Reply to the comments of the Anonymous Referee #1.

Dear reviewer, thank you in advance for your valuable time and help. We are very grateful for your comments. All the questions are addressed in the next pages. We took everything into consideration and we have revised the paper following your recommendations. The following format of answering the questions was chosen:

- Question/Comment (from the reviewer)
- Answer (reply from the authors)
- Changes (new/modified text added to the manuscript in **red**)

We are at your disposal for any further information and willing to improve further our manuscript by adding the considerations provided in our reply.
Kind regards,

Monterrubio-Velasco et al.

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Question / comment

The paper is generally hard to read. The authors frequently go from one topic to another without explaining the underlying theme that brings the paper together in the end. That is also clear in the abstract, which is very technical and the aim of the paper it's not mentioned at all. The aim is mentioned at the end of the introduction in line 14.

Answer

The grammar in the manuscript is improved. We have restructured some sections to make it easier to read, in particular the results section. Moreover, in the abstract we include briefly our objectives.

Question / comment

I understand the distinction between π_{frac} and π_{bcg} however I don't think this is fault geometry. Fault geometry usually implies information such as dip which is not taken into account here. It is more like topographic location on a map.

Answer
In our model the faults are not described with a typical 3D geometric measures (dip, strike, and slip). To introduce the fault system geometry we assume some cells to be weaker than the rest representing faults in the bidimensional array. This "weakness" is assigned by one single parameter called π_{frac}. We include this description in different sections along the manuscript

Question / comment

In large earthquakes such as Northridge, it is shown that the aftershock sequence is incomplete. This is a phenomenon termed as Short Term Aftershock Incompleteness (STAI). Since missing earthquakes have a direct impact on the fitting GR law , b value. . . how is this model affected by this?

Answer

Davidsen and Baiesi (2016), define the Short Term Aftershock Incompleteness (STAI) as a phenomenon arises from overlapping wave-forms and /or detector saturation, such that events are missed in the coda of preceding ones. One important consequence of STAI is an increase in the local magnitude of completeness, since small events are not well recorded.
Related with this definition, in this work we are not analyzing the STAI phenomena. We use the Northridge catalog obtained by the Southern California Seismic Network (SCSN), and we analyze it as a "final" catalog. In our statistics and analysis applied to the real catalog, we consider different magnitude cut-offs, as is seen in Table 3 in the manuscript. The cut-off magnitude are not related with the time.
On the other hand, is worth to note that our model is not affected by the STAI, because this phenomenon arises from overlapping wave-forms, and in our approach we are not considering explicitly this physical process. To modify the minimum magnitude in the synthetic catalogs we only filtering the events with small rupture areas.

Question / comment

Line 16 : define negligible magnitude , based on what criteria is negligible?

Answer

The algorithm of the model are defined in three process. The first one is to producing load accumulation, the second is to rupture the chosen cell, and the third is sharing the load to the neighbors.
In this model version we only simulate the seismic aftershocks. That means that we are not adding external load, after the initial load distribution. During the rupture process, the model produces two different types of events, namely “avalanches” and “normal” events to keep producing the accumulation,rupture, and distribution. However, we consider that from these two rupture types, the “avalanche” events are conceptually the rupture type that describes the physics of the earthquake rupture processes. To produce an “avalanche” event a “cell” (or individual element) has to overpass a load threshold, similarly than in seismic events where a threshold value (as the friction) also must to be overpassed. On the other hand, "normal" events are produced to keep the dynamics in the model, and we consider that are not simulating the inner physics of the earthquakes. So, in that sense is because we define the normal events magnitude as “negligible”

To visualize it, we plot in Fig. R1.1, an example of the Gutenberg-Richter (GR) relation for 5 different series considering as example one synthetic catalog. The first curve (in black markers) the series includes all the simulated events, "normal" and "avalanches". We observe that the number of events with the lower magnitude (rupture of one cell) produced by a large number of “normal” events aparts away from the curve. The second series considering all the avalanches-events including that ones of one cell size (blue points). The third case depicts the frequency-magnitude of the avalanches with a minimum of two cells size. And the third, and fourth are the curves for avalanches with a minimum size of 3 cells and 6 cells, respectively.

