Review for paper:
3-Dimensional Rockfall Shape Back-Analysis: Methods and Implications
Author(s): David A. Bonneau et al.
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General comments

The manuscript is interesting and its conclusions may be useful for other authors who deal with 3-D rockfall software simulations for hazard analysis. However – I believe it could be of use to a larger audience if the importance of a very accurate 3-D input dataset to rockfall simulations were better stressed. Perhaps a demonstration of the final simulated rockfall differences between two different output classifications of the suggested methodology on a 3-D based simulation software could emphasize its importance. This could also be achieved by referring to appropriate previous papers.
Additionally, the paper appears to focus on a specific site with little emphasis on its significance for other studies globally. Its localization is also revealed in the missing global reference as to where exactly on the globe is the study area, short acronyms/abbreviations that are not well explained in the text or figure captions, and little comparison to similar results from previous studies (if such exist). Reinforcing the global relevance of the results of this study could benefit to broaden its audience and make it more appropriate for a global publication like NHESS.

Specific comments

Abstract

It would help the reader to estimate the importance of the paper if the novel approaches or so far un-answered knowledge gaps that the paper suggests to answer are shortly presented in the abstract.

P1 lines 16-17: "a database of close to 5000 rockfalls is presented…" – the authors do not present the database, or any other database which they refer to (50/60 blocks referred to later in the results). Either present the databases in supplemental materials or not state implicitly that you present them.

Introduction

General: What is the importance of 3-D block mapping for rockfall hazard assessment?
The Introduction could benefit from more reference to previous studies which discuss that issue, and perhaps to point out the importance of the 3-D block classification for rockfall hazard estimation worldwide (as opposed to other simplified block shape methodologies, which were proven to be relatively robust so far). At current stage – this link is missing and the importance of the study is not well constrained.

P1 line 25: perhaps add a short description of rockfall triggers.
P2 lines 5-8: there are more large scale works that can be mentioned as previous works on frequency-magnitude and return periods (e.g. Malamud et al., 2004, Wieczorek and Jäger, 1996).
P2 line 28: what do you mean by 'quickly' and 'with substantial detail'? – how quickly? To what extent of detail?
Section 1.1: rockfall shape were previously described in literature and most rockfall hazard programs use some simple geometry shape for falling blocks – providing relatively good results (e.g. Guzzetti et al., 2002) . Please address what was previously used for hazard assessment and what is the novelty that TLS 3-D measurements (or the current study) contribute to rockfall hazard? Please provide references to emphasize the importance / augmentation of TLS rockfall shape determination over previous methodologies simplifications.
P4 line20: what is the CN main line?

Results

In general – there is not a word mentioned on the size of the mapped rockfalls in the results or in the discussion. It will be better to include these – and also power-law size/volume distributions so the readers from other places can relate your database and its applicability to their own study cases and areas.

Section 3.2 – what are the size ranges of the rockfalls in the 160 and the 50 blocks selected?

Discussion

In general – the discussion part is relatively short compared to other sections of the manuscript (e.g. Methods or Results). I believe it should be better balanced, as currently the discussion about the insights obtained from the analysis and their implications for other studies were not sufficiently extracted from the data. This could also be achieved by answering the following suggested issues:

Most of the rockfall objects in the study case were classified as 'very bladed' or 'very elongate'. Please consider discussing the possible source for that – i.e. the local geology and structure of the cliff-face or any other factors.

About 30% of the identified 'feasible for analysis' rockfalls were included from the suggested methodology (50 out of 160) due to irregular morphology (not to mention ~4800 excluded cases of less than 1 m^3). Consider discussing the amount of 'good' identified rockfalls valid for using your suggested methodology and relate to how much you assume it is reliable for application in the real-world.

P13 lines 20-24 (Results) + P14 lines 25-27 (Discussion): All suggested automatic methods failed to predict the shape of the single exemplary object (very elongated) with relation to its manual measurements (very bladed). Please consider discussing: (1) the significant contribution or advantage for using the automated methods vs the manual measurements; (2) the significant contribution of the two newly suggested methods in the current study over previously used methods.

Do you consider any scaling factor or effect on your results and conclusions? It appears that most of the discussed rockfalls in the manuscript are of very small size (up to 1-2 cubic meters) compared to other slopes and areas in the world reported in literature (up to tens and even hundreds of cubic meters at places).
Please consider discussing the size of the blocks in the database (volume-frequency power laws) and its implications for larger scale blocks and volumes.

P14 lines 19-24: Consider discussing the superiority of your suggested methodology (if such exists) – how much computation time / effort do these new models require – versus how better is the accuracy they obtain and how significant it is for more successful rockfall hazard estimation? Which one of them would you recommend for use (at least in your case study – and if you can – try to recommend for other readers).

Conclusion

Please try to confine the conclusion to insights from the current study only (for example – first paragraph in P15 lines 17-21 cites conclusions from previous studies.)

Please consider actively stating your opinion by suggesting a priority for block shape methodologies: which is most adequate for most cases and which is the less adequate. Try to list them by priority or robustness of success potential to predict real-world rock block shape.

Figures

Figure 2: Please consider a better World location map for readers outside Canada / N America.

Figure 6: Please refer in the figure cation to the relevant studies which presented the different models shown in the plot.

Figure 9: As the main results presented in this study – please consider putting more effort in presenting the data more vividly in this plot. There is a lot of white space and very little data presented.
The abbreviations at bottom legend are never referred to in the text or figures. Especially the ones of 'RFSHAPZ_???' should be at least detailed once in the text or figure.
Please add the 'Cubic, Platy, elongated…' the corners of the plots for clarity.

Figures 10-11: the abbreviations at right-hand legend are never referred to in the text or figures.

Figure 12: please indicate the location of each of the plots (A, B) on Figure 3 of the study area.
What are the sizes or size range of the rockfalls indicated here? It is not mentioned in the text or figures.
How do these sizes relate to the declared identification threshold detailed in the Methods?

Technical corrections

The paper is well written in fluent English. I have nothing specific to suggest.