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Discussions

Interactive comment on "Non-stationary extreme value analysis applied to seismic fragility assessment for nuclear safety analysis" *by* Jeremy Rohmer et al.

Anonymous Referee #2

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1 General comments

The paper proposes a method to derive improved and accurate fragility curves for nuclear plants subject to seismic activity by adopting non-stationary GEV for the engineering demand parameter. The capacity of the structure is simulated allowing for parametric uncertainties. The premise of the proposed method is novel and reasonable.

The analysis is rigorous and encompasses major requirements of uncertainty quantification. The results indicate that the usage of the method presented may provide better vulnerability assessment in nuclear plant safety analysis by a significant margin.

The paper may benefit from improved clarity of presentation, particularly in the final computation of fragility curves (FC) and presentation of results.

2 Specific comments: Methods

The choice of whether to use GEV is done using AIC or BIC measures. The benefit to using a non-stationary GEV may be demonstrated by showing improved goodness of fit or other custom measures as applicable. Fig.5 and 9 may be locations to include such a comparison.

The derivation of the fragility after arriving at demand and capacity may be done more explicitly. The nonlinear structural analysis section describes a scaling range with 6 steps. One might expect a few data points on the FC rather than a continuous curve based on this. A fit may be done after this and superimposed on the same graph. The absence of this plot may be due to the usage of a different method. The GEV fit appears to be for the EDP but is also mentioned as the fit for FC. Clarity here may improve readability considerably.

The same ambiguity arises in the plots of partial effects (Figs. 6,10,11). The structural variables appear to have a partial effect on the demand parameter. This seems counter-intuitive conventionally. The GEV appears to be used not just for demand in that case, this may be better presented.

The convolution of the probability density of capacity around the pre-defined damage states and the 1-CDF of the demand on the structure by different levels of ground motion would produce points on the FC. The procedure is detailed in [1]. This may be used as a starting point to show how FC derivation is different here.

Return period for a non-stationary model requires transformation which may be of significance in some cases. See [2]. This may be of no effect considering the order of scaling, but it may be of use to include/discuss.

3 Readability

The paper may benefit from an appendix or a different section for detailed methods after describing the main results. The partial effects may be consolidated in one section, the fragility curves being in another. The variation of the fragility curves based on the choice for parameters such as e4 may be better presented in measures of percentage changes. The method used by Wood et al. (line 97) could've included with more detail for completeness.

The paper may benefit from a tabular presentation of results, especially the effect of structural parameters on FC as this may be of key significance for a practitioner. Figure quality may be improved. Consider using vector graphics. x-axis of Fig. 5 requires uniformity and units may be placed in brackets.

[1] Rota, M., A. Penna, and G. Magenes. "A methodology for deriving analytical fragility curves for masonry buildings based on stochastic nonlinear analyses." Engineering Structures 32.5 (2010): 1312-1323.

[2] Salas, Jose D., and Jayantha Obeysekera. "Revisiting the concepts of return period and risk for nonstationary hydrologic extreme events." Journal of Hydrologic Engineering 19.3 (2014): 554-568.

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Discussion paper