

Interactive comment on “Assessing road segment impact on accessibility to critical services in case of a hazard” by Sophie Mossoux et al.

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Comment 1: The greatest doubt is in the way in which the Road Hazard Exposure is estimated. In the chapter Road Hazard Exposure authors state: “referred to as susceptibility here, is defined by summing up the normalized probability values of all pixels underlying the road segment, the exposure to hazard is strongly influenced by the segment length (Figure 7). Short segments as observed in the capital and in most villages (e.g. Koimbani - Figure 7) will have low susceptibility values, even if the area is highly exposed”. Instead of the sum of the probability value on the road segment, other metrics to evaluate the susceptibility could be more appropriate (ie. Assigning the modal value of the probability to the segment or an x percentile of the probability) producing a result without anomalies related to the high influence of the segment length. I

C1

would like authors reply to this remark also in the paper, or better, they could try to use another metric to estimate the road hazard exposure also in the analysis.

Response: While doing our research we carefully considered how to include road hazard exposure in the modelling. We looked at the possibility of using the mean or median probability of the pixels constituting each road segment, as well as using a percentile of the probability values as a way of quantifying road hazard exposure. In all these cases however no consideration is given to the fact that if a lava flow occurs at one specific location along the segment, the entire road segment will be blocked, and that if two locations along a segment have a high probability of being affected by a lava flow, chances that the segment will effectively be blocked by lava flow will therefore be substantially higher than if high probabilities only occur at one location along the segment. As such longer segments indeed have a larger chance of being affected. We therefore opted for the approach proposed in the paper.

Changes in the manuscript: We propose to modify the text in section 4.1.2 as follows: “Because the hazard exposure for each segment, referred to as susceptibility here, is defined by summing up the normalized probability values of all pixels underlying the road segment, exposure of a segment to hazard is influenced both by probability values at pixel level as well as by the length of the segment. This reflects the fact that longer segments having a chance of being affected by lava flows at different locations along the segment are also more exposed to lava flow hazard and thus have a higher chance of being blocked by one or more lava flows. Accordingly, shorter road segments as observed in the capital and in most villages (e.g. Koimbani – Figure 7) will have lower susceptibility values than some longer segments, even if the area is highly exposed.”

Comment 2: Another issue is related to the value assigned to the road in the northern part of the island. Since the analysis is restricted to the lava flow produced by the Karthala volcano, in the roads of the northern part the value should be “not applicable” and not “no hazard”. I do not think it is acceptable assign the value “no hazard” since in the northern portion of the island there is another volcano, which could subject the

C2

streets to lava flows. In figure 3 it seems that the roads and inhabitants in the northern part of the island would not be affected by the lava flows of the Karthala volcano.

Response: The zero value for hazard exposure for the road segments shown in figure 7 specifically refers to lava flow hazard of the Karthala volcano. We only considered the Karthala in our study since the volcano situated in the northern part of the island (La Grille) is not considered as an active volcano: there is no clear evidence of eruptions during the Holocene (Global Volcanic Program: <https://volcano.si.edu/volcano.cfm?vn=233001>). Since La Griffe is not an active volcano and the road segments in the northern part of the island cannot be reached by lava flows emerging from the Karthala we do not think the use of the nil value in figure 7 is misleading.

Changes in the manuscript: In order not to create confusion we will clearly indicate in the figure captions of figures 7-8 that the values mentioned on the map refer to lava flow hazard exposure of the Karthala:

“Figure 7 – Road hazard exposure map for the Karthala volcano showing susceptibility to lava flow hazard for each road segment with an inset on Koimbani.”

“Figure 8 – Accessibility risk map for road segments combining road access vulnerability based on travel time (s) to the closest infrastructure with road segment susceptibility to Karthala lava flows.”

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