Hydrol. Earth Syst. Sci. Discuss., 9, C5657–C5660, 2012
www.hydrol-earth-syst-sci-discuss.net/9/C5657/2012/

Hydrology and Earth System Sciences Discussions

Interactive comment on "A model of hydrological and mechanical feedbacks of preferential fissure flow in a slow-moving landslide" *by* D. M. Krzeminska et al.

D. M. Krzeminska et al.

d.m.krzeminska@tudelft.nl

Received and published: 4 December 2012

We appreciate the accurate and constructive suggestions of the Reviewer aimed to improve the manuscript. According to the suggestions of the Reviewer, we will include in the manuscript adequate information needed for clarification and better understanding of the issues rise as specific comment.

The aim of this paper is to analyse the Super-Sauze landslide (South French Alps) from an hydrological point of view taking into account the role played by fissures. Two theoretical relationships were established in order to account on the dynamic nature

of fissure network characteristics: 1. relationship between fissure connectivity and soil moisture content 2. relationship between fissures formation and stability state

Comment#1

After the judgement of the Referee we agree that the second relationship is not sufficiently justified in the paper yet and more detailed explanation is needed.

It is important to stress that in this paper the vertical cracks resulting from drying – wetting circles are not considered and the term "fissures" refers to geo-mechanically induced cracks only. These fissures form and propagate as a result of tensile opening, sliding and tearing (induced by soil mass movements). For the Super- Sauze landslide it is mainly tensile fracturing that dominates the fissure formation at the free surface.

It is also important that fissures are conceptualized as volumes of increased porosity and increased hydraulic permeability, not directly open 'cracks' (Krzeminska et al., 2012).

Therefore we conceptualized the general relationship between factor of safety (which serves here as a proxy for the excess shear stress that cannot be accommodated by a particular soil column and, thus, can lead to soil extension, e.g., appearance and/or extension of shear and tension fissures) and fissure volume. Therefore we assume that when the soil column is relatively stable (fs >1) there are no, or very limited, fissures present within this soil column and the volume of fissures increase with decreasing fs,

We agree with Reviewer that it is necessary to stress that this is proposed relationship is a simplification the true mechanism of formation and propagation of fissures and is proposed here as a first attempt to account for dynamically changing fissure volume in hydrological modelling of landslides.

We will include in the manuscript adequate information needed for clarification and better understanding of above mentioned issue.

Comment#2

In order to run the model with both hydrological and mechanical feedbacks included it is necessary to estimate the values of fs,max and fs,min needed to constrain Eq.(2). Therefore, first we run the model with hydrological feedback only to get estimates of fs,max and fs,min. Then we introduced the mechanical feedback into the model and we calibrate the model with both feedback against the observed long term groundwater level fluctuation.

We will carefully review section 3.5 of the manuscript in order to clarify the cause-effect relation within calibration procedure.

Comment#3

Figure 6 presents the annually average factor of safety (fs,av) simulated for one year calibration period (2007) with the model (a) accounting for hydrological feedback only (first stage of calibration) and (b) accounting for both hydrological and mechanical feedbacks (second stage of calibration). In this paper the factor of safety (fs) is calculated as the ratio between maximum shearing resistance of failure and shear stress and is calculated here with the assumptions of the infinite slope model (Skempton, 1964). This is reasonable for landslides 25 times longer than they are deep (Milledge et al., 2012). The interaction between cells is neglected and the shear surface is assumed to be equal to the depth of the particular soil column, therefore calculated stability depends on the attributes of each individual soil column only.

The differences between Figure 6a and 6b are derived from the introduction of the mechanical feedback and are mostly related to the differences in water distribution within the landslide.

We will carefully review the result and discussion section of the manuscript and we will put double care to provide all necessary clarification and explanation of the presented results.

Comment#4

After the judgement of the Referee we recognize that some additional discussions on the differences between the observed and simulated landslide activity is needed. We will provide this information.

Minor comments

We will follow Reviewer suggestion while revising the manuscript.

Interactive comment on Hydrol. Earth Syst. Sci. Discuss., 9, 11161, 2012.