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Natural Hazards and Earth System Sciences
Discussions

Interactive comment on "Quantification of uncertainty in rapid estimation of earthquake fatalities based on scenario analysis" *by* Xiaoxue Zhang et al.

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General comments This manuscript is not ready for publication in its current form due to both considerable grammatical issues and scientific limitations Response: This method is not purely for China, because the model data is used in China, so the results of some parameters are for China. But if we use other countries' data, we can adjust the parameters according to the method. And the difference between earthquake casualties is very large, so the different models are to consider the difference between time and space. And Grammar, punctuation and formulation issues have been improved. Specific comments 1.The Abstract does not provide any useful

information about the study nor the model presented. Response: In the abstract, we stated the process of building the model and the superiority of the model in the result validation. 2. An early, key description of the methodology is particularly opaque to the reader: Response: I had made amendments in the manuscript text, please see in <Introduction> section, line 70-77, page 3. 3. Or, also early in the manuscript: L92. A basic scenario combination can better express the relationship between the parameters and earthquake fatalities. Then, information diffusion theory was used to diffuse the sample data based on the basic scenarios considering the temporarily no measurable factors and the extreme event under each scenario." This reveals very little to this reviewer. It is difficult to sense of either sentence. Please rewrite. Response: I had made amendments in the manuscript text, please see in < Basic earthquake emergency scenarios > section, line 96-101, page 4. 4. Later on, L155: However, when dividing the samples into each scenario, the sample size will be small, and it is difficult to obtain the relation equation using traditional mathematical statistics. Therefore, the indirect approach of this study consisted of information diffusion theory to obtain the mortality rate. If traditional statistics can't be used, isn't the problem is ill-posed? Explain why diffusion theory would change this? Response: The information diffusion theory is a domain-specific information distribution theory for small sample problems. It can expand the sample and obtain the probability of occurrence of a particular domain. The specific theory is shown in the formula (1-3) in this paper. 5. L30. At present, the methods for estimating earthquake fatalities mainly include analytical, semi-analytical and empirical models (Federal Emergency Management 30 Agency (FEMA), 2005). à Quoting an outdated 2005article for "present" methods do not seem appropriate. Response: I had made amendments in the manuscript text, please see in <Introduction> section, line 30-34, page 2. 6. L47. Jaiswal et al. (2009) established a mortality model based on population distribution according to rebuilt earthquake case scenes and studied regional earthquake cases (Jaiswal et al. 2010). In additional to grammatical problems, this does not adequately explain those Jaiswal et al studies. Response: I had made amendments in the manuscript text, please

see in <Introduction> section, line 40-49, page 2. 7. L50. Generally speaking, the current empirical model for fatality estimation is derived from available historica ldata and relies on parameter regression analysis. This implies that the prior reference to Jaiswal et al (2009,2010) are parametric regression studies (as are the earlier studies cited). That is incorrect. Jaiswal's studies are significantly more advanced in terms of hazard input (ShakeMap) and empirical model building than those proposed in the current manuscript, at least from what I can glean from the descriptions herein. Response: We want to express our approach is different from the traditional empirical approach, not based on parameter fitting, not to negate previous studies. I had made amendments in the manuscript text, please see in <Introduction> section, line 40-49, page 2. 8. L52. First, it will ignore extreme events when there is lack of historical data. Second, most models consider fewer factors and do not consider the influence between know factors and possible unknown factors. Response: Here we want to express the advantage of our model, and what limitation of the most empirical model. 9. L58. During recent years, the study of uncertainty in the estimation of earthquake fatalities has mainly regarded the qualitative. These statements are incorrect. Two of the references cited (Jaiswal et al 2009, 2010), among others (Wald et al. 2010), specifically address uncertainty in fatalities estimates. Extreme events are fine as long as the model is calibration. For areas without data (lack of damaging earthquakes), of course empirical models are inadequate. This point was not articulated. Response: I had made amendments in the manuscript text, please see in <Introduction> section, line 40-49, page 2. 10. L62. There are many linguistic uncertainties when describing the uncertainty in terms of vagueness and context, which can result in an inaccurate qualitative description. Wald et al (2010) specifically address these issues. This manuscript under review does not address any of them directly. Response: I had made amendments in the manuscript text, please see in <Introduction> section, page 2. 11. L63. The numerical quantification of uncertainty is possible for emergency decision making when the information is partial or not quantifiable during the process of estimation. I don't understand this sentence. Response: I had made amendments

