

Overview:

Thank you to the authors for submitting a revision of their manuscript which includes several important improvements, including a title and abstract that more closely reflects their work, improved organization, clarification about the sources of landslide data cited in this study, and improved clarity regarding the analysis of theoretical landslide ARIs. The overall writing and organization is well done. The primary conclusion of the paper is that there are likely debris flow fans in New Zealand where there exists unacceptable but as-yet unidentified risk to life from debris flows. This conclusion is based on the fact that the annual probability of debris flows that would result in unacceptable risk falls within a range of debris flows reported in some cases of published debris flow return intervals in the region. While this is a valid observation that could potentially be used to justify further research in the region, in my view it still falls short of a truly meaningful contribution to knowledge. I encourage the authors to continue refining the conclusions of the paper to push an interesting thought exercise into a form that offers impactful conclusions and improve the intellectual merit of the work.

The authors then present a methodological framework that could be useful for identifying areas where risk from debris flows may exist, even if no landslides or debris flows have been documented. While the results of this exploratory analysis are interesting, I am unconvinced that the paper presents a framework that would be applicable by practitioners or that would improve upon informal, ad hoc assessments that a dwelling or community may be exposed to risk of debris flows. This is because:

1. Bayesian analysis of posterior distributions are quick and low-cost, but are not accessible to most risk managers or practitioners without advanced technical expertise and analytical skills. This could be mitigated by providing a map or look-up table for different settlement/records scenarios in their community.
2. The minimum acceptable ARI is estimated with a risk equation that is only very coarsely parameterized for the entirety of New Zealand. See the "Risk Estimate Parameters" section below.

The idea the authors present to use the length of no-observation as to contain posterior ARI distributions is an important one, and some expansion on this idea could support a meaningful contribution to the scientific literature. To improve the applicability of the product and the intellectual contribution of this paper, the authors might consider generating a look-up table that a practitioner could use to estimate likely ARI based on the length of "no landslide" observation, along with guidelines for parametrizing risk based on local observations like the number of houses or relative location to the active debris flow channel.

Alternatively, how could this work be expanded on to provide spatial granularity of risk estimate based on housing density?

Risk Estimate Parameters:

I disagree with some of the parameter values the authors have chosen to estimate risk, as described in my first review. I understand that the authors wish to present a simple metric, but I worry that coarse parameter estimates that are difficult to justify and with no sensitivity analysis are likely to result in misleading estimates of risk and ARI, which may be off by an order of magnitude. This is particularly important given the presentation as a methods paper that the authors suggest would be applicable to other regions or for more detailed analysis. I will defer to the editor on the best approach here, but have outlined my primary concerns with some of the parameter estimates here.

- Maximum acceptable risk to life (0.001) - I don't have an issue with this specific value, but it is important that the authors acknowledge that risk tolerance varies greatly according to community values and priorities, and that practitioners could adjust this value for local analysis. For example, some communities may need to balance risk from one natural hazard against another, or may have different risk tolerance for sensitive populations (children or elders). Consider consulting the literature on risk tolerance to add to this discussion. (E.g., Wachinger et al., 2010; Enright 2014, and others). This could be a simple acknowledgement in the paper but is important for future research or practitioners.
- Probability of impact to a dwelling (1.0) - There is almost certainly less than 100% probability that a debris flow would impact a dwelling on a debris flow fan. In fact, the authors undermine their estimate when they describe that 100% probability is credible *if* certain conditions are met. If they have to qualify the probability, then 100% is not appropriate. I recognize that it may be difficult to estimate this value and that the authors wish to choose a conservative value, but they need to explore a range of reasonable values or some other justification, such as an estimate of the average inundation proportion of a debris flow fan during a single event.
- Probability of individual death if an impact occurs (0.1) - I recognize the regional variability in this value, but in my experience the fatality rate is much higher (at least half of impacted debris flows that I have seen that impacted buildings resulted in at least one fatality). To align with your desire for a conservative value, consider using the upper estimate you cite from Glade and others (0.25).
- Dwellings / catchment (1) - This value could easily be off by one or more orders of magnitude. The authors follow an approach from Bell and Glade (2004) to estimate individual risk, which may then be multiplied on the back end, but I would like to see a more explicit analysis of how a larger number of dwellings would change the minimum ARI and discussion in the rest of the paper.

Minor Comments:

Overall the language and writing is readable and accurate. I appreciate the clear writing style. Some of the line-by-line comments from the first two reviews have not yet been addressed, such as the colloquial use of the term "landslips" and clarifying "*recorded* history of debris flow" in the manuscript text. Please review the minor comments to ensure that they have all been addressed.

Recommended Literature:

- [Wachinger, et al., 2010, Risk Perception of Natural Hazards](#)
- [Enright, 2014, Is there a tolerable level of risk from natural hazards in New Zealand?](#)