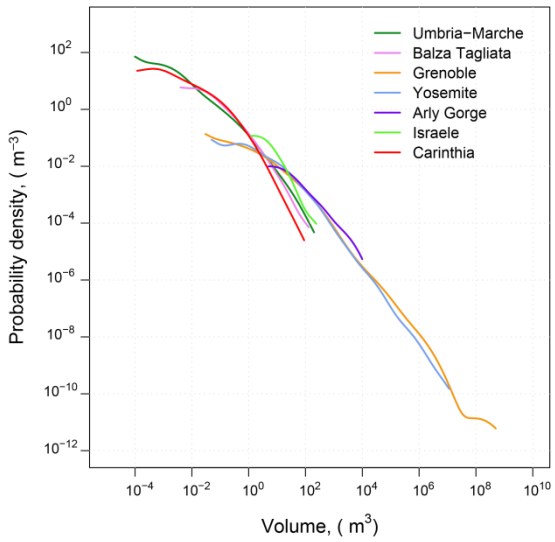

Figure 1: Probability size distribution of the volumes.

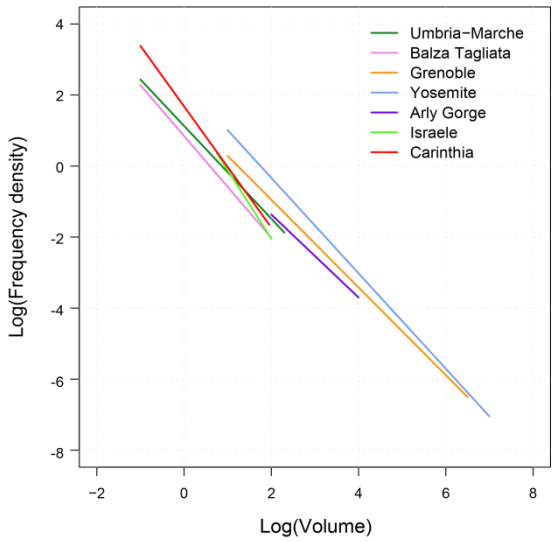

Figure 2: Frequency density fit of the volume distributions.

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To determine the probability density of landslide volume, $p(V_L)$, we prepared a script for the R free software environment for statistical computing (Brunetti et al., 2009). The script is available for free download and can be customized to analyse different landslide volume data.

References

M.T.Brunetti, F.Guzzetti, M.Rossi. Probability distributions of landslide volumes. Nonlinear Processes in Geophysics, 16: 179-188 (2009).