The article addresses a relevant issue for a seismic country as Colombia; it gives relevant information about the seismic risk of the Sabana Centro providence. Nonetheless, there is no novelty on the article and key information is not given in the paper. Results from the selected scenarios indicate consequences of concern not well supported. My main concern regards the selected fragility curves: I find it complex to perform a risk analysis using fragility functions developed by different methodologies and as stated by the authors, with different limit states definitions. I believe this is one issue that requires additional explanation. For example, comparison between fragility functions is not presented. Do the set of curves behave as expected? Information given in Table 5 is not enough. The article should present figures that allows for a visually appreciation of the curves. A brief explanation of the methodologies uses for the curves' development should also be included, as well as an opinion about how reliable the curves are. How can the authors explain that the number of collapse buildings is almost three times the number of buildings with extensive damage? Furthermore, the number of collapse buildings exceeds the number of buildings in any other damage state.

Dear Dr. Ana Acevedo

You kindly spent time delving into our manuscript, and we are grateful. Thank you for your appreciation of the study's performance and writing style and acknowledging the relevant information for seismic risk in the region. Thank you for all your comments. We will do our best to provide a complete answer to all of them.

1. My main concern regards the selected fragility curves: I find it complex to perform a risk analysis using fragility functions developed by different methodologies and as stated by the authors, with different limit states definitions. I believe this is one issue that requires additional explanation. For example, comparison between fragility functions is not presented. Do the set of curves behave as expected? Information given in Table 5 is not enough. The article should present figures that allows for a visually appreciation of the curves. A brief explanation of the methodologies uses for the curves' development should also be included, as well as an opinion about how reliable the curves are.

R/: Thank you for your main comment. We agree with your point. Other reviewers also raised their attention to this fact. Therefore, for consistency in the revised version of the manuscript, we decided to use only analytical fragility functions. Most of them were those calculated by Martins and Silva. (2021) and Villar-Vega et al. (2017). These functions are analytical and all of them use the same modelling approach. We used these functions for several buildings, with some exceptions such as the thin reinforced concrete buildings, for which we kept the fragility functions developed by Arroyo et al. (2021), because these are also analytical and use a more accurate mathematical model for these types of structures which allows capturing local behavior of the walls. We kept the comments about the issue that the fragility functions by Martins and Silva. (2021) were not developed accounting for the particularities of Colombian construction.

2. How can the authors explain that the number of collapse buildings is almost three times the number of buildings with extensive damage? Furthermore, the number of collapse buildings exceeds the number of buildings in any other damage state.

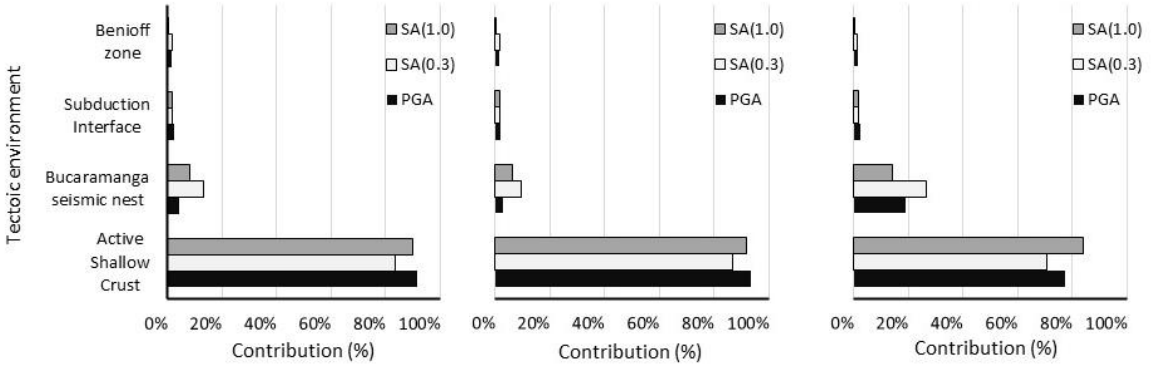
R/: We will update the discussion in the revised manuscript, with the results obtained using a new exposure model and the set of fragility function described in the answer of comment # 1.

Regarding the question of about the number of collapses in the initial manuscript, in the scenarios developed using the initial selected set of fragility functions, the intensity measure for several earthquakes was in the range where collapse had the highest probability.

Additional comments:

3. Why do all the scenarios are crustal shallow events? In the article it is mentioned that for SA (1.0s) there is an important contribution of subduction events. As the number of scenarios is important (18) some of them should be subduction events.

