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Landslide Monitoring and Early Warning Systems Based on Failure Index "Fragility" Curve (FIFC) through Numerical Analysis

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Early warning systems are crucial to reduce the landslide risk, especially at the places where the structural measures are not fully capable to prevent the devastating impact. Furthermore, designing and implementing successfully a complete landslide early warning system is a highly complex task. The main technical challenges are linked to the definition of heterogeneous materials properties (geotechnical and geomechanical parameters) and the variety of the triggering factors. In addition to that, real-time data processing creates a significant complexity, since data collection and numerical models for risk assessment are time consuming tasks. Therefore, uncertainties in the physical properties of a landslide together with the data management represent the two crucial deficiencies in an efficient landslide early warning system.

Within this study the application of the concept of fragility curves to landslide is explored; fragility curves are widely used to simulate systems response to natural hazards, i.e. floods or earthquakes. The application of fragility curves to landslide risk assessment is believed to simplify emergency risk assessment; even it cannot substitute detailed analysis during peace time. A simplified risk assessment technique can remove some of the unclear features and decrease data processing time. The method is based on synthetic samples which are used to define the approximate failure thresholds for deep seated landslide, taking into account the involved material and the piezometric level. The outcomes are organized in charts. The method presented in this paper is called Failure Index Fragility Curve (FIFC). Assessment of the actual real-time risk in a case study can be evaluated referring to the most appropriate FIFC. An example of the application of FIFC to a real case is presented in this work.

This method of assessing the landslide risk is another step toward a more integrated dynamic approach to potential landslide prevention systems. Even if it prevents to define an absolute threshold, the accuracy is satisfactory for a preliminary risk assessment. It can provide more lead time to understand the hazard level and to make decisions as compared with a more sophisticated numerical approach. Hence the method is promising to become an effective tool during landslide emergency. In order to improve this method, a more comprehensive model should be tested, taking into account other important parameters.