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Regolith-vegetation dynamics and landslide versus runoff erosion

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In humid uplands, landslides episodically disturb vegetation growth and soil development, erode regolith and bedrock, and facilitate enhanced denudation by runoff processes. Here these interactions are modeled to show that greater storm and landslide frequency can nevertheless lead runoff processes to overtake landsliding frequency as the dominant process of regolith erosion and means of sediment delivery from hillslopes. The model treats an ensemble of idealized subcatchments in which biomass and regolith co-evolve as a two-dimensional dynamical system subject to stochastic disturbance by slope failure. Such mutual dynamics give rise to a notional stable equilibrium between regolith and biomass, but persistent mass-wasting ensures such a balance is never achieved. Instead, an average catchment state arises in which higher storm frequency entails thinner regolith and weaker protection by vegetation. As a result, time-averaged soil erosion rates and suspendable sediment fluxes from hillslopes are progressively weighted towards runoff processes.