
NH33D-01: A Physically-Based and Distributed Tool for Modeling the Hydrological and Mechanical Processes of Shallow Landslides (Invited)

Wednesday, 16 December 2015

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This work presents the capabilities of a model, i.e. the tRIBS-VEGGIE-Landslide, in two different versions, i.e. developed within a probabilistic framework and coupled with a root cohesion module. The probabilistic model treats geotechnical and soil retention curve parameters as random variables across the basin and estimates theoretical probability distributions of slope stability and the associated “factor of safety” commonly used to describe the occurrence of shallow landslides. The derived distributions are used to obtain the spatio-temporal dynamics of probability of failure, conditioned on soil moisture dynamics at each watershed location. The framework has been tested in the Luquillo Experimental Forest (Puerto Rico) where shallow landslides are common. In particular, the methodology was used to evaluate how the spatial and temporal patterns of precipitation, whose variability is significant over the basin, affect the distribution of probability of failure.

Another version of the model accounts for the additional cohesion exerted by vegetation roots. The approach is to use the Fiber Bundle Model (*FBM*) framework that allows for the evaluation of the root strength as a function of the stress-strain relationships of bundles of fibers. The model requires the knowledge of the root architecture to evaluate the additional reinforcement from each root diameter class. The root architecture is represented with a branching topology model based on Leonardo’s rule. The methodology has been tested on a simple case study to explore the role of both hydrological and mechanical root effects. Results demonstrate that the effects of root water uptake can at times be more significant than the mechanical reinforcement; and that the additional resistance provided by roots depends heavily on the vegetation root structure and length.

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