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A Geographical Information Archive for the estimation of landslide hazard and specific risk, in Monte Castello di Vibio municipality, Umbria, Central Italy

Michele Santangelo (1) , Mauro Cardinali (1) , Francesca Ardizzone (1) , Paola Reichenbach (1) , and Fausto Guzzetti (1)

(1) Consiglio Nazionale Delle Ricerche - Istituto Di Ricerca Per La Protezione Idrogeologica, Perugia, Italy (Michele.Santangelo@irpi.cnr.it);

The Umbria Region, in Central Italy has a long history of mass movements. Landslides, in Umbria, range from fast moving rock falls and rapid moving debris flows in the mountain areas, to slow moving failures in the hilly part of the region. We performed a method to evaluate the landslide hazard and risk in 79 urban areas in Umbria and for these areas we determined qualitative landslide risk levels. For each urban area the methodology has: (i) identified the extension of the study area, (ii) ascertained the landslide hazard and (iii) identified the vulnerable elements for which the specific risk had to be evaluated. We recently revised the methodology and realized a Geographical Information Archive (GIA), using the software ArcGIS 9.3.1, ArcMap module. The study area is about 5 km2, in the municipality of Monte Castello di Vibio (Perugia). We carried out a multi-temporal landslide inventory (MLI) by stereoscopic analysis of 5 sets of aerial photographs (1941, 1954, 1977, 1985, 1996) at different scales. We stored the MLI in a geodatabase of 14 feature classes (spatial reference: ED50 / UTM zone 33N). Landslides were classified according to: typology, depth of the slip surface (shallow or deep seated landslides), frequency (recurrence of slope failures detected on aerial photographs of different age), velocity (rapid, slow and fast moving landslides), and intensity (combination of velocity and estimated volume). The procedure requires to define the hazard in terms of an evolution of the landslides observed in the past 50/60 years. This involves the identification of possible evolutionary scenarios of instability (Landslide Hazard Zones) (LHZ), which estimates the area of possible expansion of existing landslides or of possible occurrence of new landslides, according to: the intensity and type of movement, the degree and type of activity of failures, the morphology of the slope. We defined LHZs related to slow, rapid and fast moving landslides as polygon features. The attribute tables of the LHZ feature classes contain information on typology of the landslide, estimated depth of the slip surface, estimated volume, estimated velocity and recurrence of the landslide. The intensity value was obtained automatically by the fields of volume and velocity. The Hazard is expressed by a positional index (PI) in which each digit contains information about velocity, volume (i.e. intensity) and recurrence of the landslides. We mapped the vulnerable elements of the municipality on a orthophoto map of 2006 (National Cartographic Portal, Italian Ministry of Environment, http://www.pcn.minambiente.it/PCN/) distinguishing polygonal and linear elements (buildings and roads) and classified the elements at risk according to their typology. The information was stored in 2 feature classes in the same geodatabase. The intersection between LHZ and vulnerable elements layers gave 4 specific risk layers containing information about slow, rapid or fast moving landslides and elements at risk (polygonal or linear). We obtained a complex attribute table containing the specific risk PI as the combination of hazard and vulnerability values. The GIA consists in 22 digital files containing information on landslides, vulnerable elements, hazard and risk zoning. This approach allows to keep records of every step of the adopted procedure, and allows to build a number of queries about landslides, LHZs and specific risk. We think this kind of Archives can be a very useful tool to municipality planners for: (i) the risk management depending on different types and intensity of landslides, and different kind of elements at risk, (ii) evaluating the direct or indirect damage to the population and (iii) contributing to the evaluation of the total risk.