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Natural Hazards and Earth System Sciences
Discussions

Interactive comment on "Quantifying the effect of forests on occurrence frequency and intensity of rockfalls" *by* Christine Moos et al.

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1 Title

The actual title of the paper without the term 'occurrence' (see specific comments on terminological approximations) could be used to describe the work done in the paper. However it could be better to highlight the work done on the development of statistical models (meta models) which can predict the protective efficiency of forests against rockfall hazard. The latter result is the innovation in the paper.

2 General comment

This paper investigates the influence of forest on block propagation for different scenarios. For each rockfall scenarios, simulations are performed and information on the passing frequency and energy of the blocks is registered at 5 evaluation lines placed along a virtual slope. Using the data from the simulations, different statistical models were developed to predict the effect of forest on rockfall.

I recommend major revisions of the paper for the following reasons:

- Terminological approximations can be found in the paper (Details in specific comments 1).
- Recent references have to be added in the paper, essentially in the introduction, discussion and conclusion sections (Details in specific comments 2).
- Too many objectives are presented in the introduction section (5 are presented P3 L24-32).
- Section 2 (material and methods) has to be restructured to identify clearly the different rockfall scenarios, the input parameters, and data used to build the statistical models presented in the paper. Additional information on the calculation of the indicator of rockfall intensity is requested to evaluate the robustness of the statistical analysis (Details in specific comments 3).
- Presentation of the results has to be improved. Data have to be added in the tables and in the figures. In addition, all the indicators and parameters used in tables have to be presented in the material and methods section (Details in specific comments 4).

- The firs part of the discussion and conclusion has to be improved. Comparison between this study and recent works done to characterize the effect of forest on block propagation would be much appreciated (Details in specific comments 5).

3 Specific comments

3.1 Specific comments 1

1. The phrase "occurrence frequency" is not adequate. The author can use frequency instead. In addition to this remark, it would be appreciated to use a consistent terminology related with the frequency of blocks passing through an evaluation line: either frequency or return period.
2. P1, L30: "reducing effect of forest" is not adequate. It could be replaced by "protecting effect of forest".
3. P2, L12: "the propagation probability and thus the occurrence frequency" could be modified in reaching probability.
4. P2, L25, L28 "... the annual exceedance frequency ..." this sentence has to be improved.
5. P4, L18: What is a 3D vector? RockyFor3D simulate rockfall propagation using a 3D raster map.
6. P4, L20,L24: "The elasticity of the surface material". Elasticity cannot be used to describe the response of the surface during a block impact. If a soil is elastic no energy dissipation occurred during the impact. It would be preferable to use "the response of the surface material" instead. P10, L28 "Soil elasticity" should be replaced. For example : capacity of the soil to dissipate energy.

7. P5, L30: "aisles" could be replaced by corridors.

3.2 Specific comments 2

1. P2, L13: Maybe English references can be added.
2. P2, L16: More recent references can be added on protective measures.
3. P2, L20: More recent references can be added on the protective effect of forests and their maintenance.
4. P3, L15: References can be added on the influence of the forest structure on rockfall propagation.
5. P3, L16: References can be added on tree capacity to absorb energy.
6. P7, L22: References are needed for the calculation of the Spearman correlation coefficients
7. P7, L23: References are needed for the calculation of the AIC
8. P11, L30: Add references
9. P12, L5: Add references

3.3 Specific comments 3

The section material and methods has to be improved to present a clear and synthetic description of the rockfall simulation scenarios and the presentation of the input parameters (dedicated sections can be added). In addition, some justifications are missing for the choices of the input values of rockfall simulations.

1. P4: The first paragraph of the material and methods section is not an introduction. It may be placed in a subsection or restructure according to my last comment.

2. P4: The presentation of RockyFor3D can be improved by adding a description of the input raster maps associated to the tree generation. An highlight on the output used for the creation of the statistical models would be appreciated.

3. P4, L33: This sentence should be placed in a section describing all the input parameters used for the simulations.

4. P5, L8: The value chosen for the parameter β needs to be added.

5. P5, L10-13: Why didn't you take an interval of block volumes ranging between 0.05 and 5 m^3. The justification of the interval: 0.05 and 2 m^3, could be improved. In Stockes 2006, forests are presented as having a protection function for block volume until $5\ m^3$ (Berger et al. 2002; Stoffel et al. 2005).

6. P5, L31: According the element given in the paper, 68 simulation scenarios are identified (2 soiltype * 2 rugosity * 4 forests * 4 horizontal structure + 2 soiltype * 2 rugosity * 1 noForest). The author reach only 49 scenarios.

   Did you define 49 scenarios or 68? It would be appreciated, in both cases, to present them clearly in your paper.

7. P5, 32: Can you give us details about the number of blocks considered for each interval, in particular the interval [1.9-2] m^3. Could you create a table to indicate the number of blocks for each interval? This point is particularly important to evaluate the robustness of your statistical analysis.

8. P6 L15-20: It would be preferable to choose either the passing frequency of the block through a line or the return period for all the analysis.

