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An analytic approach to model susceptibility to rainfall-induced shallow landslides in the eastern Umbria region of central Italy

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We examine the susceptibility to rainfall-induced shallow landslides in an area of central Italy using the TRIGRS (Transient Rainfall Infiltration and Grid-based Slope-stability) model. By combining an infinite-slope stability calculation with a transient, one-dimensional analytic solution for pore-pressure response to steady-state and transient rainfall infiltration, the TRIGRS approach allows us to investigate both the timing and location of shallow landslides in response to rainfall over broad regions. Input data for the TRIGRS model include time-varying rainfall, topographic slope, colluvial thickness, initial water-table depth, and material strength and hydraulic properties. Because of a paucity of input data we focus on parametric analyses to calibrate and test the model. The results show the effect of variation in material properties and initial water-table conditions on the distribution of simulated instability in the study area in response to realistic rainfall. To measure the significance of our results and validate the model, we evaluated the agreement between the TRIGRS prediction and a landslide inventory map for the region. Next, we compared the predicted success of our TRIGRS simulations with results based on slope categories and show that methods based on slope categories produce an over-prediction of unstable areas compared to the TRIGRS predictions. Differences in the distributions of predicted slope failures between the two models are primarily a function of the spatially varying soil depth and mechanical and hydrological properties that are included in TRIGRS simulations.