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Landslide prediction using combined deterministic and probabilistic methods in hilly area of Mt. Medvednica in Zagreb City, Croatia

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The hilly slopes of Mt. Medvednica are stretched in the northwestern part of Zagreb City, Croatia, and extend to approximately 180km2. In this area, landslides, e.g. Kostanjek landslide and Črešnjevec landslide, have brought damage to many houses, roads, farmlands, grassland and etc. Therefore, it is necessary to predict the potential landslides and to enhance landslide inventory for hazard mitigation and security management of local society in this area. We combined deterministic method and probabilistic method to assess potential landslides including their locations, size and sliding surfaces. Firstly, this study area is divided into several slope units that have similar topographic and geological characteristics using the hydrology analysis tool in ArcGIS. Then, a GIS-based modified three-dimensional Hovland's method for slope stability analysis system is developed to identify the sliding surface and corresponding three-dimensional safety factor for each slope unit. Each sliding surface is assumed to be the lower part of each ellipsoid. The direction of inclination of the ellipsoid is considered to be the same as the main dip direction of the slope unit. The center point of the ellipsoid is randomly set to the center point of a grid cell in the slope unit. The minimum three-dimensional safety factor and corresponding critical sliding surface are also obtained for each slope unit. Thirdly, since a single value of safety factor is insufficient to evaluate the slope stability of a slope unit, the ratio of the number of calculation cases in which the three-dimensional safety factor values less than 1.0 to the total number of trial calculation is defined as the failure probability of the slope unit. If the failure probability is more than 80%, the slope unit is distinguished as 'unstable' from other slope units and the landslide hazard can be mapped for the whole study area.