R/: We looked at the contributions by tectonic environments to the seismic hazard at the PGA Sa (0.3) and Sa(1.0s) In figure 1 it is possible to observe that the seismic hazard is controlled by active shallow crust events, being its contribution greater than the 75% in all the municipalitie1s. Moreover, at the PGA it is greater than 90% for municipalities like Chía and Cajicá, where a significant number of one and two-story building concentrate. The contribution of the Bucaramanga seismic nest is more relevant in the municipalities at the north of the region in Cogua, Nemocón and Zipaquirá. In such cases, the contribution of the Bucaramanga seismic nest is around 25%. Based on this, we decided to keep the eighteen crustal scenarios and run one from the Bucaramanga seismic nest. We would like to point that the damage results for this scenario are low (collapses range between 0.1% and 0.2%).



Cajicá Chía Cogua

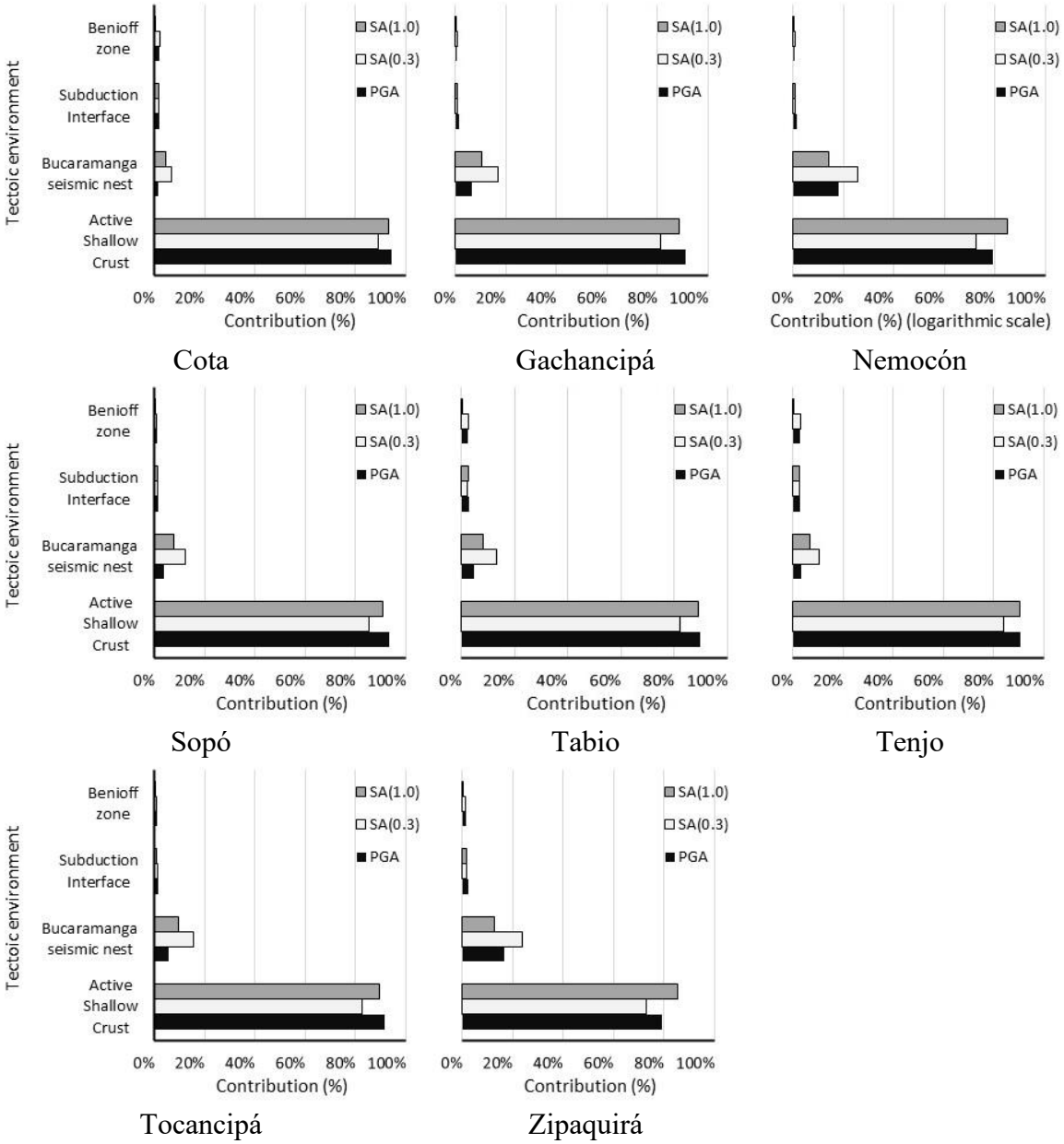


Figure 1. Contribution of tectonic environments to the seismic hazard of the Sabana Centro municipalities

4. The authors mentioned the use of population census data to infer the number of buildings added to the original exposure model of SARA. It is not clear why the authors did not use the census data to directly obtain the number of buildings. The 2018 Census provides relevant information that can be used to have a more precise number of buildings.

