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Natural Hazards and Earth System Sciences
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Discussions

Interactive comment on "Geologic and geomorphic controls on rockfall hazard: how well do past rockfalls predict future distributions?" *by* Josh Borella et al.

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Dear NHESS,

We appreciate the comments made by referee Dr. Martin Mergili (RC1). Below we respond to each of the interactive comments:

(RC1). An earlier paper led by the same first author (Borella, J. W., Quigley, M., & Vick, L., 2016: Anthropocene rockfalls travel farther than prehistoric predecessors, Science advances, 2(9), e1600969) appears partially similar to the present manuscript in terms of the work described. It should be made clear in this manuscript what are the

innovative aspects, compared to the earlier paper.

JB et al. Response: Our NHESS paper distinguishes itself from Borella et al. (2016) and innovates by investigating a range of influences (i.e. geologic, geomorphic, seismogenic, anthropogenic) on rockfall hazard as they relate to the highly relevant question: How well do past rockfalls predict future distributions? The research is supported by robust prehistoric and contemporary rockfall data sets at two study sites in the Banks Peninsula (NZ), numerical rockfall modelling, and the exceptionally well-recorded seismicity of the 2010-2011 CES. Within our NHESS manuscript we focus on the complexity of interpreting future rockfall hazard based on former boulder distributions due to a variety of natural and anthropogenic factors. [This is different from the motivation behind Borella et al. (2016) which focused primarily on testing the hypothesis that anthropogenic deforestation increases rockfall hazard.] The conditions listed below represent several geological influences comprehensively investigated within our NHESS study that were not within Borella et al. (2016).

- Lithological variability effects on the type of material liberated in successive events and travel path/transport scenario and final resting location.

- Changes in rockfall source (i.e. progressive emergence of bedrock sources from beneath sedimentary cover).

- Remobilization of prior rockfalls by surface processes including debris flows.

- Collisional impedance with pre-existing boulders.

- Variations in location, size, and strong ground motion characteristics of past rockfall-triggering earthquakes and their impact on rockfall flux and boulder mobility.

Our NHESS paper expands upon the Borella et al. (2016) data set by including the Purau study site, which enabled us to evaluate the influences of rockfall hazard over a broader area that included multiple interfluve and drainage canyons.

RAMMS modeling at Purau intentionally used a similar approach/method for evaluating

CES and pre-CES rockfalls. However, there were a few exceptions (see below).

- For Purau we added a RAMMS_3 scenario which models the potential future rockfall hazard at Purau. We assumed bare-earth (deforested) hillslope and dry soil moisture conditions to insure a worst-case (conservative) outcome. Locations for existing and future residential development are shown to highlight the potential impact to dwellings.

- At Purau, separate terrain polygons were defined for drainage valleys. The polygons were assigned a unique set of terrain parameters to account for the influence of collisional impedance with pre-existing boulders and other potential dampening effects within the valleys.

We have made modifications to the NHESS paper to highlight the unique and innovative contributions of JB et al. (2019) NHESS. Please see the attached manuscript (supplemental pdf_JB et al. 2019 Revised Manuscript) below for the applied changes.

(RC1). Even though I appreciate the very detailed discussion chapter, I have the feeling that there are some redundancies with the results chapter, and some parts of the discussion which might better fit to the results. Consequently, I recommend to revise the results and discussion chapters and to condense the discussion to those issues which are really essential and have not been covered in earlier chapters. This would make it easier for the audience to capture the main points.

JB et al. Response: We thank the reviewer for his comments. We've identified several sections within the Discussion that can be included within the Results or removed to avoid redundancy. The changes have helped improve the manuscript. Please see the attached manuscript for the modifications/omissions.

(RC1). Despite the fact that the manuscript is generally well written, I have found a couple of minor issues of grammar and style – so, please go through the paper carefully again in order to polish the language.

JB et al. Response: We have thoroughly reviewed the manuscript and have identified

a few locations where grammatical and stylistic errors have occurred. Please see the attached manuscript for the applied changes.

Special note = Modifications and additions to the attached manuscript text are shown in red. Any removed text is shown in red and crossed out.

Please also note the supplement to this comment:
https://www.nat-hazards-earth-syst-sci-discuss.net/nhess-2019-178/nhess-2019-178-AC1-supplement.pdf

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