9. P6, L29: A precise description of the method used to calculate the indicator E95red is required to evaluate the robustness of the method. Calculating E95 using the average of E95 values along an evaluation line (these values being averaged over a hundred simulations) cannot be used as a relevant statistical indicator. In addition using the percentile 0.95 of a distribution is only valid for a high number of blocks passing through a line.

   How many blocks are used to calculate E95 for the different evaluation lines (especially for large block volumes)?

10. P7, L5-13: In this section a complete description of the two main statistical analyses is required. The statistical model are the main results of this work. Thus, a description of the hypothesis associated to each one is requested.

    In addition, for the regression tree models, (P7, L10-11) either you have to explain all the method to select the splitting variable and the impurity reduction or you have to remove those two sentences from the article.

11. P7, L23: The presentation of the GLM method is to short, additional information on the method is requested.

12. P8, L1-3: These two sentences could be placed in the discussion and conclusion section.

3.4 Specific comments 4

1. Results of the Wilcoxon rank sum test (methodology section P7 L5) have to be added to the results section.

2. Results of the Spearman correlations coefficient (methodology section P7 L5) have to be added to the results section.

3. P8, L16: In the legend of Fig 4 and 5, the volumes of the blocks ranging between 0.01 to 2 m^3 are indicated. A different range is presented in the material and methods section (block volumes ranging between 0.05 to 2 m^3).
4. P8, L19-L25: The results presented in Fig 6 and Fig 7 should be improved. The data on which each curve are fitted could be placed in the background of each figure. In addition, the smoothing techniques used to create the curves (Fig 6 and Fig 7) should be detailed in the material and methods section.
5. P8, L31: A simplification of the results presented in table 3 could be done to improve its understanding. In addition, each term used in the table has to be defined in the material and methods section. For example: (Intercept), Vol, GLM-Freq, GLMInt... In table 4 RTFreq and RTE95 are not defined in the material and methods section.
6. P8, L21: Where are the results illustrating the influence of the forest structure? The only results presented are simulation scenarios with random or no forest (Fig4 and Fig5).
7. P9, L1: Why, for the level 8 of the RTFreq model (Fig 8), a volume < 1.1 m^3 has a smaller Nrpred value than a volume > 1.1 m^3, and why, for the level 11 of the RTFreq model (Fig 8), a volume < 1.2 m^3 has a higher Nrpred value than a volume < 1.2 m^3? Could you explain the difference?
8. P9, L8-10: This results could be placed in the discussion conclusion section.
9. P9, L30: Which data were used to build the Fig 9?

3.5 Specific comments 5

1. P10, L10: The reference given not correct. The result presented in Lopez et al 2016 is : 143 years for forested condition in 1850 to > 2000 years for forested

condition in 2013 for a block volume of 1.2 m^3.

2. P10, L15: These two sentences could be moved to the introduction section.
3. P10, L18: The comparison between this work and Matsuya et al 2009 and the explanation of the differences found could be improved.
4. P10, L22-32: This paragraph is currently a description of your results. A comparison between your results and other one from the literature would improve significantly the discussion. Here is a list of recent papers working on similar subjects:
    - Dupire et al. 2016: Novel quantitative indicators to characterize the protective effect of mountain forests against rockfall.
    - Monnet et al. 2016: Suitability of airborne laser scanning for the assessment of forest protection effect against rockfall.
    - Fuhr et al 2015: Protection against rockfall along a maturity gradient in mountain forests
    - Radtke et al. 2014: Managing coppice forests for rockfall protection: lessons from modelling

3.6 Other comments

1. P3, L5: "current... reference ", could be replaced by forested and non forested.
2. P3, L17-20: This two sentences should be located in the material and methods section. In the introduction, it would be appreciated to have a short paragraph describing the different rockfall models that can be found in the literature and highlight the few one that take into account the protection effect of the forest.

3. P3, L22-24: Should be placed in the material and methods section.
4. P4, L5: A justification for the choice of a concave profile with slope angle varying between 20 to 40° needs to be added.
5. P4, L6: Why do you add random slope angle variation to your profile? Adding this angle variation comes in conflict with the "controlled conditions" you are looking for P4, L4.
6. P4, L10: Why do you add a road into your slope profile? Adding a road does not appear to be necessary for the analysis done in the paper. Its influence is never presented in the result section nor in the discussion and conclusion section.
7. P5, L29: The reference Fig. 2 have to be replaced by Fig. 3.
8. P7, L16: Why do you choose to calculate cbA using a slope width of 100 m? Did you test other widths and analyse their influence on this indicator?
9. P8: Can you give a ranking of the influence of the different parameters for the 4 statistical models?
10. The author have to pay attention to the consistency of the form of the variable name. Ex : Table 3 GLMFreq and in table 4 GLM_{Freq}. See also Table 5.
11. Corrections are suggested in the pdf

Please also note the supplement to this comment:
http://www.nat-hazards-earth-syst-sci-discuss.net/nhess-2016-230/nhess-2016-230-RC2-supplement.pdf

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