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Comment on nhess-2021-306

Anonymous Referee #1

Referee comment on "Geologic and geodetic constraints on the magnitude and frequency of earthquakes along Malawi's active faults: the Malawi Seismogenic Source Model (MSSM)" by Jack N. Williams et al., Nat. Hazards Earth Syst. Sci. Discuss., <https://doi.org/10.5194/nhess-2021-306-RC1>, 2021

Content of the article :

In the manuscript, the authors present a seismogenic source database for Malawi and surrounding regions. The database contains information concerning both the 3D geometry of the faults and their activity. A special care is given to the estimation of the slip rate of each fault structure and the underlying uncertainties. Three types of seismogenic sources are presented : sections, faults and multifaults. For each source, an estimation of the slip-rate and the magnitude of earthquakes that can be hosted by the source is given. All the results presented in this study are easily accessible in an online repository.

General comments :

In the introduction, the authors give a good description of the use of fault databases in the framework of seismic hazard and risk assessment. While the results of this paper, in the shape of a seismogenic source database, are a major component of seismic hazard assessment, there are not seismic hazard results themselves. Therefore, my opinion is that the title of this paper should be modified and the words "seismic hazard" should be

removed, since no hazard results are presented in the paper.

In order to allow the results of these study to be used in a PSHA study, the way the weighting of the different source types should be done needs to be better discussed. It is not clear how the earthquake rate from the different source types should be combined. Should the weighting be done in order to fit a given MFD for the entire system? I would be useful if the authors added a section in the discussion part of the article to clarify this point. If possible, a comparison of their computed earthquake rates with the rates calculated using the earthquake catalogue could be added.

Specific comments :

Line 169 – I suggest modifying the term “statistical treatment” by “exploration”

Line 218 – Simplifying the surfaces of the faults is a potentially impactful hypothesis in terms of hazard assessment. The change in the surface can both affect the moment rate estimate for the fault and the distance taken into account in the GMPEs. While it is possible that the complexity observed in the fault trace might not be present at depth, the straight line is the other end-member of the possibilities for the fault surface. Why not let the final user of the database, the hazard modeller, choose the level of simplification to be applied? Especially since modern PSHA codes can now handle rather complicated geometries.

Line 230 – Would it be possible to add the uncertainty on the dip in the database ? This parameter can be source of large uncertainties in the hazard levels, and since the knowledge of the dip is not uniform in the system, adding the uncertainty on each fault could be useful.

Line 278 – Simplifying the fault system by removing splay faults also implies to consider that the whole deformation is accommodated by the main fault. Since the metrics used in GMPEs don't usually take into account such details, the impact on the hazard would probably be minimal or within the simplification already made when using a GMPE. However, the impact of the simplification on the deformation should be commented in the text.

Line 441 – A point is missing.

Line 455 – Some underlying assumptions behind these results should be stated here, even if there are discussed later in the article. These recurrence intervals are obtained assuming that the slip-rate is fully seismogenic. It is also assumed that each source can only host on magnitude (for one branch of the logic tree), but other magnitude frequency distributions could be possible.

Table 3 – In this table, it is not very clear if the values are for one specific fault or for the system as a whole. If it is for the system as a whole, can the different lines be read together? For example, is the table saying that the mean recurrence of a M6.8 earthquake is 10900 years?

The legend of the table should be better detailed.

Line 465 - The 5% threshold is probably too severe for this type of analysis. For some fault the two distributions are very similar, and the difference are minimal, sometime affecting only the width of the distribution, but the mean values are similar. The discussion in the following paragraph is probably more useful in order to understand the difference between the slip-rate estimates.

Figure 8 - The authors should add indexes to these figures, so each individual fault could be identified on the map in figure 2 and in the database. Additionally, the t-test result value could be added to the figure, helping to understand the reason why one is accepted and not the others.