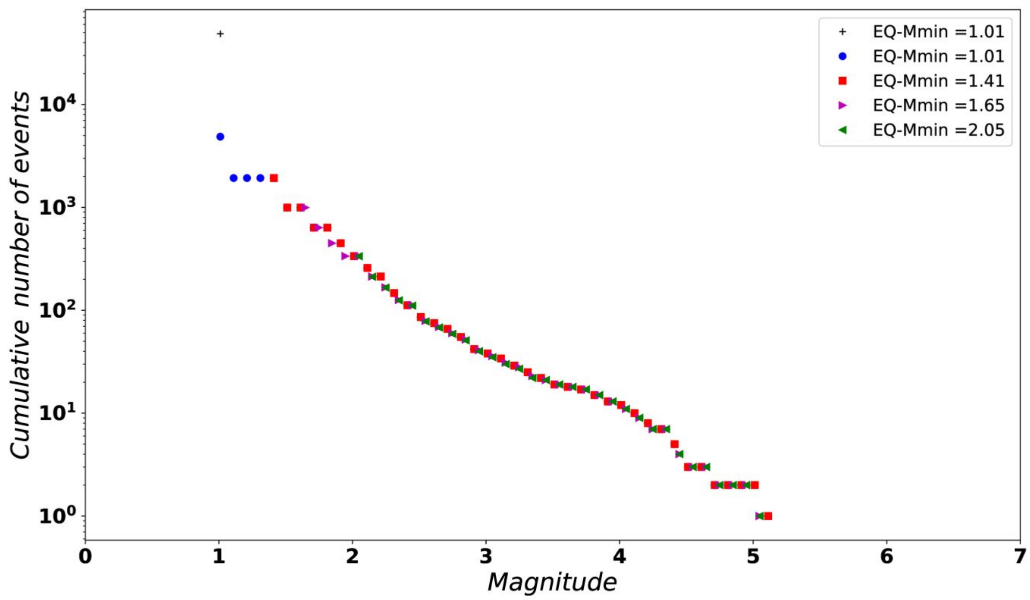

Figure R1.1. Synthetic frequency-magnitude curves considering five different minimum cut-offs areas. The equivalent magnitude is computed from the Hanks and Bakun (2008) relation.

Question / comment

Line 26, the seismic moment is Mo

Answer

Yes.

Question / comment

In section 5.1.2 , line 13, approaches what? I think the whole section is unclear. Explain what are the theoretical values and non conservative properties.

Answer

In order to give a better explanation of the results we restructured the whole section.
We refereed that the b-values finded approaches to that reported for Northridge sequence, we modify the phrase to leave it complete.

Theoretical values are the values commonly reported for the b-value (*e.g*. El-Isa, Z. H. & *ref. there in*). The non-conservative properties are referred to the parameter π_{frac} . For example, the extreme value π_{frac} = 1, means that the load of the failed cell is fully share to their neighbors, and there are not dissipation (100% conservative). On the other hand, values of π_{frac} <1, indicates that the percentage (1- π_{frac}) is lost out the system. In these cases we incorporate load dissipation, i.e. a non-conservative process.

Question / comment

Since the model is dependent on the minimum magnitude, missing events could affect your model parameters.

Answer

Usually in statistical seismology the completeness of a catalog is a important value to evaluate their behavior and to analyze its parameters. As we modify the minimum magnitude in the frequency-magnitude relation, for example in Figure R1.1, we could estimated different *b*-values. However, from a minimum magnitude value, for example $M_{min} \geq 2.0$ (in Fig. R1.1), the *b*-values remains similar. Also, as the cut-off of M_{min} increases, the number of events decreases, and part of the information is loosed. So, a compromise between the M_{min} and the number of events has to be found.

Question / comment

Some typos, missing references (appearing as ?) and very long sentences throughout.

Answer

Thank you for your comments and observations we try improve the mistakes and the lack of information, see the new manuscript.

Additional references

El-Isa, Z. H. (2018). Frequency-Magnitude Distribution of Earthquakes. In *Earthquakes-Forecast, Prognosis and Earthquake Resistant Construction*. IntechOpen.

Davidsen, J., & Baiesi, M. (2016). Self-similar aftershock rates. *Physical Review E*, *94*(2), 022314.