Response to Anonymous Referee #1

I would like to thank the anonymous referee #1 for his remarks. Following, you can find my response to the general and the specific comments.

General Comments:

-The referee points out that the authors work has been cited too often in the article (9 out of 37 References). I considered this necessary since I have been working with both methodologies extensively in the past, however, I could certainly reduce this number in a new version of the paper.

-A historical review of the vulnerability curves is missing indeed. The author would like to confirm that she would include this review in a new version of the paper if the editor considers it also necessary.

-Reference to engineering approaches such as numerical modelling and simulations is indeed limited for the following reasons:

1. The focus of the paper is not a review of all existing approaches for the vulnerability assessment but the comparison of two dominant approaches (curves and indicators).
2. The approaches that the referee refer to in the comment, in my opinion, are not vulnerability assessment approaches as such, but engineering approaches (process, impact, or structural and physical response modelling) that produce information that may be used by vulnerability assessment approaches. For example, numerical modelling of a past debris flow event may reveal information on the intensity on individual buildings that may be used for the development of a vulnerability curve (e.g. Quan-Luna et al, 2011) or simulations of debris flow events in the lab may be used to define thresholds for wall collapse under different intensities, grain size, viscosity, etc. that may be also used for the development of vulnerability curves (Gems et al., 2016, Mazzorana et al., 2014).

A reference to these approaches is also possible in a reviewed version of the paper especially as they offer an alternative to empirical data for the development of vulnerability curves.

Specific Comments

Page 2, lines 2 and 3: This statement is strictly not correct. Ignoring the characteristics of the building is a choice made by the person developing the vulnerability curves, mainly because of lack of data. In earthquake engineering, vulnerability curves (which are called fragility curves in that discipline) are developed for different classes and typologies of buildings

I have to agree with the referee as far as earthquake hazards (and maybe also floods) are concerned. In most of the other cases (having debris flow in mind) the person developing the vulnerability curves has rarely enough buildings to make several curves for different types of buildings. Additionally, an indicator-based methodology would make use of numerous building characteristics and not only the building type (surroundings, number of openings, presence of basement etc.). Making a set of vulnerability curves for each of these characteristics would be time consuming. However, I agree that the statement is quite inflexible and could be rewritten as follows:

"The most common method for assessing vulnerability is the development of vulnerability curves that **often** ignores the characteristics of the buildings, **especially when it comes to hazards involving a limited amount of buildings (e.g. debris flow), focusing mainly** on the intensity of the process and the corresponding loss. **Nevertheless, vulnerability curves for different types of buildings may be found in the literature for earthquake, wind and flood hazards**".

Page2, line13: The definition of physical vulnerability is not in "conflict" with other, more general definitions of vulnerability. It is just one possible quantitative interpretation of it.

I will have to disagree with the referee at this point. The UNDRO (1984) definition is not a quantitative interpretation of the UNISDR (2009) definition. There is a big difference between them which lies on the fact that the one claims vulnerability to be loss (the result of a hazardous natural process-ex post) whereas the latter reflects the direct relationship of vulnerability to a pre-existing condition (ex-ante) of the element at risk. From these two types of definitions different methodologies derive that have different data needs (e.g. vulnerability curves need empirical data) and of course different results.

Page 18, line 14: The author seems to forget that physical vulnerability is basically the conditional probability of loss, given that a hazard of certain occurs. A building with high vulnerability will suffer little damage if it is subjected to low intensity hazard. Likewise, a building of low vulnerability may be totally destroyed during an extreme event.

The referee gives a definition of vulnerability which sounds more like a definition of risk. ("Risk is the probability of harmful consequences (…) resulting from interactions between natural and human induced hazards and vulnerable conditions (UNDP-BCPR, 2004)). The term "probability" is relevant to the "fragility curves" (functions that describe the conditional probability that a damage state will be reached or exceeded for a given hazard intensity) which are not the focus of this paper. A distinction between vulnerability and fragility functions has not been made in the article, however, the author could do so if the editor thinks that it is necessary.

The referee's statement following this definition has been also made by the author herself elsewhere in the text (page 18/ lines 18-23, page 20/ Line 13-15 and page 23/ lines 16-21).

Page 18, line 21: The indicator-based relative vulnerability index could be transformed to site-specific vulnerability curves if enough data exist for doing the transformation. When there is lack of data, the transformation could be based on expert engineering judgement. This of course involves some uncertainty, but the level of uncertainty is not necessarily greater than the variability observed when data are available (e.g. Figure 5 of the paper).

The referee here suggests that one could develop curves for different building types or buildings with different characteristics based on expert engineering judgement. This is a very interesting suggestion that is difficult to implement. First, as the referee also suggest the level of uncertainty will be very high but also the subjectivity of the method will limit the possibility of the curves to be used in other case studies. Second, this transformation as the referee also notes, would require a significant amount of data that for some hazard types are simply not available. Last but not least, the indicator based methodology considers a large amount of information regarding the buildings and not only the construction type or the number of floors. How would the combination of these characteristics be possible if we would attempt such a transformation?