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Interactive comment on "Approach for combining faults and area sources in seismic hazard assessment: Application in southeastern Spain" *by* Alicia Rivas-Medina et al.

Anonymous Referee #4

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This manuscript presents an attempt at modeling the contribution of fault sources and zone sources for probabilistic seismic hazard assessment (PSHA). The authors start with explaining the methodological approach used to develop a hybrid model made up of faults and zones and then illustrate an application of this hybrid model in southern Spain. In this application, they also include a classical zone model to compare their hybrid model with.

The basic idea of this work is not new. It is at least as old as the seminal paper by Cornell (1968) on seismic risk analysis. Since then, there have been countless PSHA works that deal with the combination of zone sources, fault sources, and point

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sources. None of these previous works is cited in the introduction, and with much disappointment of the reader, none of them is cited in the discussion. Indeed, not any other paper is cited in these two sections of the manuscript. On the one hand, this has to be regarded as an unethical issue related to the lack of recognition of others' work. On the other hand, this represents a major flaw that prevents the readers to understand what is actually different, innovative, and possibly better in this work with respect to other previous approaches. More specifically, it is very clear that the hybrid model presented by Rivas-Medina and coworkers is surprisingly similar to the Fault Source and Background (FSBG) model presented by Woessner et al. (2015) which, having being applied to all of Europe, obviously also covers the area of the application to southern Spain in this work. The only difference being the fact that Rivas-Medina and coworkers present their approach as if they have just (re)invented the wheel.

As regards the merit of this work, I found it is affected by a number of methodological flaws and possibly some miscalculations that challenge the overall validity of the results. Too many details are also missing to correctly understand how the model is developed and how the application to southern Spain was carried out. Mentioning the use of the software CRISIS is not enough for an explanation of the method and justification of strategic choices.

To be more specific, I'll touch in the following some of the main issues (I use P for the page number and L for the text line to identify the position of the text I'm referring to).

P3L18. The approach by Stepp (1972) for estimating the completeness periods needs various data manipulations that should be explained in more details to let the reader understand and replicate what was done here. This lack of details prevent the reader to appreciate the validity of the results.

P4L16. Here it is stated that the seismic moment rate of faults is calculated by summing up the seismic moment of earthquakes with magnitudes "close to m=0" up to a certain given maximum. To get an accurate seismic moment rate estimate for the

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faults, all earthquakes with moment M0>0 must be considered. Notice that magnitude m=0 corresponds to seismic moment M0=1.27E+09 Nm using the relation by Kanamori and Brodsky (2001). Basically, this mistake leaves out a lot of seismic moment from the moment rate estimate when the Eq. (5) and Eq. (6) are used. This significantly impacts into the correct estimation of the number of earthquakes for which the hazard is then calculated.

Figure 5. Although this figure is not very clear (a map view would have been much better), it shows that several faults are cut by zone boundaries. How was the fault moment rate assigned to the zones in these cases?

Table 3 and Table 4. The b-values reported in these tables are utterly absurd. Are they really the b-values of the GR relation? If not, please explain what they actually are, otherwise I suspect that they result from gross calculation errors. In general b-values are ca. 1 everywhere in tectonic regions all around the world. I've seen b-value estimates in various works ranging from 0.7 to 1.3, but here they are in the range 1.7-2.4 that has never been seen anywhere.

P7L15. The use of the Stirling et al. (2002) fault scaling laws is questionable and potentially the source of additional miscalculations. First of all, which one of the Stirling et al.'s (2002) relationship was used here? Stirling et al. (2002) provide relationships between Mw and either length (L) or area (A). In the second case, A is obtained from L multiplied by an assumed fixed width. In both cases, L is the surface rupture length. Since the hazard model is concerned with seismic shaking that is generated at depth, the surface rupture is not the most suitable observation to relate with. Rather, a relationship between Mw and rupture dimension at depth should be used. The relationships by Leonard (2014) do provide such parameters and are based on a much larger and more updated dataset than Stirling et al. (2002). In addition, Leonard's (2014) would allow for differentiating between strike-slip and dip-slip faults. In all cases, the statement that the maximum magnitude is estimated from the fault geometry is too general. More detailed explanation is needed to let the reader understand and possibly replicate was

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has been done here.

P8L5. Here it is stated that the GMPEs by Campbell (2013) are used. I suspect it is the Campbell and Bozorgnia (2014) in the references. These are GMPE developed for shallow crustal earthquakes in the western US in the moment magnitude range of 5.0 to 8.5. How well do they apply to earthquakes in the range starting at magnitude 4.0 in southern Spain? What criteria have been used to select this GMPE? The paper by Delavaud et al. (2012) delineates a robust procedure to select the appropriate GMPE to be used in Europe, why was this paper ignored? In addition, the GMPEs are different depending on the sense of movement. The QAFI database provides indication of the sense of movement of faults, but how was the sense of movement determined for the zones?

P9L27-28. What is said here does not prevent double counting at all. To prevent double counting every earthquake that is assigned to its causative fault should be removed from the rate estimate of the zone and vice versa to ensure it is counted only once.

The results of the various calculations are very poorly presented. The fault parameter estimates are not provided at all, and other results are provided only in aggregated form. It is thus very hard to judge the validity of the hazard results if the results of the intermediate calculations are missing.

In general, I found the English grammar and the organization of the manuscript to be rather poor. For example, there are sentences in the results that belong to the discussion. I've already commented on the lack of referencing. The symbols used in the equations are never explained. There is often confusion between symbols used for seismic moment and earthquake magnitude (M, M0, m, which is which?). The same also for the b-value (b or beta?). The units in the vertical axis of diagrams in figures 3 and 4 are unclear. Overall, the figure captions do not help much to understand what the figures show.

My conclusion is that this manuscript is not fit for publication. I also cannot see how

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this manuscript can evolve quickly to an acceptable standard for the readers of NHESS and thus recommend it be rejected.

I don't give more technical suggestions here on how to improve the manuscript because they won't be useful until the major flaws are fixed.

References

Cornell CA (1968) Engineering seismic risk analysis. Bull Seismol Soc Am 58:1583–1606.

Delavaud E., Cotton F., Akkar S., Scherbaum F., Danciu L., Beauval C., Drouet S., Douglas J., Basili R., Sandikkaya M., Segou M., Faccioli E., Theodoulidis N. (2012). Toward a ground-motion logic tree for probabilistic seismic hazard assessment in Europe. Journal of Seismology, 16(3), 451-473, doi: 10.1007/s10950-012-9281-z.

Kanamori, H. & Brodsky, E.E., 2001. The physics of earthquakes, Phys. Today, 54(6), 34–40.

Leonard, M., 2014. Self-Consistent Earthquake Fault-Scaling Relations: Update and Extension to Stable Continental Strike-Slip Faults. Bulletin of the Seismological Society of America, doi: 10.1785/0120140087.

Woessner J., Danciu L., Giardini D., Crowley H., Cotton F., Grünthal G., Valensise G., Arvidsson R., Basili R., Demircioglu M., Hiemer S., Meletti C., Musson R.W., Rovida A., Sesetyan K., Stucchi M., and the SHARE consortium. (2015). The 2013 European Seismic Hazard Model - Key Components and Results. Bulletin of Earthquake Engineering, 13, 3553-3596, doi: 10.1007/s10518-015-9795-1.

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