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Comment on nhess-2022-57

Tom Robinson (Referee)

Referee comment on "What drives landslide risk? Disaggregating risk analyses, an example from the Franz Josef Glacier and Fox Glacier valleys, New Zealand" by Saskia de Vilder et al., Nat. Hazards Earth Syst. Sci. Discuss., https://doi.org/10.5194/nhess-2022-57-RC1, 2022

De Vilder et al detail a quantitative risk assessment study for landslides in the Fox Glacier and Franz Josef Valleys, building on a wealth of data and using a series of informed assumptions to estimate both risk and uncertainty. This is a really well written and thorough manuscript - I enjoyed reading it and it will be a useful tool both in NZ and the wider communities. The authors provide a large amount of detail and a particularly useful appendix for the various gnarly details that aren't required in the main text.

In my view, this is a strong piece of research that requires minimal additions/changes. I've outlined some of they key elements below, and note that several of these relate to taking information from the appendix into the main text for added clarity. Hopefully these are not too difficult and do not require any further analysis.

Introduction:

A few more key references on landslides in S Alps would be useful – Korup, Davies, McSaveney etc all have plenty of articles relevant here that would be useful background.

It would also be good to see some more landslide QRA works referenced, at least breifly as there are certainly several around that would be useful to highlight

Study Site

This needs an overview of at least the pre-covid number of visitors for reference. How many people on average visit per day?

L75: Aseismic landslides needs a reference to support

Method

Each representative earthquake event? Some more details on this would be good – is this just an Alpine Fault event or does this consider far-field sources too? What about potential seismic sources within the ranges (e.g. Cox et al 2012 – Tectonics)?

Compiled info on visitor / worker duration – could you expand this description a little here in the main body. This is crucial to understand some of the key variables to the risk equation. You've provided some nice details for the hazard part, so it would be good here to have some details on the exposure part. For instance, is this data pre-covid (something for the discussion). Is it averaged, or do you take demographics into account which may change exposure time (e.g. how did you determine an average walker vs a slow one?).

Empirical estimates of vulnerability – largely agree, although the central estimate for 1000 m3 seems optimistic to me, even with evasive action

Seismic landslide inventories – are these 3 events likely to be representative though – rock types are similar enough as is the topography, but the climate is variable as is the earthquake history. Perhaps a point for the discussion, rather than expanding here in the methods but worthwhile all the same

L204 – Alpine Fault earthquake date needs a reference

You've assumed landslides won't occur on slopes <30 deg – could you not use your compiled inventory to assess just how likely this is? Surely you have a slope frequency distribution you could use to inform this decision, or at least weight the probability component?

Fig 2 – hard to read the legends and quoted power laws, particular in panel a

PGA input from NSHM – does this vary much over the valleys or is it pretty constant?

Given the short valley lengths and distance from the Alpine Fault I would have thought there is little variation across the valleys, meaning it's the other factors that play the biggest role in determining landslide source?

Fig 3 – would be good to see the NSHM here to since that's a key input for the seismic landslides

All slopes >45deg can generate rockfall – I don't necessarily disagree, but what is the justification for this?

Field measurements show average boulder size is 1 m3 – again, would be good to see the distribution of this here in the main text somewhere to help support this - it would also be useful to see the range and skew of the data

Results

Fig 5 and 6 are very nice, but a more variable colour scheme would help, rather than graduated shades of blue which make it difficult to distinguish close classes

Fig 7 – its not immediately obvious that the y-axis scales differ here. At first glance I assumed the valleys were comparable. Could you either scale the axis, or make clear note in the caption

Discussion

If you think the order that you increase the variables influences the outcome, could you easily test this be changing the order and measuring the effect?

The climate change discussion is a really interesting one and worthwhile here. However, the role of climate change on landslide rates in these areas is really complex and it's hard to confidently say what might happen – landslide frequency could drop while size increases for instance.

One aspect missing from the discussion for me is the temporal variation in exposure. Firstly, covid may well have long term implications for visitor numbers that your values won't account for. Secondly, visitors in the valleys are no doubt much lower on rainy days when aseismic landslides are more likely than dry days, when aseismic landslides are less likely. The question is whether these changes cancel each other out. It's also not clear to me if you take diurnal variations into account or not – how many people are in the valley at night?

Fig 10 – excellent, very valuable. Could you maybe add the suggested 'acceptable' risk thresholds from the ChCh rockfall work for further added context?