

Interactive comment on “Probabilistic seismic hazard analysis using logic tree approach – Patna District (India)” by Panjamani Anbazhagan et al.

Anonymous Referee #3

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Journal: NHESS Title: Probabilistic seismic hazard analysis using logic tree approach – Patna District (India) Author(s): Panjamani Anbazhagan et al. MS No.: nhess-2018-328 The article titled “Probabilistic seismic hazard analysis using logic tree approach– Patna District (India)” utilize logic tree technique to conduct PSHA study for Patna District, India. Authors employ different branches in the logic tree for PSHA calculations to handle the epistemic uncertainties. Although the work is extensive and the exerted efforts are great, this paper still needs many clarifications so it can be accepted for publication. It is not well organized and in many parts, it is non-properly sequenced with non-threaded paragraphs, leaving the reader confused and suffering to catch the idea. The English language of the paper is poor and negatively affects the understanding of many paragraphs. English needs to be revised critically. Abbreviations should be

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mentioned at its first appearance. Avoid to use the same abbreviation for two different terms (e.g. SA is used for spectral acceleration and for study area). What are SSA, MBT, MCT, S60, ...etc. All abbreviations should be defined at their first appearance in the text. All localities, faults and geological structures mentioned in the manuscript should be shown on maps. I could not appropriately follow the seismotectonic part of the area due to the lacking of such illustrations. Now let me provides some other comments in a sequential form: Introduction Page 1, lines 20-21: Which gap? Please provide more explanation. Page 2, lines 3-5: Very accurate sentence, but nothing is carried out in the end. Why this sentence is written here? Page 2, line 27: I could not understand "Maximum magnitude has been determined weighted mean using increment" Geology, Seismotectonics and seismicity of the study area (SA) Page 3, line 8: coordinates here are for a point, it is not for an area. Page 3, line 29: "and published literatures" give references. Page 4, lines 1-3: Authors should show the priority scheme in selecting the earthquake from each data base. I mean if the same earthquake is available in more than one database, which one will selected? Which magnitude scale from which database has the first priority and which has the second and so on? Is the same magnitude scale for the same earthquake at different database yield the same value? All the above queries should be clarified in detail. Please show the start and end time of the catalogue to be able to assess its reliability. Page 4, lines 15-18: Please revise the earthquake numbers in each magnitude range as their sum should be 818 as mentioned in Page 4 line 9. a and b parameters This is the most confusing part of the manuscript. In this section the a and b values are calculated for two regions (I and II). What is the role of these two area and their seismicity parameters in the hazard calculations. The classical method used 178 seismic sources and the zoneless method used 7 area seismic zones. Why this is interfered in the current study. Secondly, the magnitude of completeness should be calculated before evaluating the seismicity parameters as GR parameters should use complete data only. Magnitude of completeness Page 5, line 12: This great difference in the M_c values casts doubt on the calculated values. Please explain why different methods have such different

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outputs. Also justify the great difference in a and b values in lines 17-19. B values of 0.149 and 0.176 are not physically accepted. Again, it is not clear how the authors used the a and b values shown in this section in the hazard calculations? Page 5, line 32: "based on b values" to add 0.5 based on b value, b value should range between -0.9 and -1.0, which is not the case here. Maximum magnitude estimation (Mmax) The authors used the region specific rupture technique to calculate M max and provide it the maximum weight. The technique depends on the ratio between the rupture length and the total fault length. My questions are: 1- Is the seismic record enough to be sure about the above ratio? The answer is definitely NO as the authors themselves clarified when they justify the use of zoneless method, stating that "many sources given in Figure 1 are not well studied to prove its seismic activity". This raises great uncertainty on the maximum magnitude calculated for these seismic sources. 2- Is there any possibility to rupture the entire fault length in one earthquake? Recent studies suppose that the entire fault length will be ruptured in one earthquake when calculating the maximum earthquake. 8.1 classical approach Page 9, line 27: Authors used 178 seismic sources. The seismicity of many of these faults are not well studied. It is not clear how the seismicity parameters are calculated for each single source. It is well known that GR model cannot be used to calculate a and b values for single faults. Slip rate could be used but with many not well studied sources, the results should be at least uncertain. Using logic tree does not mean ignoring use the right input parameters for each method. Zoneless approach Page 10, line 27: use return period instead of "frequency of exceedance" Four models (figure 4) using zoneless approach (Frankel, 1995) Page 11, line 15: the return period 85 years (of what? This is most probably PGA) Page 11, line 19: From which model the deaggregation plot is calculated? Or the authors used weighted deaggregation values based upon the weights given for each of the four models. This should be very clear. Authors should explain why the results of the two methods are completely different in terms of hazard values and terms of the change in the spatial distribution (many low hazard areas in one method show very high hazard in the other method). This should be justified, as it is not enough to say for this the

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logic tree is created. A mistake could be done in the calculation or a method is not adequate for the region. Therefore, it is better to justify the use of zoneless methods. Page 12, line 5: Please add for 10% probability before "The PGA values" Final hazard map using logic tree Page 12, lines 26-27: As the high hazard values are related to the East and West Patna Fault, then, why the classical hazard values which are more related to the faults show very much less values?? Authors compared their final results with previous studies. I recommend to compare the results of each method with the recent observations and with the previous studies to show a reason why the results are very inconsistent. If the current results are accurate, authors should recommend to change IS 1893 (2002) in Patna as the current hazard values highly exceed its summit. Figure 1 is very unclear and need to be provided in a higher resolution way.

The manuscript should be thoroughly and meticulously revised and minimize self-citations and refer to more original, only essential published articles.

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