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The Fiber Bundle Model (FBM) for hydrologic triggering of shallow landslides

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Rainfall induced rapid landslides represent a significant natural hazard to life and infrastructure in mountainous regions. Notwithstanding progress in quantitative description of landslides, basic understanding and modeling of key triggering mechanisms remain a challenge hindering efforts to develop effective early warning systems and establish indicators for incipient failure. Numerous studies have attempted to establish links between rainfall intensity and duration and susceptibility of shallow landslides, others have focus on the hydromechanical conditions for onset of failure. Our study addresses the intrinsic processes and potential chain of events leading to the characteristically abrupt transition associated with shallow landslides. Recent studies have shown that localized failures within a slope may not always progress to development of a shear zone. We propose the use of Fiber-Bundle models (FBM) formalism that offers a rich and well-developed framework for quantifying progression from small and localized mechanical failures to global failure. The advantage of FBM conceptual model is not limited only to overcoming the limitations of continuum models in describing abrupt failure, but it naturally incorporates features related to soil constitutive mechanical behavior and quantitative aspects of lateral root reinforcement in vegetated hillslopes. The FBM provides a natural framework for interpreting and quantifying acoustic emissions during small local- and global failure, hence, could potentially provide a basis for monitoring activities in support of an early warning system.