in the manuscript text, please see in <Introduction> section, line 62-64, page 3. 12. L71 This study not only breaks the traditional empirical model form but also quantifies the uncertainty in the estimation results. Actually, the form of model used (again, as I try to interpret it) is traditional and is no longer used, and uncertainty of fatalities estimates has been done in the past (see #9 above). Despite the claim that this has not been done before, it has. Yet, nowhere is the current study being uncertainty actually quantified or well described. The only quantification of the model is an "accuracy rate" based on hindcasting a subset of the events for one sampled subset. Response: I had made amendments in the manuscript text, please see in <Introduction> section, line 70-71, page 3. 13. L78. number of victims. "Victims" is not defined. Is it injured (to what degree), displaced persons? Response: 'Victim' means the people affected by the disaster in the specific area. 14. L79. The disaster information was derived from EM-DAT (http://www.emdat.be/), and the earthquake parameters were obtained from PAGER (https://www.pager.com/). What is meant by disaster information"? Which earthquake parameters where obtained from PAGER? PAGER does not provide epicentral intensity, so where did that come from? PAGER is NOT www.pager.com. Response: The epicentral intensity is not come from PAGER, the paper sated in line 117, the epicentral intensity is calculated by the empirical formula. And the epicentral intensity was modified as the intensity of epicenter, and the error issues had made amendments in the manuscript text, please see in < Earthquake fatalities in mainland China> section, line 78-80, page 3. 15. L86. "Scholars have discussed the factors that affect earthquake fatalities, which include magnitude, intensity, initial time, population exposure, housing fragility, and individual factors (Oike, 1991; Nichols, 2003)". These are antiquated references given the rapid evolution of this science. Response: The selected references are long-standing, but the research results are widely circulated, and the research results are affirmed by the industry. 16. L91. "Basic earthquake emergency scenarios were constructed based on a combination of the main factors." Please rewrite; I can't understand. Response: I had made amendments in the manuscript text, please see in < Basic earthquake

emergency scenarios > section, line 103, page 5. 17. L218. We collected data on destructive earthquakes that caused casualties in China from 1970 to 2017. Wasn't it stated on L.79 that these data were collected by USGS (PAGER)? Or if you did collect such data, what where the sources? Response: They are the same, but there are some data of typical earthquake cases selected for verification are mainly from the book named "Assessment Compilation of Earthquake Disaster Losses in Mainland China", which compiled by the Earthquake Disaster Emergency Rescue Department of China Earthquake Administration. 18. L97. Via qualitative analysis using the collected data, the main factors affecting earthquake fatalities were acquired. There is an approximately linear relationship between the magnitude and the number of fatalities (Figure 2). As the magnitude increases, the number of fatalities increases. This correlation is known to be inadequate. Magnitude is a poor proxy for shaking for a number of reasons, and fatalities are related to shaking damage, not magnitude. Depth, distance to the fault, population exposure at a given shaking intensity and vulnerability are known predictor variables in modern studies. Response: In this paper, we use the first-time acquired basic seismic parameters to evaluate the earthquake as it occurs before other loss data are obtained, so we selected the parameters, which are easy obtain. Magnitude is the easiest way to get. 19. L101. The relationship between the number of fatalities and the initial time is relatively vague. Fatalities vs time of day cannot simply be related without considering the population exposure per intensity level at the time of the earthquake for each event. Nighttime events should be more deadly than during the daytime, but one event at night may be in an area of high population and one during the day in low; one needs to normalize for these other important variables. Response: In this paper, we use the first-time acquired basic seismic parameters to evaluate the earthquake as it occurs before other loss data are obtained, so we select the intensity rather than the ground motion. Intensity is more macroscopic. And the relationship between the intensity at epicenter and the seismic precautionary intensity can indirectly express the building losses. 20. L108. Based on the aforementioned analysis, the magnitude, epicentral intensity and initial time were

