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Integrated magnitude-frequency analysis of real mass movements with synthetic prototypes generated by slope stability simulator

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The central aim of this work is to integrate magnitude-frequency analysis, applied to tropical holocenic mass movements, with synthetic mass movements prototypes generated by slope stability simulator (SSS), for to help us in the parameterization efforts. The Anhert′s (1987) semi-logarithmic approach was adapted and applied directly in the holocenic slump deposits and scars mapped by air-photos for São José, São Carlos and Borba sample areas. In this case, the magnitude-frequency index refers to the spatial recurrence interval "SRI" (Km^2) or spatial frequency "SF" (events/Km^2) for deposits and scars of varying magnitudes (Colangelo & Cruz, 1997). The same magnitude-frequency approach was applied also to present day cumulative rain data, for the same localities. With these data and estimated hydraulic conductivity of soil, we may evaluate the magnitude-frequency of soil percolation water increments and estimate the spatial magnitude-frequency behavior of saturation level variations: considering the slope semi-hyperbolic hydrologic model (Colangelo, 2007). The results of this analysis were introduced in the relief unity emulator - slope stability simulator (RUE-SSS) device for investigate threshold conditions that may generate mass movements prototypes at different geomorphic scenarios. With this device is possible to perform a detailed mass movement threshold analysis of 16 geotechnical, hydrological and geomorphological variables, each one described by specific algorithm in 3D environment. The relief unity emulator was conceived by finite element solution, that permits generate a synthetic slope system by means of a mesh of cells. For each cell, the factor of safety was calculated considering the value of shear strength (cohesion and friction) of material, soil-regolith boundary depth, soil moisture level content, potential rupture surface gradient, slope surface gradient, top of subsurface flow gradient, apparent soil bulk density and vegetation cover surcharge. In all cases the slope soil was considered as cohesive material. This device produces a 3D graphic cinematic sequence of mass movement evolution experiments in synthetic slope systems and numerical results about physical and morphological data of scars and deposits. The slope analysis furnishes data about total slope, height, middle and foot areas, and the mass movement scar and deposit areas. This device evaluates, mean gradient, mean soil thickness and area of effective potential rupture surface (EPRS), sub-region of potential rupture surface (PRS) where the safety factor is minor than unity ($F<1$). For each cell that composes the effective potential rupture surface is calculated cohesion, friction angle, shear stress, shear strength, safety factor, threshold gradient, soil thickness and saturation level. Another important information provided by this device is to locate at "EPRS" and evaluate the maximum strength debt, the origin of soil collapse. The mass movement deposit is described in terms of thickness, volume, soil bulk density, density of solids and weight of mobilized soil and vegetation cover. With the magnitude-frequency of soil saturation level modulation is possible to estimate the magnitude-frequency of mass movements in terms of total mobilized material per unity square Kilometer and determine the dominant mass movement: the event with the better magnitude-frequency relation.