Geophysical Research Abstracts
Vol. 15, EGU2013-9070, 2013
EGU General Assembly 2013


# How can an alpine catchment react so slowly? Investigation of slow drainage processes in steep landscapes

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The estimation of extreme flood events is challenging, especially if nonlinearity or threshold behaviour makes extrapolation to larger events uncertain. This project focuses on the steep alpine Schächen catchment in Switzerland, where a delayed reaction was observed during a long duration rainfall event in 2005, where discharge only increased significantly after already 100mm of rain had fallen.
Earlier attempts of modelling this event on the basis of dominant runoff process maps led to the conclusion that the mismatch between modelled and observed discharge might be the result of not correctly taking into account the storage potential and the slow drainage processes of the permeable underground that cover large parts of the catchment.
Such areas with large storage potential, mainly talus and creeping land mass slopes, were identified in the field. Discharge from these areas was measured in several springs together with electrical conductivity of spring water, showing a delay of the runoff compared to the rain event of 2 days to nearly a week. On one steep slope, piezometers that reach into the bedrock and soil moisture sensors were installed and a large scale sprinkling experiment (130m2), applying 800mm of rain over 60 hours, was carried out. Seismic refraction and electrical resistivity tomography gave insight into the geological structure and the location of the groundwater table.
Models of the observed slopes were set up with HydroGeoSphere to improve understanding of storage and drainage processes and identify the relevant parameter that lead to the differences in runoff delay. With the models, the reaction of the slopes to extreme events and the potential of nonlinear behaviour could be assessed.
This study helps to identify the relevant processes that have to be taken into account when estimating the magnitude of extreme floods in steep alpine catchments.