Medium level revisions:

- *Page 4010, line 5 onward, these methods are not explained, and are somewhat jargon without further definition.*

Thanks for the kind suggestion. We will include a brief explanation of the mentioned methods in the revised version.

- *Section 2.1 on page 4012 is very dense, and hard to follow (points a-g): (a) Please consider breaking up some of the sentences in to shorter, less ambiguous statements (e.g., lines 8-11, the way it is written is a bit ambiguous regarding whether losses of persons are measured in a monetary value; lines 15-20 is a very long and complex sentence).*

We will rephrase these sentences. The monetary values correspond only to the damages of assets in this version of the prototype.

- *(b) It is somewhat strange to introduce variables in lines 10-12 but then not use variables in Equation 1.*

The variables were introduced to use later in Equation 3-5. However, if better suitable, we can introduce them directly in the paragraph referring to Equation 3-5.

- *(c) Why does physical losses have the variable A? (d) After reading through this section about 5 times, I think that lines 15-21 should be presented more like a "caption" for the equation …. You do not have to use the variable names I have suggested, but just to give you a feel of how this could be made clearer.*

Thanks for reading it several times and providing the suggestions. We will adjust the equation and variables to be made clearer in the final paper.

- *(e) I think the term "intensity" needs better defining. From line 10, I understand this to be the number of hazard events across a region (e.g., a high intensity landslide event would be hundreds of landslides occurring across a municipality in a short space of time). Am I correct about this? If so, I think it would be useful to acknowledge that intensity could be measured in many different ways (e.g., speed, depth, size).*

According to Hungr´s (1997) definition, intensity represents "a set of spatially distributed parameters describing the destructiveness of a hazard". Intensity is defined quantitatively using various parameters, for example, in the case of debris flow, depth of accumulated deposit, impact pressure, kinetic energy per unit area, etc. We will include this in the revised version.

Reference: Hungr, O., 1997. Some methods of landslide intensity mapping. In: Cruden, D.M., Fell, R. (Eds.), Landslide risk assessment - Proceedings of the International Workshop on Landslide Risk Assessment, Honolulu, 19–21 February 1997. Balkema, Rotterdam, pp. 215–226.

- *(f) Page 4013, although the concept of a vulnerability curve is well introduced, you have not acknowledged the uncertainties involved in this process, which could have major implications for the estimation of losses. By this, I mean (a) why the selected CDF is an appropriate model and (b) what data informs these vulnerability curves, and its associated uncertainties.*

We do agree that there are uncertainties involved in the process not only because of the modelled hazard map inputs but also because of the vulnerability. In this version of the prototype, Triangular CDF is initiated as an example to experiment the possibility of applying a certain vulnerability curve in the loss calculation. Moreover, any selected CDF must fulfill the requirements mentioned at p.4021 (lines 20-24). The data (parameters) used to generate this curve is fed directly into the system by the user (after having the possibility to perform a detailed analysis outside

the web-platform), and thus, uncertainties could be associated with the expert knowledge of the users. We will include a short explanation of this in the paper.

- *(g) Page 4014, "return periods" are introduced without much description of what these are, and why they are useful. For example, for debris flows, does this represent the return period of a particular speed, size or depth of debris flow? I would like to see a one sentence definition of a return period.*

For the return period (T), it is the inverse of the average frequency of events with intensities above a given threshold. For example, flood Q100 means the discharge for T>=100. In Fig. 4 and text description, it represents the deposit height (m) of accumulated debris material for a certain return period in the area. Return periods are a set of debris flows modeled with "model parameter ranges" and intensity values (heights, impact pressures) similar to events of a certain return period. The historical events have return periods calculated according to the historical rainfall records as triggers. We will include a definition and a short explanation in the text description/caption of Fig. 4 accordingly.

