Reply to the comments of the Anonymous Referee #2

Dear reviewer,

Thanks a lot for your valuable time and comments that help us to improve the manuscript. We have substantially revised the paper following your recommendations. In the next pages, we answer all your questions. We chose the following format to answer your questions:

- Question/comment from the reviewer (**in bold**)
- Lines in the manuscript where the answer is addressed (in red color)
- Answers or replies from the authors (no special format)
- New paragraphs added to the manuscript (*in italic font*)

We are at your disposal for any further information and well satisfied after improving our manuscript by adding new plots, figures, and references. These changes are commented below, in our reply.

Kind regards,
Marisol Monterrubio-Velasco and coauthors.

1. **The motivation in the Introduction was not clear. It is pretty odd to have such a long paragraph, with inserting bullet points on specific regional settings. It is very difficult to get the major points of this study, and what might be innovative compared with previous approaches that had been carried out in the same region. I feel that rewriting the Introduction is necessary, and recommend the following structure based on my reading. You may start from the significant of G-R law on probabilistic seismic hazard analysis, but it is necessary to highlight why synthetic seismicity distribution is important (the major point to deliver in this study).**

   → see Introduction

We have restructured the introduction following the reviewer's comments, and now explicitly clarify the work's motivations at the end.

2. **For a region that has very few earthquakes, it is straightforward to produce synthetic seismic distribution. But for the Mexican subduction zone where earthquakes are frequent, with recent great earthquakes (M>8), why is it significant and necessary to conduct such synthetic GR law analysis ?**

   → lines 126 - 133:

In the lines 126 - 133 of the revised manuscript, we have answered this reviewer's question.

In this work, we focus on the Guerrero-Oaxaca (SUB3) region, because this region provides an ideal setting for testing the single asperity paradigm with the aid of TREMOL. Moreover, the quality of the database allows us to validate our code, giving support to the extension of our numerical experiments to other regions where few registered earthquakes due to scarce seismic networks. In this sense, our study pretends to be useful to generate synthetic seismicity that allows completing databases in order to carry out more accurate PSHA studies. Also we consider that our study could be appropriate to study different configuration of seismic scenarios, for example occurrence of large past events without records, or future events with a significant hazard as the case of the Guerrero gap.

3. **Then you can highlight the importance of asperities and the effects of aspect ratios of asperities on GR law. If it has not been considered in previous synthetic seismicity generators, it serves as a natural innovative point of this study.**

→ line 124 - 125

Thank you for the recommendation, we now have stressed the contribution of our model in this field in the referred lines.

4. **It will be very helpful to explain how the asperities were identified in different subduction zones that were mentioned in lines 35-40**

→ lines 104-107

Somerville et al (1999) defined an asperity as a region on the fault rupture plane that has large slip and strength relative to the average slip on the fault. An asperity encloses fault elements in which slip is 1.5 or more times larger than the average slip. The revised version includes a similar explanation in lines 100-106 (pasted below).

"Following Somerville (1999) asperities are defined as regions of irregular shape on the rupture plane at which slip is 1.5 or more times larger than the average slip. Accordingly, Rodríguez et al., (2018) use finite-fault solutions reported for the Mexican subduction zone to estimate effective dimensions, average displacement, the combined asperity area to effective rupture area ratio, among other parameters."

5. **Why do they have anything to do with TREMOL, which was first introduced in line 41?**
   The statement here was really disjointed and should be rewritten.

We rewrite this phrase

6. **Overall the grammar in the manuscript is OK, but there are lots of fragmented and/or long sentences, which are sometimes awkward to read. For example, the first sentence in section 2 contains "low magnitude previous events", which should be "previous low- magnitude events". Many other words share the similar problems and need a thorough editing work.**

Thanks, we have carefully revised the grammar throughout the whole manuscript.

7. **Some texts/paragraphs should belong to Introduction or Discussion, but were mixed in different sections. Here I listed a few, but not all of them. Line 59-61: statement of asperities should be moved into Introduction. Some descriptions in section 3 could be moved into Introduction as well.**

Thanks again, we have moved and rearranged some paragraphs accordingly, and believe that the new version considers your comments.

8. **For the results, I think the implications of Figure 12 are important on earthquake physics. What are the potential underlying physics that lead to such transition of GR distribution to a more characteristic earthquake pattern?**

→ please see lines 362 - 375.

We added a paragraph including a possible explanation related to what we observe in the numerical results and the real seismicity behavior.

9. **Figure 2-4 can be either merged together, or grouped together to better illustrate the locations of observed seismicity.**

   Done. Figs 2-4 have been grouped together in the new and self explanatory Fig. 1

10. **I suggest deleting "for any type of" in the first sentence of the abstract.**

    Done.