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Natural Hazards and Earth System Sciences
Discussions

Interactive comment on "An extended stochastic method for seismic hazard estimation" *by* A. K. Abd el-aal et al.

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Response for referee#2 comments

The referee comment: Despite the authors' claim, this paper seems to me the application of Boore's stochastic model to a study-area in northern Egypt. In practice, the authors did not develop any specific new model, but at most introduced some variants. The authors should better explain the variants and the reason why they liked to use them. Authors replay: We would thank the reviewer for his comment. We already explained in details our philosophy in using the proposed model in our reply for first reviewer comments. As we mentioned in the article text we used the same idea of Boore 2003. However, we introduced some new variants to the Boore's stochastic

model especially in source term. Boore's model is used for simulating or predicting the ground motion from earthquakes that already took place previously at some locations having no tools for recording the earthquakes. Our new model developed (extended Boore's stochastic model) can be used to predict the ground motion from different seismic zones and estimate the maximum expected earthquake magnitude that will affect a site in the future. So we consider that our proposed model can be used as a good first tool may help in estimating seismic hazard in specific area. Definitely, our proposed model predicts the ground motion with probability of exceedance of 100%. While in PSHA and DSHA calculations, there are different probability levels of exceeding the ground motion. Our developed model overcomes the problems of over estimation or under estimation of seismic hazard values especially with areas that have variations in amplification factor as it introduces one value for predicting the ground motion from the closest earthquake inside the seismic zone for design. It estimates the seismic hazard which will result from future earthquakes. It takes into account the site effect at different frequencies. The estimates are depending on the variations of local site conditions. However, in PSHA and DSHA methods, the effect of resonance frequency and amplifications at each depth is negligible.

The referee comment: English is poor, and often the authors use different expressions in an equivalent way, though they have different meaning in the canonical literature. One example is the identification of seismic hazard with the calculation of the PGA, (or PGV, or PGD) or of the PSA (pseudo spectral acceleration). Authors replay: We would thank the reviewer for his comment. English is not our native language and we did an effort for improving it as well as, it is revised. We will correct the expressions in revised version of article. 2 The referee comment: The additivity of the amplification and attenuation functions in equation (3) is suspicious. As is stated in eq.(1) all functions (E, P, G and I) are multiplied as spectral factors. This implies that if some of these functions (like G) is formed by multiple components (i.e. A and D), then even these components should be combined together as factors. Authors replay: We would thank the reviewer for his comment. This is a mistake during the writing. The authors

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changed the equation to: G(f)=A(f) D(f).

The referee comment: From the analysis, it seems that the seismic zones contributing to the maximum PGA are the zones closest to the study area (see Table 2), i.e. zones 6, 14, 25 and 26. According to their method, the authors take the highest expected magnitude (given in Table 1, and repeated in Table 2) in each zone, and then they assume that this maximum earthquake occurs in the point of the polygonal zone that is closest to the target city. This means that the way the boundary of the zone is drawn is crucial for the analysis. But looking at the seismicity plot of Figure 2, the boundaries of these zones are quite arbitrary. And this reflects on the computations, since it changes the distance R in the path term P of formula (1). The authors should discuss this and other factors introducing uncertainties in the evaluation of the resulting PGA. Authors replay: We would thank the reviewer for his comment. The seismic zones are determined depending on the distribution of seismicity and the similarity in focal mechanism solution, focal depth and some of the faults. The model also doesn't differ a lot from the previous models that were constructed for Egypt. Note that we detected the boundary of seismic zones depending on the spatial distribution of seismicity. We have done the same step in calculating and determining seismotectonic model and maximum expected magnitude as in PSHA and DSHA study that already done by the authors and the results were published. 2 The referee comment: Using a catalogue of independent earthquakes when adopting the method of the worstcase scenario is not necessary. Indeed in principle it may be wrong. Cancelling earthquakes from the catalogue can eliminate some largest earthquakes (this would happen only rarely when a large foreshock is mistakenly taken as the main shock), but more frequently it would reduce the geographic extension of the seismic zones. Often a fault is better described by the full set of foreshock and aftershocks rather than by the independent main earthquakes that break the fault. Authors replay: We would thank the reviewer for his comment. The catalogue which is used here is the same catalogue which is used for our previous study "El-Eraki, M. A., Abd el-aal, A. K., and Mostafa, S. I.: Multi-seismotectonic models, present-day seismicity and seismic hazard assessment

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for Suez Canal and its surrounding area, Egypt, 2015. Bull Eng Geol Environ Springer Verlag Berlin Heidelberg. doi: 10.1007/s10064-015-0774-1". The catalogue here is used without cancelling any large earthquakes. The authors added to the sentence in page 6 lines 4-6 "Catalogue declustering should also be done in PSHA calculation by removing the dependent events (foreshocks and aftershocks) to satisfy the spatial and temporal principles of earthquakes independency while this declustering is not important in this study". The referee general comment: My overall opinion on this paper is that it is an exercise, that can be published only after the above remarks are replied, and after the authors show the real novelty contained in this paper with respect the Boore's method and, importantly, with respect to the previous studies of seismic hazards conducted for the northern cities of Egypt. Authors replay: We would thank the reviewer for his comment. We applied the referee remarks. Our method is an extended development to Boore's stochastic simulation method which can be applied for estimating and predicting the seismic hazard in an area from predicted estimations of the largest earthquakes of the closest seismic zones. It is a bridge connects stochastic simulation of Boore, DSHA and PSHA. We published a paper for estimating the seismic hazard in northern Egypt using the PSHA. The citation of the paper is "El-Eraki, M. A., Abd el-aal, A. K., and Mostafa, S. I.: assessment for Suez Canal and its surrounding area, Egypt, 2015. Bull Eng Geol Environ Springer Verlag Berlin Heidelberg. doi: 10.1007/s10064-015-0774-1". Our present work is used also for estimating the hazard using a different developed model and then we compared between the two different models results. We found that the obtained results from the two models are satisfactory and complementary to each other and agrees with the tectonic setting and the seismicity of the area.

Interactive comment on Nat. Hazards Earth Syst. Sci. Discuss., 3, 7555, 2015.