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Combining Models for Debris Flow Hazard Prediction in Rio de Janeiro, Brazil

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Mass movements are common phenomena especially during strong rainfall events that take place frequently in the summer season. These phenomena have been causing losses of lives and serious damage to roads, bridges, and properties. Among them, stand out the landslides that many times produce debris flows. The aim of this study is develop a methodology, which combines a model to predict landslides with another one that determines debris flows characteristics in terms of pathway and run-out. The study area is located in two catchments in Rio de Janeiro city, Quitite and Papagaio, draining side by side the west flank of the Tijuca Massif, with 5 km2. The methodology of this work consists in the following steps: (a) elaboration and definition of the best Digital Elevation Model (DEM), (b) location of the landslides prone areas using SHALSTAB model, (c) identification of the debris flows pathways and deposition using empirical model, (d) simulation of the debris flows using FLO-2D model from scars, and (e) combination of the SHALSTAB and FLO-2D model. Among the interpolation methods used in order to build the DEM, TOPOGRID module presented the best results. The empirical model results showed that debris flow pathways and deposition mapped were closely related to the affected areas. Simulations using FLO-2D model, started from landslides scars, with different parameters combination produced 150 scenarios. These scenarios were compared with the debris flow events in February 1996. The best combinations present the following parameters: viscosity (0.092 kPa.s), yield stress (0.002 and 0.02 kPa), laminar flow resistance (0) and time simulation for debris flow event (two hours). Simulations also were made from these two combinations using FLO-2D model, started from the most susceptible landslides prone of the SHASLTAB results (instead of landslide scars). The best result was obtained with viscosity (0.092 kPa.s), yield stress (0.02 kPa), laminar flow resistance (0) and time simulation of the debris flow event (2 hours). The combination of the mathematical models SHALSTAB and FLO-2D may be a useful tool in predicting both landslides and debris flows events. Such procedure may also be used to provide information for public policy and planning.