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Earth Surface Dynamics Discussions

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Interactive comment

Interactive comment on "Shallow landslides modeling using a particle finite element model with emphasis on landslide evolution" *by* Liang Wang et al.

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We wish to thank the Anonymous Referee #2 for his/her insightful and helpful suggestions. Liang Wang on behalf of all Co-Authors.

A) GENERAL COMMENTS:

(1) RC2: "The term shallow should be discarded".

AC: In the paper, we used the adjective "shallow" to emphasize the small-depth movements from the perspective of continuum modeling. However we accept that the term "shallow landslide" is not suitable as regards landslide classification, and we will correct it in the revision.

(2) RC2: “Some specifics about the difference between associated and non-associated and the flow rule should be inserted in the text. Moreover, the soil parameters, the location of the water table, the boundary conditions for all the landslide simulation should be added (maybe in a table).”

AC: Accepted. “We will add texts to explain these differences and the details of simulations will be put into a table.”

(3) RC2: “Some performance index about the congruence of your results with the monitoring data like location of the slip surface and velocity of the landslide should also be present. The MI index landslide profile change cannot be the only parameter, in fact from the definition of landslide countermeasure works the proper representation of the location of the slip surface is in a sense more important”.

AC: Accepted. “We will add a section to address the dynamic evolution of the landslide.”

(4) RC2: “The part about the ‘weakening process’ is not well developed. I would have expected to see the function you use for simulating the weakening process rather than a somewhat vague description in paragraph 4.2.4. The function was calibrated just through back analysis? Was some rheological consideration included in the definition of the weakening function? You show that “it can be done” but your results do not provide a good representation of the process, so you have to explain better why you think that these results are interesting for the scientific community even if the work is still largely in progress.”

AC: We added a time function to gradually decrease strength parameters, i.e. cohesion and internal friction angle, since the present model handles the slope geometry response to material parameters. However, we do not know the real material weakening information, so the time-function is used in the paper to distinguish between a dynamic-process and a quasi-static process. The ‘weakening process’ is important since it links the initiation and the propagation stages of the landslide. Further it has been shown that the run-out distance of the landslide is short without a ‘weakening process’. Similar efforts trying to bridge the classical slope stability analysis and the run-out analysis by simulating the whole process of landslide can be seen in recently published works, e.g. MPM (material point methods) [1] or SPH (Smoothed Particle Hydrodynamics) [3]. In the revision paper, we will try to implement a strain-soften model (e.g. [2], [4], [5]), to capture the dynamic process and compare with the existing results.

B) SPECIFIC COMMENTS:

(1) RC2: rainfall does not affect “material strength”, were you speaking of total stress?

AC: Accept and will be modified.

(2) RC2: “Modify the Figure 8”

AC: We will ask the original figure and modify it.

(3) RC2: “discard gradually”

AC: Accepted.

(4) RC2:“discard the before PFEM and FEM”

AC: Accepted.

(5) RC2: “Mapping”

AC: Accepted.

(6) RC2: “Analyze dam stability”

AC: Accepted.

(7) RC2: “to prove that our model can be used to assess landslide hazard”

AC: we will explain it better

(8) RC2: “discard deposited and add stopped/halted”

AC: Accepted.

(9) RC2: “use the same scale for Figure 9 and Figure 8”

AC: It will be done.

(10) RC2: “paragraph 4.2 l 7-11 p 10: The whole paragraph is not clear”

AC: It will be explained better.

(11) RC2: “13-15 p 10: Correct from the adopted with using. . .; the whole ïňĄrst 4 lines of this paragraph need to be edited for clarity and following the proper order”

AC: we will explain it better.

(12) RC2: “Berti placed the WT at ground level, where did you put it?”

AC: The hydrological condition is not clear for this case, Prof. Berti placed different ground level to back-analyze the slip-surface. In our model, we do not consider the hydrological condition.

(13) RC2: “paragraph 4.2.1 so for the static analysis the non-associated model does not work properly you need to discuss this result”

AC: There is a large difference between the associated and non-associated model for this case. Two different failures, i.e. local failure and a clear slip surface, are observed. This can be attributed to the slope geometry and material parameters. We also present in Figure11 (a) that the slip surface defined by static analysis is not consistent with the one resulting from dynamic analysis. This also indicates that for some complex landslides, the dynamic analysis might be more appropriate.

(14) RC2: “the 4 set of parameters used to produce the outputs of figure 11 should be summarized in a table, otherwise it is impossible to assess your results.”

AC: We will do it.

(15) RC2: “l15-16 p 11: are the virtual time and the actual time of failure somewhat comparable? what was the actual (target) maximum displacement?”

AC: The virtual time and actual time can be comparable if we define a similar time function to reduce the material parameter. The actual maximum displacement is not investigated by surveys, while the elevation change was calculated by pre-failure and post-failure profile.

(16) RC2: “l18 p 11: misfit index (MI)”

AC: Accepted.

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