Review - Elucidating the role of soil hydraulic properties on the aspect-dependent landslide initiation, by Yanglin Guo and Chao Ma (Special Issue: Experiments in Hydrology and Hydraulics)

Preliminary remark: this is a review of the revised version of the manuscript. I was not involved with the reviews of the original version.

This paper analyses soil properties within an area of shallow landslides in China using field evidence and lab measurements. It concludes that differences in landslide occurrence observed on north-facing vs. south-facing slopes are explained by differences in soil hydraulic properties.

The manuscript is mostly well written and documented; the revisions clearly have improved the paper. Since the editor invited a revised version I take it that the manuscript is within the particular scope of this Special Issue. However, I would like to draw the attention to some major and minor points of the study that need clarification. These are detailed in the general and specific comments below. Finally, some technical corrections are listed.

General comments

Interpretation of lab results, seepage model and stability analysis

The authors present different analyses to underpin their reasoning how the soil properties favor landslides on south-facing slopes (S-slopes) compared to north-facing slopes (N-slopes). They use soil physical properties determined in the lab, field observations of soil moisture, modelled water storage and drainage, and stability analysis. The results for the hydraulical properties appear to support the conclusions, in particular Table 1 and Fig. 6. The uncertainty of these estimates, however, is not reported or discussed. Given the rather small sample size, which admittedly is also attributed to the efforts of the extensive testing as done here, the uncertainty and its implications should be discussed.

For the soil moisture observations (Fig. 9), I think it is arguable whether the differences are significant and representative for the N-slopes and S-slopes. Field monitoring of soil moisture as done here is also very much influenced by the local conditions and particular installation, and interpretation of absolute values need to consider sensor calibration. The maximum value is observed for the sensor in layer 1, S-slope (Fig. 9), whereas all three layers reach a (little lower) maximum at the N-slope. This could also hint at a higher susceptibility for deeper infiltration, and thus higher pore pressure that triggers land sliding, at N-slopes.

The seepage and stability models (Figs. 10 and 11) appear to contradict the notion that S-slopes are more prone to failure, as the N-slope both reach higher soil water storage (Fig. 10), and lower safety factors (Fig. 11). The authors admit that in line 411 (“the south-facing slope has a relatively high stability”), but contradict that in lines 414-416 (“Considering the soil parameters of the soil moisture curve, the results of the infinite slope model have shown that the north-facing slope showed a higher level of stability”). Please explain this apparent contradiction better, and explain in more detail how the SMC is supposed to turn the results of the stability analysis upside down.

One aspect that I found missing from the discussion are the different depths of the slip layer at N-slopes and S-slopes (lines 211-213). At S-slopes, different material are reported above and below the slip layer at ~ 0.85 m, while the material appears to change more gradually over the slip layer at 1.05 m at N-slopes (Fig. 4). How do you think the layering influences slope stability, or slope hydrology? In turn, it would also be interesting to discuss how the interplay of rainfall, topography, and hydraulic and mechanical soil properties could be determining the depth of the slip layer.

The role of vegetation

The authors start with the hypothesis that effects of plant roots, which was found for aspect-dependent landslide initiation in other studies, are not relevant in their case. They report that the roots of the main plant species, *Larix kaempferi*, do not extend to depths greater than 0.4 m (lines 112-114), and are thus above the depths of failure of the observed landslides (line 470). They use this as a reason to investigate other possible causes for the observed differences in landslide occurrence. Unfortunately, the authors do not provide a source for the estimated root depths, and only provide very little additional information about the vegetation, which makes it hard to judge their argumentation. Further information would be needed to support the claim that vegetation cannot be an important factor.

For example, is the distribution of rooting depths different on N- and S-slopes? If north and south slopes have different rainfall, weather, and soil conditions, this could also affect plants and their root characteristics. Plants are individuals, so even when they are from the same species, their root systems might be influenced by age, microclimate, and soil conditions as well.

How is the distribution of plant heights? I am not a botanist, but some quick info on *Larix kaempferi* seems to suggest that the tree can grow rather tall (up to 30 m), and the minimum rooting depth is around 0.5 m[1]. I would expect that taller trees tend to develop a root system towards greater depths. Is the root system similar to the European Larch, which has both a shallow (for nutrient uptake) and a deep-reaching central part (for tree stability)?

Were root depths observed in the landslide scars? The photos in Fig. 4 show a number of roots, at these pits at least. Unfortunately, the depth cannot be read clearly.

