Geophysical Research Abstracts,
Vol. 11, EGU2009-1032-1, 2009
EGU General Assembly 2009

Where to look, and for which process? Hydrological field investigations at a slow-moving Alpine 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 surface and subsurface hydrological processes and mechanical processes across spatial and temporal scales.
Data from hydrological and geotechnical monitoring at an Alpine slope system (Heumoes slope, ca. 1 km^2, 915 - 1375 m a.s.l., Vorarlberg, Austria) indicate that the relatively slow movement, which is composed of sliding and creeping processes, is event driven and not of a continuous type. 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 investigations covering different subunits on Heumoes slope with the aim of an effective characterisation of slope hydrology. The methods applied include soil survey and soil hydraulic field measurements, tracer experiments using field fluorimetry with fluorescent dyes, and dye staining at selected plots to investigate infiltration processes and subsurface flow dynamics.
The central slope area exhibits fine-textured soils, a wet soil moisture regime throughout the year and widely extended saturation areas. In steep slope areas covered by pasture or rockfall debris, tracer transport and dye staining indicate that infiltration is very limited, and flow restricted to the surface and the top soil. In forested parts of the slope, fast infiltration and subsurface lateral flow could be observed during tracer experiments, and dye staining showed that the preferential pathways like shrinking cracks and soil pipes determine these processes.
The applied field techniques allowed a differentiation of hydrological processes and the discrimination of different subunits of the moving hillslope, which may or may not contribute to the slope's movement dynamics. The results show that deep infiltration is limited to specific areas as possible source areas of the confined groundwater body. Together with observations on movement rates and groundwater dynamics, these results help to understand and characterize the spatial arrangement of hydrological processes, structural features and slope movement, and provide the basis for future modelling efforts in this complex system.