- *Page 4014, line 19, What are the implications of setting the spatial probability to a uniform value of 1? Surely this results in much higher values of risk? How realistic is this? Related to this, page 4015, line 1, setting the value of vulnerability to 1. If a user sets both spatial probability and vulnerability to 1, how realistic is this risk calculation, and how is this uncertainty communicated to the user?*

Choosing the highest spatial probability value of 1 can indeed be an overestimation of the risk. However, debris flows that have occurred in channels in the past are more likely to also occur in the future. Due to the limitation of our regional scale model (Hussin et al., 2014b) which simulates the extent of many debris flows for large areas, we were not able to recreate all historical debris flows that occurred. The reason we chose the value 1, is an assumption based on the fact that we are 100% sure that this area witnessed a debris flow in the past. Also, we tend to rather slightly overestimate than underestimate the risk in some areas in regional scale studies, where we are calculating possible loss estimations for large areas. Since there are also areas that will be underestimated. Thus, the value of 1 for spatial probability is an assumption to be on the safer side, but needs to be acknowledged that it is a subjective decision based on the knowledge of the expert. In this revised paper, we will include an extra line mentioning about this assumption.

Moreover, this option of setting both values to 1 is made possible in the case where the associated spatial probability of a hazard event or vulnerability information of elements-at-risk is not available. In reality, lack of data is an issue and it is not always possible to even obtain a hazard intensity map. After the calculation of loss scenario, the user can check the parameters he/she gave during the process. However, we think it will be a good idea to communicate the uncertainty of parameters he/she used in the process. Thanks for this nice suggestion and we will include it in the discussion part for the improvement.

- *Page 4014, line 26, up until this point you have not really discussed the data structure, but now you are mentioning column attributes. This needs some earlier introduction or clarification.*

We will revise this part and replace 'column attributes' with an another term for explanation.

- *Page 4016, line 26 what is the "mapping index attribute"?*

This attribute acts as a lookup attribute and is mainly used to retrieve the data stored in the main table with an associated link to a 'child' table. For example, 'mapping index attribute' of 'elements-at-risk' main table stores the associated information (i.e. the name of the table/layer created by the system) of the uploaded 'Fella buildings' child table.

- *Page 4020, line 17. How realistic is it to have this type of detailed building characteristics information for other locations where this tool might be used? I think one sentence describing the data collection methodology of Ciurean et al., 2014 would be useful here.*

Although it is expected that such a detailed building database is rather difficult to reproduce, the tool can still be used in other locations even if no detailed building information is available for the loss estimation. For example, it allows to calculate only the number of affected buildings or rough estimated losses if the monetary values (amount) of buildings is available. Indeed, we can carry out a more detailed analysis if such detailed building and vulnerability information is available in a considered study area like Fella. For the methodology of Ciurean et al., 2014, after line 17, we add in the revised version: "The building database was developed using an initial digital dataset which was subsequently updated and validated through GIS-desktop and field mapping; this gave us information about the building geometry, type, use, etc. Building value was calculated based on existent cadastral information, whereas population at individual building level was estimated using a dasymetric mapping technique."

- *Page 4021, line 2-5. A better explanation is needed of how it is possible to calculate the spatial probability of a debris flow using this method. This sentence is not clear.*

All debris flow areas that are part of the historical inventory are given a spatial probability of 1, this includes modeled areas that overlap with the historical events. The spatial probability of the simulated debris flows that do not overlap with past events, are calculated by dividing the total area of the historical events of a given return period scenario by the total area of the modeled debris flows of that scenario (Hussin et al., 2014b). In the text, we will include this better explanation.

- *Page 4025, line 24, please provide a definition of a "qualitative impact-probability matrix".*

We will include a short explanation of the matrix approach. The matrix illustrates the levels of impact and probability in the form of a 2D matrix, allowing to rank the risk in classes qualitatively (for example, high or low).

Comments on the figures:

- *Figure 1. What is the difference between "user" and "group"? Is this discussed in the text? Where does "hazard" appear in this figure? The symbols for the data management module are not that clear – perhaps these could be labelled.*

We have not discussed "user" and "group" in the text. By meaning "group", various stakeholder groups can be involved in the later stage of the decision-making process in the platform, while this risk analysis tool is intended mainly for expert users (risk managers). The "hazard" symbol was represented in the data management module, which is the leftmost icon with a river. We could label these symbols for better clarification.

- *Figure 3. The caption needs work – it is hard to understand what A1 to A4 mean from this caption.*

A1-A4 represents the area derived from the loss calculation of four return periods. Each A1-A4 contribute to the risk total of the considered hazard event (e.g. debris flow). We will revise the caption accordingly.

