



Characteristics of an historical landslide catalogue for the Emilia-Romagna Region, Northern Italy: frequency-size, temporal clustering and triggering factors

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We investigate the statistical properties of historical time series of landslides in three provinces of the Emilia Romagna Region, northern Italy. The time series were obtained from a catalogue of historical landslides events in the Bologna, Modena, and Reggio Emilia provinces. The historical information was compiled through the review of exiting national and local catalogues of landslide events, and by searching local historical archives and chronicles. The catalogue lists 3216 historical landslides occurred in the 589 yr period between 1414 and 2002. The last 52 years of the catalogue, consisting of 2255 reported landslides, were analyzed to (i) describe the frequency-size distribution of the triggered landslide events, (ii) understand whether landslides are temporally correlated or uncorrelated with themselves, and (iii) investigate the correlations \dot{C} or the lack of correlations \dot{C} between landslide occurrence and rainfall, the primary trigger of landslides in the study area. Two measures for the intensity of landsliding over time are used: (i) the number of reported landslides in a day (DL), and (ii) the number of reported landslides in an event (Sevent), where an event is one or more consecutive days with landsliding. From 1951 to 2002 in our study area, there were 1057 days with 1 to 45 landslides per day, and 596 events with 1 to 129 landslides per event. To characterize the frequency-size (frequency-magnitude) distribution of landslide events first the frequency density of (DL) and (Sevent) were determined, obtaining that the empirical data are power-law distributed

over at least two orders of magnitude. Then probability values predicted from different distributions, including the Gamma, Exponential, Weibull, Pareto, Zeta and Zipf distributions, were compared with the empirical data obtaining the best fits using the Zipf and the Zeta distributions. To determine whether the landslide intensity time series, DL and Sevent, are temporally correlated, (a) we analyzed the distribution of interevent occurrence time, τ , defined as the time between two extremes of the series above a given threshold, and (b) we computed the Fano Factor and we analyzed its variance. Both the analyses on the temporal correlation provide evidences that the studied historical events are clustered in time. The correlation between landslide intensity and rainfall was investigated performing the analysis of the correlation between the rainfall trend and the occurrence of landslide events. Results suggest that the trigger of landslides is related to seasonal rainfall.