2010 AGU Fall Meeting

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Landslide hazard, vulnerability and risk assessment: methods, limits and challenges (*Invited*)

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Landslides are common and widespread geomorphological phenomena that contribute to shape landscapes in all continents. Slope failures are caused by different climatic, meteorological and geophysical triggers and by multiple human activities, and pose a threat to the population, to private and public properties, and to the environment. The large variety of landslide phenomena makes it difficult to establish a single methodology to determine landslide hazard, to ascertain the vulnerability to landslides, and to evaluate landslide risk, at different spatial and temporal scales, and in diverse geomorphological settings. Establishing landslide hazard in a region requires deciding “where”, “when” and “how destructive” landslides are expected. Probabilistic models exist to determine landslide hazard, but these models work under general geomorphological assumptions that are difficult to prove locally. In general, the most difficult – and the most uncertain – component of a landslide hazard assessment is the determination of “when” landslides are expected. Methods based on statistical or deterministic thresholds, or on the analysis of time series of landslides, exist but do not lack limitations related chiefly to the scarcity of data. In addition, validation of the results of a landslide hazard model is a challenging task with the information commonly available. Vulnerability is the degree of loss to a given element, or a set of elements at risk resulting from the occurrence of a landslide. Standards for measuring the vulnerability to landslides have not been established, and catalogues listing information on landslide damage to different types of elements at risk are rare. Lack of information on landslide vulnerability limits our ability to ascertain landslide risk. Risk analysis aims to determine the probability that a specific hazard (an individual landslide or a group of landslides) will cause harm, and it investigates the relationships between the frequency and magnitude of the damaging landslides and the severity of the consequences, measured e.g., by the number of fatalities caused by a slope failure. Where catalogues of landslide events and their consequences exist, risk can be ascertained quantitatively and forecasts of the possible losses can be made. Investigating the geographical and temporal variations of landslide risk is a particularly difficult task subject to large uncertainties. Since landslides are triggered or affected by meteorological and climatic triggers, and by changing environmental conditions, it is legitimate to ask what consequences climate and environmental changes will have on landslide hazard, vulnerability, and risk. Unfortunately, quantitative information and models on the effects of climate and environmental changes on the type, abundance, frequency, size, and destructiveness of landslides are lacking.

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