Statistical regression models for predicting landslide hazard

C.F. Chung

Geological Survey of Canada, 601 Booth Street, Ottawa, Ontario K1A 0E8, Canada

Based on several layers of spatial map patterns, regression methods have been developed for the construction of landslide hazard maps. The method proposed in this contribution assumes that future landslides can be predicted by the statistical relationships established between the past landslides and the spatial data set of map patterns. The application of regression techniques for delineating landslide hazard areas runs into two critical problems using GIS (geographic information systems): (i) the need to handle thematic data, and (ii) the sample unit for the observations. To overcome the first problem related to the thematic data, favourability function approaches or dummy variable techniques can be used. For the second problem related to the sample units, the unique condition subareas are defined where each subarea contains a unique combination of the map patterns.

Weighted least squares techniques are proposed for the zonation of landslide hazard using those unique condition subareas. The traditional pixel-based multivariate regression model becomes a special case of the proposed weighted regression model based on the unique condition subareas. This model can be directly applied to vector-based GIS data without the need of rasterization.

A case study from a region in central Colombia is used to illustrate the methodologies discussed in this paper. To evaluate the results adequately, it was pretended that the time of the study was the year 1960 and that all the spatial data available in 1960 were compiled including the distribution of the past landslides occurred prior to that year. The statistical analyses performed are based on these pre-1960 data about rapid debris avalanches. The prediction was then compared with the distribution of the landslides which occurred during the period 1960 to 1980.