The authors write in section 2 that the landslides in the area mainly occured on south-facing slopes where vegetation was “sparse” (line 107). Ddid landslides occur in clear terrain, or were trees affected as well? How different are the stand densities on N- and S-slope (cf. lines 61/62: “different types and densities of vegetation and soils develop on north-facing versus south-facing convergent slopes”)? Are there other relevant plant species on either N- or S-slopes, which could contribute to soil strength by their (deeper) root systems?

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[1] https://plants.sc.egov.usda.gov/home/plantProfile?symbol=LAKA2; 2023-02-11

Specific comments

Lines 99-100: Are the soils made of Loess, or is it just situated in the larger area of the Loess Plateau? What are the soil types on the N and S slopes?

Lines 160-162: Eq (2) - I fail to find the part where this is used or discussed in the paper.

Lines 189-192: How was c_l parameterized? Which value were chosen for root cohesion? S_{sr} and τ are not defined.

Lines 201-202: Why is the definition of south-facing slopes not symmetrical around 180°, as is the definition for north-facing slopes around 0°? How does this definition affect the results?

Lines 218-220: The lines in Fig 3b, which is where you base this statement on, are questionable and should be checked (also see comment on Fig 3). The difference in upslope contributing area is not easily visible in the data points in the figure, and the regression lines seem to be far away from the data points. Is the statement thus actually supported by the data? And, you are looking at the upslope contributing area above the head scar. The landslides on the S slopes have a longer stretch, and the initiation does not necessarily have to be at the uppermost point; more likely, it will start further downslope. Is the contributing area still smaller for the south-facing slopes, if you determine it from the lower end of the landslides?

Line 239, Fig 3b: The regression lines neither fit the mean values nor the individual data points?

Line 250, Fig 4: The photos show a number of roots. Unfortunately, the depth cannot be read. Please indicate a scale. Weights/Porosity diagrams: The (non-linear!) interpolation of the point measurements is misleading. It is not known if there is gradual or abrupt change in these values over the profile. The porosity diagram does not match the numbers in Table 1.

Line 363, Table 2: The difference between K_s^d and K_s^w is strikingly high. What is the uncertainty of the estimate, and is that not the opposite from what would be expected? In the paper of Wayllace and Lu (2012; reference cited in manuscript), the reported Ks of all samples were lower in the wetting, not in the drying phase. Also, it should be discussed how the values compare to K_s in Table 1.

Lines 369-370: In comparison with the porosities in Table 1, soil moisture also almost reaches saturation on N-slope in all layers. It could also slightly exceed porosity in layer 1 on S-slope, but the other layers remain below saturation in Fig. 9.

Line 418-419: “change in soil stress was more sensitive to slope stability than the change in root soil cohesion”: A bit unclear, which results for soil stress you refer to, the stability analysis? And change in root soil cohesion was not investigated or discussed, just excluded a priori.

Lines 439-444: This discussion of the higher cohesion observed at S-slopes is a bit confusing, because you first cite literature that would support greater depth of the slip layer and smaller sizes, but the opposite was observed. I think you want to argue why cohesion is not the crucial parameter here, but this should be made clearer.

Line 441: “some statistical results”: Please specify.

Lines 451-453: This appears to be the opposite of what Fig. 11 shows: Failure potential reaches higher peak and is more fluctuating at N-slopes.

Line 476: “Rich in clay content”: Clay content appear to be below 5 % in all samples (Fig. 5). I am not sure if this already considered rich in clay. Is the silt content significant in this context?

Technical comments

Lines 13-15: “Remote sensing information … shallower depth” – Was landslide depth assessed with remote sensing or field observations?

Lines 108-109: Check sentence “The strong root network may promote […] the landslide initiation condition of the upslope contributing area–slope gradient,”

Line 189, Eq (8): g and z are not italicized in the numerator

Lines 189 & 195: F_s is used in both equations, which might be misleading

Lines 236-237: Different definitions of the whiskers exist, please provide complete information.

Line 250, Fig 4: “Gain” should be “Grain”

Lines 283-284: “The results … were taken here” – Check sentence

Line 292, Fig. 6: The units of the X-axis are unclear. Does the graph start at 10^0 = 10 s, or at 10^0 = 1 s? Please give unambiguous units (seconds); scale the numbers if needed.

Line 309: “south” would rather be “north”? At least the higher permeability and lower pore pressure were observed at the N-slopes.

Line 327, Fig. 7: The units of the X-axis are unclear. Does the graph start at 10^0 = 10 min, or at 10^0 = 1 min? Please give unambiguous units (seconds); scale the numbers if needed.

Line 335: Check sentence structure, and give a reference for the TRIM method.

Line 470: “These observations cannot be attributed to plant roots” Unclear, which observations “these” are. Check this, and the previous sentences.