selected as the main parameters used to establish the basic earthquake emergency scenarios. In the sentences above this, Time of Day was should to not be correlative. Why is it then used? Magnitude should not be used (as described in #18), and there are problems with epicentral intensity (described above). So, it is unlikely that these parameters provide a robust fatality estimate model. Response: With the data fitting, there is no correlation between the focal depth and earthquake fatality obviously. The fitting result is not suitable for modeling parameters. 21. L112. The magnitude was divided into three levels ($4.5 \leq M < 6$, $6 \leq M < 7$ and $7 \leq M \leq 8$ (M means magnitude)) according to the principle of magnitude 112 division in the earthquake emergency programming of China (The National Earthquake Emergency Plan, 2012). The citation for these terms is "The national earthquake emergency plan" which is in Chinese. Moreover, not only is magnitude not a proper predictor variable, bins of M4.5 to M6.0 or M6 toM7 cover enormous ranges; binning them together is not justified or justifiable. (M6 fault is $\sim$10-15 km in length; M7 is $\sim$60 km in length). Likewise, would one expect shaking (and thus, fatalities, all other things being equal) from an M4.5 to be in the same category as shaking from an M6.0 event? Response: In this paper, we use the first-time acquired basic seismic parameters to evaluate the earthquake as it occurs before other loss data are obtained, so we select the intensity rather than the ground motion. Intensity is more macroscopic. And the magnitude is more easy accept. All the setting is for the rapid assessment without the other loss assessment. 22. L115. The relationship between magnitude (M) and epicentral intensity (I0) is as follows: M = 0.58I0+1.5 (GB/T17742). The Reference given is: "GB/T17742, The Chinese seismic intensity scale, 2008." I don't know what this source is, but the Chinese Seismic Intensity Scale has not been published, as far as this reviewer knows. The Reference is also in Chinese. I cannot examine either the scale or equation cited. Response: This is an empirical relationship between the epicenter intensity and magnitude of earthquakes in China, as described in the paper. 23. L132. The term "basic earthquake emergency scenarios" is a term not used as far as I know, and it's not clear what exactly it refers to. Response: The term "basic earthquake emergency scenarios"

base on scenario analysis and data used in the article, all possible scenarios are combined with parameters. 24. L139. We needed a functional form describing the fatalities with the victim and mortality rate. In addition to grammatical and typos, I cannot decipher this sentence. Response: I had made amendments in the manuscript text, please see in < Basic earthquake emergency scenarios > section, line 134, page 7. 25. L143. seismic intensity elliptical attenuation model. Elliptical attenuation needs justification; it is not used in any modern ground motion prediction equations. Response: In this paper the seismic intensity elliptical attenuation model is uses to estimate the area of the disaster and calculate the population affected. It is not the main factor in the model. 26. L265. The overall evaluation result of this estimation model was good. This statement does not provide any information to the reader. What evaluation, with what statistics and what does "good" mean? Response: In this paper, the validated assessment results are good in the same order of magnitude without affecting the start-up of emergency plans in China. 27. L277. The interval estimation of the fatalities in the model can consider the extreme events with larger mortality rates but small probability. Please rewrite. I don't know what this means. Response: In this paper, the validated evaluation results are in the same order of magnitude, and do not affect the proportion of the evaluation results in different regions of China's emergency preparedness initiation. 28. Table 5. I don't understand this table. Please explain. Response: To verify the accuracy of the quantified results of the uncertainty, we used the random selection of 20% of the samples under each scenario. And the table 5 is the accuracy of each fatality level. 29. Table 6. First "victims" is not defined in the paper. Does this mean displaced? Injured? If either, data for displaced persons or injuries is so uncertain that it challenges credibly that the model can accurately predict them (100% as reported there). If is not believable that one can get an exact answer to an uncertain problem. Please define "victims" and explain how it is possible to calculate this number especially with such a simplified shaking model (elliptical shape)? Response: I had made amendments in the manuscript text, please see in < Basic earthquake emergency scenarios > section, line 77, page 3. 30. Table 7. Define

"interval of fatalities". Response: Interval value of estimation result of the earthquake fatality. 31. Conclusions. L291. Based on the current study, the following aspects were mainly improved: 1. During the actual emergency process, the information on on-site earthquakes will be acquired as time progresses. Therefore, how to update the results with the updated information is in need of further study. 2. With the development of remote sensing and unmanned aerial vehicle (UAV) technology, images can be used after the earthquake for damage estimation. These are not "conclusions" since these topics were not even discussed in the paper. Please clarify. Response: I had made amendments in the manuscript text, please see in < Conclusions > section, line 298, page 17. Technical Corrections Response: I had made amendments in the manuscript text, please see in < Conclusions > section, line 314-367, page 18-20.

Please also note the supplement to this comment:
https://www.nat-hazards-earth-syst-sci-discuss.net/nhess-2018-187/nhess-2018-187-AC3-supplement.pdf

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