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Understanding hydrological triggers of a large moving hillslope

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To assess the development and the complex dynamics of mass movements on large hillslopes, it is essential (1) to identify critical slope areas and their behaviour within the framework of geological and climatological conditions, and (2) to understand the mechanisms, especially the interaction of "fast" surface and subsurface hydrological processes and "slow" mechanical processes across spatial and temporal scales. Investigations at an Alpine slope system, which shows deeply seated creeping mass movements (~1 km^2, 915 - 1375 m a.A., Vorarlberg, Austria), indicate that the movement is event driven and not of a continuous type; the triggering of the slope movement is related to the pressure dynamics of a confined groundwater system in the central slope body. The work presented here focuses on field observations covering different subunits identified on the slope with the aim of an effective characterisation of slope hydrology. The methods applied include artificial tracer tests with surface application to investigate the dynamics of a steep forested subsystem, a measurement cluster for continuous determination of soil moisture profiles on a pastured area, and distributed soil permeability point measurements. Fast hydrologic processes, i.e. infiltration, surface and subsurface lateral flow, are observed, despite low matrix permeabilities of the soils (silty-clay loam to clay loam). The spatial pattern of these interacting processes is determined by dominating heterogeneities, i.e. preferential pathways like shrinking cracks and strata in the fine-grained slope body. In turn, these preferential processes are correlated to fast (hours-days) pore pressure responses after heavy precipitation events. The field techniques applied allow a differentiated characterization of dominating structures and patterns on the slope. Together with observations on movement rates and groundwater dynamics, these results help to understand and model the interaction of hydrologic processes, structural features and slope movement.