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Hydrology and Earth System Sciences
Discussions

Interactive comment on "Modeling root reinforcement using root-failure Weibull survival function" *by* M. Schwarz et al.

M. Schwarz et al.

massimiliano.schwarz@bfh.ch

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Authors response to comments on article hess-2013-112: "Modeling root reinforcement using root-failure Weibull survival function" Schwarz et al.

General comments We kindly thank the reviewers for their comments and constructive suggestions. We apologize for not being able to respond quickly enough to the comments for the online discussion. We have now revised the manuscript following comments and suggestions by the referees; in particular we re-evaluated and improved the following main issues: - Better introduce the importance of root reinforcement in hydrology for the HESS audience, referring to previous works published in HESS - Emphasize the importance of the present work in terms of a step towards the quantification

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of root reinforcement for theoretical and practical applications - Extend the presentation of the methods

The last point, the presentation of the method, was, in our opinion, the most critical comment of the reviewers. In the new version of the manuscript we introduce a new section illustrating the calibration of the survival function, step by step. This section should now make clear the meaning of the survival function and the importance of its application. Moreover, we revisited the introduction and the conclusion sections substantially, empathising the importance and the novelty of the proposed model. Finally, the discussion section was reorganised following the suggestions of reviewer #2.

The specific answers to comments are addressed in the following and the modified version of the MS is uploaded as supplement.

################################## Referee #1:

Assumption that root are linear-elastic: We now indicate in the method section that root mechanical behaviour is more complex than linear-elastic and explain why we use the secant Young's modulus.

Effects due to interaction and linking of neighbouring roots: We include this point in the discussion and refer to the work of Giadrossich et al. (2013).

"Material cited as being in App. A is not available" Corrected.

################################## Referee#2:

First general comment In this first comment we have the feeling that the lean presentation of the method in the MS has lead to a misinterpretation of the results. The reviewers misread the Weibull survival function graphs where the variable is the normalized displacement and is independent of root diameter. For this reason, and as mentioned by the reviewer himself, we introduce a new subsection in the method's section to better present the calibration procedure of the survival function (see section 2.4).

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Second general comment Based on the suggestion, we implemented in the discussion how to perform calibration of the RBMw parameters for different vegetations and soil conditions. We argue that field pullout experiments are the most appropriate to characterise the stiffness of the complete root-soil system in terms of a secant Hook's coefficient at maximum pullout force.

Organisation of the discussion's section We found the suggestion useful and we reorganised the section based on that suggestion.

Finally, we addressed in the revised version of the MS all specific suggestions addressed by the reviewer and we extended them to make other improvements to the MS: we introduced a new subsection on the fitting procedure of the survival function, we introduced a new figure (Fig. 1), and we did improve Fig. 2 (previously Fig. 1),

################################## Referee#3:

Too limited novelty of the MS To our knowledge there are no studies on root reinforcement that implement the concept of survival function and consider the mechanical variability of root material and thus root tensile/pullout strength. Our results show clearly that this new approach leads to better results (about 10% error in the estimation of maximum pullout force) compared to previous method (Wu = 100% error, and RBMw with high omega exponent = 60 % error – little root strength variability). Moreover, we believe that recognising the importance of root-strength variability in a narrow range of root diameter (i.e. a single diameter class) is a step as important as recognising the importance of progressive failure in a root bundle when moving from the classical method of Wu et al. (1979) to that of the fiber bundle model. This consideration may be of particular importance for the application of the fiber bundle model to the estimation of herbaceous root reinforcement (numerous roots in a small range of root diameters) or for the characterisation of root reinforcement at large spatial scales. We hope that the new conclusion emphasizes this point.

Link to hydrology We better introduced the importance of root reinforcement in hydro-

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logical issues for a wider audience, referring also to previous works published in HESS in the introduction section as well as in the discussion.

Analysis with compound datasets We better emphasised that the objective of the paper in to present a new method and not new experimental results. Moreover, we explained that we performed new tensile experiments with roots from the same geographic area where pullout tests were done. Since the analyses of pullout data are unique, it was necessary to perform new tensile experiments. Finally, we added the results of Ammann et al. (2009) in order to investigate the variability of tensile force for roots with diameters larger then 5 mm (which are unique for spruce!).

Calibration survival function A new subsection in the Methods is introduced to better explain the calibration of the survival function.

Discussion on fitting power-laws with R or MS Excel We hope that the modified introduction of the method now clarifies the discussion.

Conclusions We revisited the conclusions section moving some parts in the discussion and adding some other new important points

Please also note the supplement to this comment:
http://www.hydrol-earth-syst-sci-discuss.net/10/C2572/2013/hessd-10-C2572-2013-supplement.pdf

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Interactive comment on Hydrol. Earth Syst. Sci. Discuss., 10, 3843, 2013.