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State of the art of hillslope hydrology understanding

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This talk attempts to synthesize the current state of the art of hillslope hydrological processes understanding. We begin by presenting a number of hillslope case studies from a variety of steep, upland humid environments around the world to illustrate the various dominant behaviors of subsurface stormflow generation. After exposing the litany of factors affecting hillslope response, we then explore how models can be used to identify the hierarchy of controls and interactions among them. We present a number of virtual experiments using a 3D physics-based finite element model to systematically investigate the interactions between soil depth, soil hydraulic properties and slope angle on pore pressure development and subsurface lateral flow generation, timing and magnitude. Our base case model domain is the Panola experimental hillslope in Georgia USA. We use Panola as a shell for these simulations where we build and calibrate the model using the measured soil surface and subsurface geometry. The parameterization of the soil and bedrock properties is based on detailed field measurements at the site. Following calibration, topography and soil characteristics are varied to establish response surfaces between them and various hillslope flow measures. The interactions between these variables illustrate some of the challenges in classifying hillslope behavior.