Large-scale risk analysis in the Arno river basin (Italy)

Geophysical Research Abstracts, Vol. 8, 08357, 2006
SRef-ID: 1607-7962/gra/EGU06-A-08357

Large-scale risk analysis in the Arno river basin (Italy

V. Tofani (1), F. Catani (1), N. Casagli (1), , M. Kukavicic (1), A. Bartolomei (1),G. Menduni (2)

(1) Department of Earth Sciences, University of Florence, Italy

(2) Authority of the Arno river basin, Italy

veronica.tofani@geo.unifi.it / Fax: +39 055-2756296 / phone : +39 055-2757532

We present the methodologies adopted and the outcomes obtained in the analysis of landslide risk in the basin of the Arno River (Central Italy) in the framework of a project sponsored by the Basin Authority of the Arno River, started in the year 2002 and completed at the beginning of 2005.

A new landslide inventory of the whole area was realized, using conventional (aerial-photo interpretation and field surveys) and non-conventional methods (e.g. remote sensing techniques such as DInSAR and PS-InSAR).

The great majority of the mapped mass movements are rotational slides (75%), solifluctions and other shallow slow movements (17%) and flows (5%), while soil slips, and other rapid landslides, seem less frequent everywhere within the basin. The assessment of landslide hazard in terms of probability of occurrence in a given time, based for mapped landslides on direct and indirect observations of the state of activity and recurrence time, has been extended to landslide-free areas through the application of statistical methods implemented in an artificial neural network (ANN). Unique conditions units (UCU) were defined by the map overlay of landslide preparatory factors (lithology, land cover, slope gradient, slope curvature and upslope contributing area) and afterwards used to construct a series of model vectors for the training and test of the ANN. Model validation confirms that prediction results are very good, with an average percentage of correctly recognized mass movements of about 85%. The analysis also revealed the existence of a large number of unmapped mass movements, thus contributing to the completeness of the final inventory. Temporal hazard was estimated via the translation of state of activity in recurrence time and hence probability

of occurrence.

The definition of position, typology and characteristics of the elements at risk has been carried out with two different methodologies, partially derived from the “Plans d’Exposition au Risque” proposed in France: i) buildings and infrastructures were directly extracted from digital terrain cartography at the 1:10,000 scale, whilst ii) non-urban land use was identified and mapped based on an updated and improved CORINE land cover map at the 1:50,000 scale. The definition of the exposure of the elements at risk relies upon contingent valuation methods and form-based interviews.

Landslide intensity, usually defined as proportional to kinetic energy, was obtained considering landslide typology as a proxy for expected velocity. In the case of the Arno River Basin the definition of intensity is influenced by the fact that the large majority of mass movements are deep-seated reactivated slides evolving into flows. Two main cases were so considered: deep-seated rotational slides and shallow flows or planar slides with virtually constant depth. In the latter case, intensity as a function of volume was set proportional to the area of the mapped phenomenon. In the former case, a simple geometric model was used to compute the volume.

Intersection of hazard values with vulnerability and exposure figures, obtained by re-classification of digital vector mapping at 1:10,000 scale, lead to the definition of risk values for each terrain unit for different periods of time into the future. Numerical results indicate that in absence of mitigation measures, large economic losses must be expected due to landslide activity in the few next years. The final results of the research are now undergoing a process of integration and implementation within land planning and risk prevention policies and practices at local and national level.