R/: We appreciate a lot this comment. We used population as a simple and practical process to directly obtain the number of buildings. The census provided information to obtain the number of dwellings. We compared our results with those reported by the 2018 census and the difference is 28%. This difference is mainly because the census considered dwellings

whose wall material is poured concrete and we did not include it since it was not possible to assign a percentage of construction.

Based on your comments and those of the other reviewers, we decided to update the exposure model and use the information of the dwellings in the 2018 census instead of the one based on population. Nonetheless, we think if worth highlighting that in the absence of census information, inferring based on population can provide a result with a moderate degree of approximation.

5. How was the building typology assigned to the added buildings to the original exposure model?

R/: Initially we updated the number of buildings keeping the same typologies and the same relative percentages between building typologies. Based on your comments and those of the other reviewers to have a more reliable estimation we decided to update the exposure model following the methodology used in Yepes-Estrada et al. (2017), where taxonomies are assigned according to the materials of the walls and roofs of the dwellings. The information used for this process was obtained directly from the census data.

6. Which replacement cost did the authors use? The authors only mention that the cost is assigned according to the socio-economic levels, but it is not clear which cost was used and how was it computed: cost per area? Cost per building? It is suggested to include the replacement cost in Colombian pesos as the exchange currency fluctuates.

R/: Thank you for this comment, we have realized that we did not mention it in the manuscript. We have used the cost per building. We will include a sentence mention that is the cost per building, and we will include the replacement cost in Colombian pesos.

7. It is not clear how the information of the base exposure model (SARA) was complemented with the information of the 6249 surveys. Furthermore, all these buildings belong to the same municipality. A description of the buildings characteristics of each municipality should be included.

R/: We used the information of the surveys to update the percentage of the taxonomies only in the municipality of Chía because we had remote field surveys of this municipality that were conducted by students of Universidad de La Sabana. We will include a sentence clarifying this procedure.

8. The authors mention that 8.24% of the stock are wood buildings. How does this information compare to the Census data? (The Census provides information about building's wall material). In addition, the authors assigned a fragility function for wood buildings developed for Chilean buildings. Although the reference of the fragility functions used for wood has not yet been published, it is not clear that Colombian wood buildings have the same seismic behavior as Chilean wood buildings. A support for the use of Chilean wood fragility functions is needed.

R/: In the previous exposure model we only compared the total number of dwellings. For the updated exposure model we used the census data which includes walls and roof materials. This allowed us a better estimation of the total number of buildings for each taxonomy.

In the case of wood houses, we decided to use the fragility curves calculated for Chilean buildings. These curves were developed by the authors using detailed drawings of Chilean houses, which are similar in configuration to the wood houses found in Sabana Centro. Regarding the method, we used a single DOF oscillator. In general, the wood houses found in the field surveys in the region have good quality materials and adequate construction, thus we consider that the fragility curves used are suitable.

9. It is not clear why the authors use only two building heights: 1 and 4. Does the exposure model only comprise building with 1 and 4 stories? Or does the exposure model have buildings of several number of stories, but the authors decided to group them in just to building heights? Whatever the option, for a region where most of the buildings are low-rise buildings (as stated in the paper) a differentiation of number of stories is very important.

R/: Thank you for this important comment. Other reviewers also raised their attention to the need of updating the exposure model, further discretizing between building heights. We agree specially that the difference between one- and two-story houses is significant. Based on this comment and the other reviewers' suggestions, we decided to update the exposure model using information of the 2018 national census, with further differentiation between building heights. To discretize the building height, we used information collected using remote and field surveys of 9000 houses in the Sabana Centro region, conducted by students of Universidad de La Sabana. We found that for houses between 1 and 3 stories, 34% are one-story houses, 48% are two-story houses and 18% are three-story houses. Accordingly, we updated our exposure model.

In addition, we decided to use the fragility functions calculated by Martins, which all use the same modeling approach, and they account for the differences in height. Furthermore, we also updated the discussion section, including the suggested reference and the above-mentioned facts.

