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Temporal and size distibutions of landslides in the Collazzone area, central Umbia, Italy

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Probabilistic landslide hazard assessments require an estimate of the temporal probability of landslide occurrence, or of the expected recurrence of landslides in a given area. Landslide hazard assessments also require estimates of the magnitude or intensity of the expected slope failures. In certain areas, the size (i.e., area or volume) of a landslide is a reasonable proxy for the magnitude. Attempts have been made to predict the temporal occurrence of landslides, exploiting historical and geomorphological information on multiple landslide events. These attempts are based on models of the temporal occurrence of landslides that assume a probability distribution for the expected landslide events, including the Poisson, binomial and Weibull distributions. In the field of landslide hazard assessment, little has been made to evaluate the prediction skills of the temporal prediction models. Through the analysis of accurate and reasonably complete landslide inventory maps, a few investigators have determined the frequency-area statistics of landslide areas. However, the accuracy and prediction skills of the available models for the estimation of the probability distribution of landslide areas remain largely untested. For the Collazzone area, which extends for 79 square kilometres in Umbria (central Italy) we prepared a detailed multi-temporal inventory map, at 1:10,000 scale. The landslide map shows more than 2500 landslides, shallow slides and deep-seated rock/earth slides and complex earth slides - earth flows. Landslides were mapped through systematic and combined interpretation of five sets of aerial photographs taken in the period from 1941 to 1997, at scales ranging from 1:13,000 to 1:33,000, and through field surveys carried out in the period from 1997 to 2006. We exploit this information: (i) to prepare and compare models for the temporal occurrence of landslides in the Collazzone area, adopting Poisson and binomial probability distributions, and (ii) to determine the probability density of landslide size (area)

in the investigated area using different probability distributions, including a double-Pareto distribution and an inverse-Gamma distribution. Splitting the multi-temporal landslide information into temporal subsets, we verify the prediction skills of the temporal and size models for landslides in the Collazzone area. We consider this important information for the quantification of landslide hazards in the study area, and for the validation of probabilistic landslide hazard assessments.