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Forecasting landslide hazard and risk

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Landslides are complex phenomena caused by different climatic, meteorological and geophysical triggers, and human activities. The large variety of landslide phenomena makes it difficult to establish a single methodology to determine landslide hazard, ascertain the vulnerability to landslides, and evaluate landslide risk at different geographical and temporal scales. Determining landslide hazard in an area involves establishing where, when (or frequency), and how large or destructive individual or multiple landslides will be. Probabilistic models determine landslide hazard. These models work under geomorphological assumptions often difficult to prove. In addition, validation of the results of a landslide hazard model – and of its individual forecasting components – is a difficult task with the information commonly available to landslide investigators. Vulnerability is the degree of loss to a given element, or a set of elements, at risk resulting from the occurrence of a landslide. Only a few catalogues of landslide damage to different types of elements at risk (including the population) exists, and information on the vulnerability to landslides is generally missing. Lack of information on landslide vulnerability severely hampers our ability to ascertain landslide risk. Quantitative (probabilistic) or qualitative (heuristic) landslide risk assessment is the final goal of several landslide studies. Landslide risk analysis aims to determine the probability that a specific hazard (an individual landslide or set of landslides) will cause harm, and it investigates the complex relationships between the frequency and magnitude of the damaging events and the severity of the consequences. Where catalogues of landslide events and their consequences (e.g., to the population) have been compiled, landslide risk can be ascertained and forecasts can be made. Investigating the geographical and temporal variations of landslide risk involves designing landslide scenarios. This is a difficult task subject to large uncertainties.