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Natural Hazards and Earth System Sciences
Discussions

Interactive comment on "A theoretical model for the initiation of debris flow in unconsolidated soil under hydrodynamic conditions" *by* C.-X. Guo et al.

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Thanks for editor's comment. In this paper, the original idea is to propose a theoretical model for shallow failure under hydrodynamic condition. For the debris flow initiation, it still needs a complex transformation process which is not the key studying point in our paper. So the related content which may cause misunderstanding has been modified in the revised version (see details in supplement).

Thanks very much for the editor's comment. The original aim of our experiments is to observe the unconsolidated soil slope failure and debris flow formation process. The

phenomenon that shallow failure occurred without subsequent debris flow formation under rainfall condition alone has been illustrated on Engineering Geology (Cui et al, 2014;). With rainfall together with surface runoff, the unconsolidated soil slope failure process is presented in this manuscript, which is that large scale shallow failure firstly occurred, and then debris flow is triggered with abundant water. Moreover, based on the two types of experiments, a theoretical model for shallow failure is built and verified in the end.

Generally, debris flow can be divided in two categories: landslide failure debris flows (which is always huge landslide) and runoff generated debris flows. However, there is still little attention to be paid on shallow failure transforming into debris flow. Though authors regarded the model of shallow failure as a debris flow initiation model, it is easy to make a misunderstanding for surface erosion. First of all, due to its small scale and shallow position, it does not fall under the debris flow initiation type triggering from landslide. And the main characteristic of erosionâĂŤsingle particle moving much less occurring in this process and obvious sliding surface appearing determined the debris flow initiation process is firstly shallow failure and then transforming into debris flow. Therefore, numerical model in this paper is to determine the position and scale of shallow failure. The subsequent formation of debris flow is depending on hydraulic condition or water and soil coupling condition to be more specific. However, this subsequent process is not studied in this paper. Nevertheless, in our experiment with runoff coupling with rainfall, the overwhelm water flow ensured the shallow failure will transform into debris flow. However, based on the referee's suggestion which we fully agreed, failure soil on slope is not always triggering debris flow. So the 'shallow failure' model is more appropriate to represent the content in this paper.

In addition, for the readers, distinguishing shallow failure and debris flow is very important. It is not suitable to regard the failure soil in channel or on slope as debris flow initiation which may be common in current literatures. In fact, it should be strictly defined as debris flow through volume-weight, density, fine particle content and so on.

The previous title ‘debris flow’ and current title ‘shallow failure’ are both correctly reflect the main content of this paper. With the analysis above, we agree that the previous title is too general, comparing to the new title which is more exact and narrow down the field of interest. It distinguishes the shallow slope failure from conventional debris-flow initiation mechanism and summarized the key and innovation points of this paper more clearly.

Reference

Cui, P., Guo, C. X., Zhou, J. W., Hao, M. H., and Xu, F. G. (2014). The mechanisms behind shallow failures in slopes comprised of landslide deposits. Engineering Geology. DOI: 10.1016/j.enggeo.2014.04.009

Iverson, R. M., Reid, M. E. and LaHusen, R. G.: Debris-flow mobilization from landslides 1, Annual Review of Earth and Planetary Sciences, 25, 85-138, 1997.

The above response can also be found in Supplement.

Please also note the supplement to this comment:
http://www.nat-hazards-earth-syst-sci-discuss.net/2/C2168/2014/nhessd-2-C2168-2014-supplement.zip

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Interactive comment on Nat. Hazards Earth Syst. Sci. Discuss., 2, 4487, 2014.