



Exact solution of a stochastic model of rainfall-induced shallow landslides in hollows

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P. D'Odorico and S. Fagherazzi (2003) recently proposed "A probabilistic model of rainfall-triggered shallow landslides in hollows" (Water Resour. Res., 39(9), 1262, doi:10.1029/2002WR001595, 2003). Their model describes the long-term evolution of colluvial deposits through a probabilistic soil mass balance at a point. The model accounts for hollow infilling, expressed as a deterministic function of the deposit thickness, and soil erosion by shallow landslides, modeled as a time-dependent stochastic point process related to the occurrence of triggering precipitation events. Further building blocks of the model are: an infinite-slope stability analysis; a steady-state kinematic wave model of hollow groundwater hydrology; and a statistical model relating intensity, duration, and frequency of extreme precipitation. The authors provide an analytical solution to their model under the simplifying assumption that the occurrence rate of landslide-triggering rainfall events is independent of the colluvial deposit thickness. We present exact (both discrete-time and continuous-time) solutions to the stochastic landslide model for the general case where the triggering rainfall occurrence rate depends on the soil thickness and hence on time. Finally, we discuss the implications of incorporating a more realistic description of hollow hydrology in the stochastic landslide model.