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Validation of a landslide susceptibilty model using event inventory maps

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Any serious attempt to determine quantitatively landslide susceptibility in a region needs proper validation. For susceptibility assessments obtained through statistical modelling, the performance of the statistical model needs to be checked: (a) against the data used to prepare the model, i.e., the geographical distribution and abundance of known landslides at the time the model is prepared; and (b) against independent landslide information not used to construct the model. The latter information can be obtained by mapping landslides which occurred after the model was prepared. The first test provides a measure of the goodness of fit of the model, which is the model ability to properly describe the known distribution of landslides. The second test provides an estimate of the ability of the model to correctly predict the spatial occurrence of new landslides. One expects the first test to be less severe than the second, because describing the known distribution of landslides in an area is easier than forecasting the location of new slope failures. For the Collazzone study area, which extends for 89.9 square kilometres in central Umbria (Italy) we prepared a landslide susceptibility model through multivariate analyses (i.e., discriminant analysis and logistic regression analysis) of a large set of independent environmental variables, including morphological, hydrological, lithological, structural and land use factors. As a dependent variable we used the percentage of landslide area in each of the geo-hydrological mapping units in which the study area was partitioned. The distribution and abundance of landslides was obtained from a detailed landslide inventory map prepared through systematic interpretation of five sets of aerial photographs at 1:13,000 to 1:33,000 scale flown in the

period from 1941 to 1997, supplemented by field surveys carried out in the period from January to March 1997 and in the years 2002 and 2003. In the periods from March to April 2004 and from December 2004 to mid January 2005, prolonged rainfall caused new and reactivated landslides in the Collazzone area. We mapped the rainfall induced landslides in two distinct field campaigns conducted in April-May 2004 and in January 2005. The new landslides were recognized directly in the field and mapped at 1:10,000 scale, producing two separate event landslide inventory maps. For the March to April 2004 event landslide inventory map, a total of 71 landslides were identified in the studied region, with areas ranging from 97 m2 to 32,422 m2 (mean value = 3,723 m2, standard deviation = 5,061). For the December 2004 to mid January 2005 event landslide inventory map, a total of 102 landslides were identified, with areas ranging from 87 m2 to 47,884 m2 (mean value = 2,852 m2, standard deviation = 4,964). In this work, we use the two recent event inventories to test the performance of the landslide susceptibility model. We perform three sets of tests. In the first set we compare the spatial distribution and the abundance of the rainfall induced landslides shown in the two separate inventories with the susceptibility map. For the second test we combine in a GIS the two events inventories into a single landslide map, and we repeat the comparison with the susceptibility map. The third test involves preparing a new landslide susceptibility model considering the presence of the new landslides, and in comparing the old and the new landslide susceptibility maps.