Geophysical Research Abstracts
Vol. 13, EGU2011-13951, 2011
EGU General Assembly 2011

On the influence of fissure flow on the landslide activity

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This research uses a conceptual model to study the influence of fissure flow on landslide (re-)activation. Fissures influence the water buffering and transport capacity of the vadose zone and create spatial and temporal heterogeneity which can act as preferential flow paths. Furthermore, the distribution of fissures (open, filled or partly filled) within a landslide can change due to the displacement. Although infiltration processes are generally accepted as one of the most common triggers of landslides, the feedbacks between hydrology, landslide activity and fissure formation have not received much attention.

The main goal of this research is to study the influence of preferential fissure flow on landslide hydrological behaviour, and thus slope stability at the field scale. The conceptual model approach was based on the adopted Storage and Redistribution of Water on Agricultural and Re-vegetated Slopes model (STARWARS), which is a distributed model coupling hydrological and stability dynamics developed in the PCRaster environmental modelling software package. The ensuing feedbacks in landslide activity were explored, using fissure geometries based on the Super-Sauze landslide in the French Alps, by running the model statically (no changes in hydrological properties in time and space) and dynamically, i.e. accounting for dynamic fissures characteristics (i.e. fissures density and connectivity).

This work presents the results of the static and dynamic modelling for both simplified and real case study of Super-Sauze landslide. In the static modelling it was proven that both the appearance of fissures and their connectivity is very important for the landslide hydrology. By means of a sensitivity analysis the range of landslide responses were determined as function of fissure geometries and their connectivity. When allowing for dynamic feedback between differential displacement and changes in fissure patterns and their characteristics the significant spatial and temporal changes in hydrological responses were modelled.

Mutual dependence between fissure distribution, slope stability and hydrology is showed. Furthermore, the future research directions and the value of that knowledge for landslide hazard assessment are discussed.