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Natural Hazards and Earth System Sciences
Discussions

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

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Thank you for your comments and remarks, which imply a considerable improvement to the manuscript. We give response to all the points raised by referee 2 below.

General comments We include 33 new references in the document, specially in the introduction. This paragraph is changed, including the appropriate references and explaining the method. The graph of figure 2 illustrates this point. Equations 8 and 9 (new 12 and 13) add cumulative seismic moment rates and cumulative seismicity rates. Both are point values and not functions (as GR curves). The b-value give the ratio between events of different magnitudes and thus it changes the rate of earthquakes produced of

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each magnitude, but not the total earthquake rate nor the total released moment rate. We adjust the b-value that keeps those values (cumulative seismic moment rates and cumulative seismicity rates) constant for each source. We agree with you when you state that the GR curves cannot be just added, as they have different b-value.

Specific Comments References have been included for all cases - P 3, Line 15: We wanted to refer to the fact that when recurrence periods are long, there are a few records of those events in the catalog, and consequently, the catalog presents a small sample, with limited statistical significance to establish recurrence periods. We changed the phrase for: “Magnitude values above MMaxC present recurrence periods higher than the catalogue OP. These values usually constitute a sample that does not include a high enough number of records to clearly establish the recurrence period, as this makes it increasingly difficult to constrain rates for rarer events.” However, we want to indicate that we refer to recurrence periods (as the inverse of the earthquake occurrence rate) and we do not consider return periods at this point of the work (it is considered in hazard calculations). - P 3, lines 17-18: This paragraph is changed, references are included and the method is explained to understand figure 2 better. The reference to Stepp was a mistake that we have changed. - P3, Lines 19-20: We include two equations to explain how both parameters are estimated. However, we want to indicate that we extract these data from the catalog, and we do not assign a GR distribution in this part of the calculation. - P 3, Line 24: The text has been modified: “In this way, we avoid using magnitudes with long recurrence periods that have not been recorded in the catalogue within the completeness periods”. Again, we make reference to recurrence periods and not to return periods. - P 4, Section 2.2: We consider as many faults per region as available in the fault database. All faults are assigned the same b-value and different occurrence rate (as each fault presents different moment rate). We corrected the ambiguity in the manuscript. - P 4, line 12: The slip rate (v), can be obtained from paleoseismicty studies and GNSS measurements. We include a reference to database of active faults providing this information. The shear modulus value is μ = 3.2 $\times$ 1010 Pa (Walters et al., 2009; Martínez-Díaz et al., 2012) - P 4, line

16: The text is modified - P 4, line 26: We do not include events with magnitude below Mmin to estimate seismic hazard, but we take into account the moment rate related to events with magnitudes below Mmin to estimate the seismic moment rate in the interval Mmin-MmaxC. The moment rate assigned to each interval (0- MMin), (MMin, MMaxC), (MMaxC, MMax) depends on the b-value estimated for the fault. Hence, we must take into account this interval until a b-value is fixed. This part is changed for a better understanding. - P 4, line 22: The notation is changed and all parameters are defined - P 5, line 9: A comment is included - P 5, line 14: This topic is answered in "General comments". We remark that we do not equal the GR distributions, but only the total seismicity rate and moment rate, both values are concrete and constant for each source independently the ratio of different magnitudes that are calculated later on. - P5, Section 2.4. The uncertainty analysis focuses on how the input data (seismic catalog and fault database) affect the uncertainty in the end result. Concretely, table 1 shows how the magnitude interval, the number of records and the b-value of the seismic catalog affects the uncertainty in the seismic moment rate of the region, a parameter that will have a strong influence on the final result for all sources. Thus, table 1 only considers the uncertainties of the seismic catalog, which is used to model the seismic potential of the region. The uncertainty related to the input parameters of faults is tackled in the last paragraph of the section. - P7, line 4, line 14: The text is changed and the references included - P 7, line 16: For each fault we obtain a different Mmax, as a function of the length of the fault plane - P 7, line 29: Zone 30 only has 7 seismic records. Any statistical analysis with this sample size is not representative. The text is changed to clarify this point. - P 8, line 13: The text is changed - P8, line 20: A reference is included

Technical corrections - P1, Line 6, P2, Line 18: The text is changed P2, Line 18: We understand that is that fault is active and generates earthquakes with not very long recurrence periods, the events associated to the fault are contained in the seismic catalog. We have rewritten the text to clarify this point. - P 2, line 26: Yes, it is complicated to assign a Mc value non-arbitrarily'. We have changed the text - P2: L28,

P3: L5,10,11, P4: L1,20, P5: L9,19, P6: L11,12, P7: L26. line 9: 'An new' should be 'A new' We have changed the text

Please also note the supplement to this comment:
https://www.nat-hazards-earth-syst-sci-discuss.net/nhess-2018-28/nhess-2018-28-AC2-supplement.pdf

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