10. Results should include the uncertainty as 1000 ground motion fields were generated and two GMPEs were used.

R/: Thank you for this recommendation. We will include statistics in the updated version of the manuscript.

11. The taxonomy MCF/DNO/H:1 is not correct as it is missing the lateral load resisting system.

R/: Thank you for noting this omission. We fixed this in the updated manuscript.

12. The taxonomy CR/LFINF/DUM/H:4 is used for buildings constructed using thin RC walls. This is not the original definition in the GEM taxonomy. It is suggested to use a different taxonomy.

R/: Thank you for this observation. We will use an appropriate taxonomy consistent with the GEM methodology.

13. The taxonomy W/H1 is missing the information about the lateral load resisting system and the ductility level.

R/: Thank you for noting this omission. We fixed this in the updated manuscript.

14. It is not clear why the authors present mean values for the 18 seismic events. As each scenario has a different epicenter and different consequences mean values are not representative (results for each scenario should be presented by themselves). See Table 19 and Figures 10 and 13.

R/: We appreciate this comment. We agree that 18 scenarios are not enough to represent 100% of the hazard. We should though mention that the selected scenarios do represent a significant percent of the contribution to the seismic hazard, as the examination of figure 4 of the manuscript can reveal, particularly for the PGA. We added this comment in the corresponding section of the revised manuscript.

In the light of the comment, we decided to remove table 9 and instead include a figure that shows the statistical variability of each damage state for the eighteen scenarios. We also decided to remove Figure 13. We kept figure 12 but we improve our analysis of this figure. The main point here is that Sabana Centro has an uneven distribution of the building stock, therefore, similar earthquakes with the same magnitude and similar depth such as the Mw 6.25 Sopó, Mw 6.25 Tabio and Mw 6.25 Nemocón have different consequences in terms of economic losses.

15. The sentence of line 410 “One out of four buildings will experience extensive damage or collapse” is a strong conclusion that requires a big certainty to be written. I suggest the authors to revise the fragility curves of the masonry buildings (as most of the buildings are of this typology) and to compare the ground motion fields with the building damages to be sure that results are correct. Furthermore, as all the buildings form this typology are one-story buildings results should not be as bad as shown in the article.

R/: Based on this comment and the other reviewers concerns about not discretizing between the height for buildings in the range of one to three stories, we decided to update the exposure model using information of the 2018 national census, with further differentiation between building heights. In addition, we decided to use the fragility functions calculated by Martins and Silva. (2021), which all use the same modeling approach, and they account for the differences in height. Furthermore, we also updated the discussion section, including the suggested recommendation and the above-mentioned facts.

16. Line 440. The authors mention “the damage and losses estimates presented in this study should be considered as lower bound”. See the previous comments.

R/: The statement refers to the fact that existing fragility functions do not account for the informal construction practices which are common in the Sabana Centro region.

17. Figure 4. Add a color scale. It is difficult to read the percentage associate to each bin.

R/: We added a color scale to the figure

18. Figure 9. It is suggested to include the earthquake epicenter as well as a figure with the ground motion field generated by the event.

R/: We added a figure with the epicenter and the ground motion field.

19. Figure 11. Expected losses including SVI should be greater than the expected losses without SVI. This is not shown at Chía and Sopó. For the ease of understanding it is suggested to use the same color scale in both maps of the figure.

R/: We updated the figure with the same color scales.

20. Figure 12. It is suggested to include the uncertainty in the figure.

R/: We did not include uncertainty in this figure; however, we did include a new figure in the paper to represent the variability in the damage and losses.

21. Table 2. Add the distance for the epicenter to the study area. Complement the information with a figure in which the epicenters are shown. As the events have an associated municipality, is the epicenter located at each municipality? How feasible is this? Results indicate important consequences that can be misinterpreted if the article does not mention the possibility that such events occur with epicenters in each municipality.

R/: Based on your suggestion and other reviewers’ comments, we replaced table 2 with a figure that includes the location of the epicenters. We also clarified the statement about the epicenter location.

22. Line 179. How does the “significant number of low-rise stiff buildings” relate to the selected crustal events?

R/: Thank you for this comment. We realized that the sentences is clearer if we limit the discussion to the dissagregation (Figure 4 in the paper), which shows that the highest contribution to the PGA comes from crustal events with magnitudes that range between 5.0 to 6.5 and distances smaller than 30km. We updated the paper removing the sentence quoted by the reviewer.

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