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Geomorphological hazard assessment in the mountain basin of the Panaro River (Northern Apennines, Italy)

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Every year in Italy landslides and rivers cause disasters resulting in fatalities, injures, destruction of houses, infrastructures and properties, as well as loss of productive land. The spreading of urban and productive settlements in the past decades increased the potential impact of geomorphological disasters.

This abstract illustrates a research which takes into account the study and mapping of geomorphological hazards (i.e. landslides and fluvial processes) in the mountain-basin's areas of the Panaro River which host productive activities.

The mountain basin of the Panaro River has a catchment of about 800 km^2;from the hydraulic viewpoint it is managed by the Land Reclamation Syndicate of Burana-Leo-Scoltenna-Panaro which cooperates with this research. The Panaro River, which collects the waters from the central section of the Northern Apennines, flows into the Po River after running across the Modena Apennines for some 63 km and across the Po Plain for 85 km.

The first phase of the research dealt with the identification of areas where significant productive activities subject to geomorphological instability are present. The methodology used to identify those areas is as follows: a) acquisition of the Town-Planning Scheeme (TPS) ad and of the Instability Inventory Map (IIM), both in digital *shape file* format for ArcGis, of all municipalities laying within the study area; b) cartographic overlay (in GIS) of productive areas (existing or planned) from the TPS and of instability areas from the IIM ; c) selection of only productive areas that lay within instability zones; e) field check of all potential study areas: in this phase some productive areas have been found affected by relevant gemorphological instabilities which

were neglected or underestimated in extent by the IIM. In this way, 16 productive areas have been selected for instability analyses.

The second phase has been the acquisition of all available information and documents regarding the 16 productive areas and their surroundings subject to geomorphological instability. This has been carried out by: a) the analysis of thematic maps in order to identify areas affected by instabilities; b) the historical and bibliographical research of past instability events; c) the study of instability events through interpretation of aerial photographs, satellite images and maps of different scales and time periods; d) field survey accompanied by enquyries among local inhabitants about instability events.

The second phase has produced, for each one of the 16 study areas, a map of geomorphological instability processes (scale 1:5000 and 1 :10000) and a digital geodatabase containing all information gathered.

For the assessment of geomorphological hazards, a method recently applied for the Bolzano Autonomous Province in Northern Italy has been used with some adaptations. It is based on a classification of the intensity and frequency of the events for each category of instability processes (i.e. landslides and fluvial processes). This is achieved by means of univocal matrix combinations which allow the definition of various levels of geomorphological hazard.

Substantial differences have been identified between the geomorphological hazards assessed through this study and those represented by the IIM. This is due to the fact that the IIM is derived from geological maps where, by definitions, geomorphological processes and deposits are of secondary importance with respect to geological and structural aspects. Therefore, the IIM, having a restriction character in local territorial planning, should be elaborated on the base of an accurate geomorphological mapping which integrates all sources of information available by critical cross-analyses. In this sense, eye witnesses like local inhabitants, are a precious and costless “monitoring system” that must be better considered and used by scientists and practitioners, although to be prudently validated.

The geomorphological evolution that comes out from this study adds an important piece of information to understand the effects that geomorphological hazards (often strictly linked to climate change and human impact) produce on the landscape. In particular, shallow earth-flows and earth-slides have experienced a small retrogressive activity, while historic large landslides show limited partial reactivations mainly nearby torrent and small river beds due to erosion.