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Earth Surface Dynamics Discussions

Interactive comment on "Tree-roots control of shallow landslides" *by* Denis Cohen and Massimiliano Schwarz

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Thank you very much for your constructive and helpful review. Below are responses to comments and how we have modified/improved our manuscript.

General comments

1) The introduction is too dispersive: you should shorten this section by removing the superfluous information and focusing instead on the difficulties concerning the modelling of shallow landslides in rooted soils, then emphasizing how SOSlope is able to overcome these problems. The novelty of your model should be highlighted both in the introduction and in the conclusions of the paper;

The introduction is now re-organized to separate the importance of root reinforcement for vegetated slope stability and how our model provides a new approach (Section 1, Introduction) and the motivation and background for our work and the geomorphic importance of landslide processes in general (Section 2, Background and motivation). We kept the second part because we could not find an equivalent discussion in the shallow landslide/slope stability literature. We feel this motivation and description of the geomorphic aspect of landslide and slope stability is essential and brings in the 'big picture' often needed for motivating research. We also have now better emphasized the novelty of our work in the introduction.

2) In my opinion, the model description is over-detailed: considering that the main peculiarity relies on the simulation of the root-soil interaction, you should shorten the description of the hydrological part by referring more clearly to the bibliography

This somewhat contradicts a comment by reviewer 2 that "the hydrologic component of the model is lacking". We have kept the details of the hydrologic model as is since parts of it are entirely new. We also feel that, since the focus of the paper is on a new model and its capabilities, a high level of details is necessary for a complete understanding of the model without the need to look into earlier literature that describes incompletely parts of our model.

3) You should clearly distinguish the "results" and "discussions" section, in order to clarify what conclusions can be drawn from the results, then avoiding undue redundancy . This modification is necessary also considering the great amount of data reported in the text. In this respect, on the basis of your conclusions you should also reconsider if all the twenty figures that you have included in the manuscript are required for the comprehension of the text.

In general we would agree that results should be separated from discussion. How-

ever, here, because of the quantity of results provided by our new analysis, separating results from discussion would mean going back and forth several pages for finding figures and explanatory text. We have organized our results and the associated discussion by clearly separating (using subsection headings) the various effects related to root reinforcement. We feel separating results that basically show graphics, from discussion that analyze the graphics would be more confusing, producing an unnecessary lengthening of the paper, already long. Grouping results and discussion when various aspects of a model are evaluated is commonly done (e.g., D'Odorico and Fagherazzi, 2003; Lehmann and Or, 2012) and we believe, in this specific context, that it is clearer. All figures were kept as we believe they all describe important aspects of the model results.

SOSlope comments

1) The slip surface is currently predefined by the user. This point should be modified in view of performing provisional analyses: are you planning to modify the model in this sense?

This is inherent to most slope stability models. This will be implemented in the model but is, at this moment, beyond the objective of this paper.

2) Is the model able to account for different infiltration rates by varying the vegetation type?

No but this could easily be introduced by modifying the infiltration rate as a function of an evaporation function that would depend on the type of tree/plant species, the density of roots, etc. This is an interesting effect that could be taken into account in future development of the code but that is beyond the scope of the present paper.

Specific comments

p 4. line 24: are you sure its' hPa? Corrected to kPa.

p. 12 line 31: "Than 1" in place of "then 1". Corrected

p. 14 line 13. "Eq.33". Maybe it's "Eq. 31". Corrected. Actually Eq. 30. Thank you for the detailed check.

p. 19 line 15-16. "The extent of cells ... suffer displacement". Please clarify this sentence. Sentence was rephrased.

p. 21 line 12: "kN" in place of "kPa". Corrected

p. 29 line 5: "configurations". Corrected

p. 29 line 7: "factors of safety". Corrected

p. 30 lines 20-24: These sentences are not clear. Please rewrite this part. Sentences rewritten.

p. 32 lines 2-3: I think that this sentence is quite superfluous. Removed.

p. 32 line 5: Please check the commas. Tree diameter used. Modified. Diameter used should now be clear

p. 32 line 6-7. Again, sentence is quite superfluous. Shorten 4.3.2. Removed and section now slightly condensed.

p. 33 line 14 and figure 19: why only the 5-mm results? The 5-mm result shows the extreme behavior of the small roots (5, 7, and 8 mm). 7 and 8-mm roots do not add any other insight and were not included to keep the figure readable.

p. 37 line 10: "smaller small". Please fix it. Corrected

p. 37 line 29: Please check the syntax of this sentence. Modified

Table 3: F0T is repeated twice: please fix it. Changed to F_o^C

Fig. 9: Which is the meaning of those fluctuations for the Safety Factor? Details and reference added in main text (related to Self-Organized-Critical (SOC) oscillations).

Fig. 13: Again: which is the meaning of those fluctuations for the Safety Factor? See above.

Fig. 13: From the figure it is not clear when the FS goes below 1. When FS goes to one is either visible from the curve (a jump to a value significantly less than 1) or by a line pointing to it (e.g., 50/10 case).

Fig. 13: Why those two arrows are shown in the figure? Arrows refer to the vertical axes used for these curves (on right side). Now indicated in the figure caption.

Fig. 13: The double scale on the two axes is a bit confusing. Because of the large scale difference between the different simulations two scales for the y axis were used. Without two scales, the two curves would basically overlap with the x axis.

Fig. 13: Why the failure in the 50/10 simulation occurs before the 50/0 one? An explanation is now included in the text. This is actually an essential point that emphasize the importance of root elasticity.

Fig. 16: Zoomed picture is useless. Kept as is since no space is wasted. Text in figure caption added to explain the inset significance.

Figure 18: Why arrows are in the figure? Double scale confusing. Because of the large scale difference between the different simulations two scales for the y axis were used. Meaning of arrow now added in figure caption.

References

- D'Odorico, P., and S. Fagherazzi (2003), A probabilistic model of rainfall-triggered shallow landslides in hollows: A long-term analysis, Water Resour. Res., 39(9), 1262, doi:10.1029/2002WR001595.
- Lehmann, P., and D. Or (2012), Hydromechanical triggering of landslides: From progressive local failures to mass release, Water Resour. Res., 48, W03535, doi:10.1029/2011WR010947.

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