- *Figure 4. Needs a legend – e.g., what do red and green mean, what do yellow buildings and yellow buildings with a blue outline symbolise? Why are there different vulnerability curves and how are these used – this could be added to the figure caption.*

We will include a legend for the symbolization. A reference letter for each mini-figure in Fig. 4 will be included, so that we can refer to them in the caption more easily. For example, "(c): Comparison of the Fella debris flow vulnerability curve with existing ones from the literature." The different vulnerability curves come from various

studies and are illustrated as an example in the figure for a local study area. For example, building vulnerability value for a certain intensity level of debris flow (i.e. deposit height at the location of the affected building) are extracted to obtain the degree of loss of that particular building.

- *Figure 5. Needs a much more detailed figure caption. You sometimes switch between full words and notation, which is confusing (e.g., spatial probability versus SP) – please be more consistent. Without going back to the text, some things are not clear – e.g., "amount" (of what?), "column" (of what?).*

Thank for the suggestion. We will revise the figure accordingly and include the full notation of the terms.

- *Figure 7. Again, the caption needs to be more standalone – it is difficult to look at this figure and understand what is going on without having to read the text in detail. It also appears that the text in bold is not actually the text that should be emphasised – I think column one of each table is more relevant? Each table needs column headers – e.g., what do things like «pk nn» mean?*

This data model figure was generated using the pgmodeler software. There are three types in the table:

1. Actual column header names (e.g. haz_id in the 'hazards' table)
2. Type of these column headers (e.g. serial number)
3. Attribute of these column headers (e.g. «pk nn» is the primary key of the table and null values are allowed for this column attribute)

We will include a good caption explanation in the revised version.

- *Figure 8 (and relevant section of text). Legend – the word "value" needs replacing with a variable name – i.e., what does 35 Kpa refer to? It would seem unlikely that all of these debris flows would fail simultaneously. Is this dealt with in the model? It would be useful to include a brief (couple of sentences) discussion about this.*

We think the reviewer meant to refer to Fig. 10? We would update the legend accordingly. The debris flow maps were modelled and carried out by Hussin et al. (2014b). It is not a physical based model, but an empirical regional scale model with some limitations that gives only run-out extent. By using the expert based approach and comparing with past events, we gave these run-outs impact pressure intensities. The modeled debris flows have not all occurred, but they are all the possible debris flows that could occur in the study area if they would be triggered, based on a susceptibility analysis of the most likely areas to be debris flow sources in the future. Their intensities (including run-out distance and extent) correspond to similar events with a return period scenario that have occurred in the past. We will include a brief explanation of this in the paper.

- *Figures 12, 13, 15, 16, 18, 19 I do not think that all of these figures are necessary. Please consider combining some of them into two-part figures where A and B can be placed next to one another (this may require you to add some larger font labels), or using supplementary material.*

Fig. 12, 13, 15, 16 and 18 represents the interfaces and processing steps done in the platform. As kindly suggested, we could try to combine them into one figure (side-by-side). In that case, the figures might not be quite readable. Otherwise, we would consider putting them as supplementary materials. For Fig. 19, we think it might be better to remain as it illustrates the final results of the calculation process.

- *Figure 17. Needs a legend.*

We will update the figure with a legend for the styles used for the visualization of layers.

Minor comments:

- *Section 2.3, I see that Reviewer #1 has provided more substantial comments here. As this is section is rather reliant on the reader having some background in geocomputation, for non-experts, I think it would be useful to have one summary sentence stating why this approach is used or why it is different from existing approaches.*

As suggested, we will include a summary statement in the revised version. Please also kindly check the response given to the reviewer#1, for more information.

- *Several places where plurals are used when it is not necessary. E.g., page 4009, line 4 "rainfalls"; line 6 "constructions"; page 4011 line 5 "openstreetsmap". I have not caught all of these, but please go through and check carefully.*

Thanks for the correction. We will check all again.

- *Page 4017, lines 21-24, is this description of how the data is managed a contribution to scientific knowledge (i.e., is this novel?). If not, perhaps this could go in the user manual.*

We think this description might be useful for the open-source community (and interested readers) of how the process was carried out programmatically and technically, if such a similar problem was to face. We have also provided a detailed explanation to the reviewer #1.

- *Page 4011, line 23, should read "The purpose of the loss component. . ."*

Thanks for the correction, we will update accordingly in the text.