LANDSLIDE HAZARD ASSESSMENT AT DIFFERENT SCALES: TWO ITALIAN EXAMPLES

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Landslide hazard is usually defined as "the probability of occurrence, within a specified period of time and within a given area, of a potentially damaging failure". A more complex definition includes the magnitude of the event, i.e. the area, volume, velocity or momentum of the expected landslide. The definition of landslide hazard is not trivial, as it incorporates the concepts of location, time, and magnitude. Review of the literature reveals that even the more advanced attempts to determine landslide hazard do not fully comply with the given definition. Most commonly, deterministic or statistical models are prepared to determine "where" a landslide can be expected, with a certain probability, within a given mapping unit (e.g., grid cell, unique condition unit, slope unit, litho-hydro-morphological unit, etc.). Such models are best classified as "susceptibility" models, because they do not provide an estimate of "when" landslides are expected. In the presentation we will show the results of two attempts at determining landslide hazards at different scales. The first example we will show how landslide hazard was ascertain for the Staffora River basin, which extends for about 275 square kilometres in the Northern Italian Apennines (Lombardy Region). The second example will describe an attempt to ascertain landslide hazards for Italy.

To ascertain landslide hazard the Staffora River basin, the area was first partitioned into 2243 litho-hydro-morphological units. Spatial assessment of landslide hazard (landslide susceptibility) was obtained by multivariate analysis of 50 predicting thematic variables, including morphological, lithological, structural and land use variables. Systematic interpretation of five sets of aerial photographs of different ages, from 1954 to 2000, allowed preparing a multi-temporal landslide inventory map. For each mapping unit, average landslide recurrence was obtained by dividing the total number of landslide events by the time span of the investigated period. Assuming that landslide recurrence will remain the same for the future, and adopting a Poisson probability model, we determined for different time intervals the exceedance probability of having one or more damaging landslide in each mapping unit. Landslide hazard was then obtained by multiplying the spatial and the temporal probabilities. Lastly, an estimate of the magnitude of the expected slope failures was obtained by analysing the frequency-size statistics of landslide areas obtained from the multi-temporal landslide inventory map.

To obtain a synoptic evaluation of landslide hazard for Italy we used an historical catalogue listing 22,547 landslide events, in the period between 1900 and 2001. We obtained the average recurrence of landslide events in each municipality dividing the total number of events listed in the historical catalogue by the time span of the investigated period (103 years). Assuming that the recurrence of landslides and floods will remain the same for the future, and adopting a probability model, we determine for different time intervals the exceedance probability of having one or more damaging landslide in each municipality. We obtained the spatial assessment of landslide hazard by multivariate analysis of morphological variables obtained from a 90x90 meter digital elevation model (DEM) acquired by the Shuttle Radar Topography Mission (SRTM) in February of 2000. Lastly, we obtained an estimate of the magnitude of the expected damaging landslide events in each municipality by analyzing the frequency statistics of historical events with human consequences. For the purpose we used a catalogue of landslides that occurred in Italy between AD 1279 and 2002 and caused deaths, missing persons, injuries and homelessness.