# Author Response to Referee Comment 2 (B. Pace)

We thank the referee for the detailed and constructive feedback. Point-by-point replies to the comments are provided below.

1) First of all the authors have to better explain, at the beginning of the paragraph, that only fault-based and time-dependent seismic hazard models, and not all the current probabilistic seismic hazard calculations, are mainly based on Brownian passage-time (BPT) distribution.

   We changed "Current probabilistic seismic hazard calculations are [...]" to "Fault-based and time-dependent seismic hazard models are [...]".

2) The assertion that such fault-based seismic hazard models do not consider the slip rate variability is not totally correct.

   We believe this is related to the statement "However, our results show that in addition to the variability in inter-event times around a constant slip-rate, faults show heightened activity and quiescence over time periods lasting a few millenia relative to the longer term deformation rate. The differences in slip-rate between time of heightened activity (>1cm/yr) and quiescence (<0.1 cm/yr) are dramatic. These two timescales of slip-rate variability are not considered by current methods for calculating probabilistic seismic hazard (Pace et al., 2006, 2016; Tesson et al., 2016)."

   This is not stating that such fault-based seismic hazard models do not consider the slip rate variability at all, but that such models are not explicitly accounting for slip rate variability on both timescales. To our knowledge, our approach is the first of this kind, if this is not true then we would be grateful if you can provide references.

3) What is missing, from my point of view, is a comparison of the results with the classical BPT distribution, both in terms of next earthquake probability and, if possible, of probabilistic expected ground shaking (using a simple model). The probabilities shown in Fig. 16 seems to me very high but without a comparison with other approaches (e.g. FiSH approach, Pace et al., 2016, SRL) [...] is not easy to understand the impact of the proposed methodology.

   We have now included a comparison in our examples with the standard BPT approach using the MCMC samples based on the earthquake records produced by our MCMC algorithm, because there is to our knowledge not any earthquake record for a single fault that is not too sparse to estimate the parameters of the BPT distribution and that will typically underestimate the probabilities. In Figure 1, we can observe the difference between the results.

To the best of our knowledge some damaging earthquakes produce slips on the fault as small as 10 cm. However, if one is convinced that damaging earthquakes have a minimal size of 50 cm then obviously the MCMC will result in scenarios with less earthquakes and thus in lower hazard probabilities for the next earthquake. To illustrate this fact, we have also included a run of the MCMC algorithm for the slip size 50 cm.

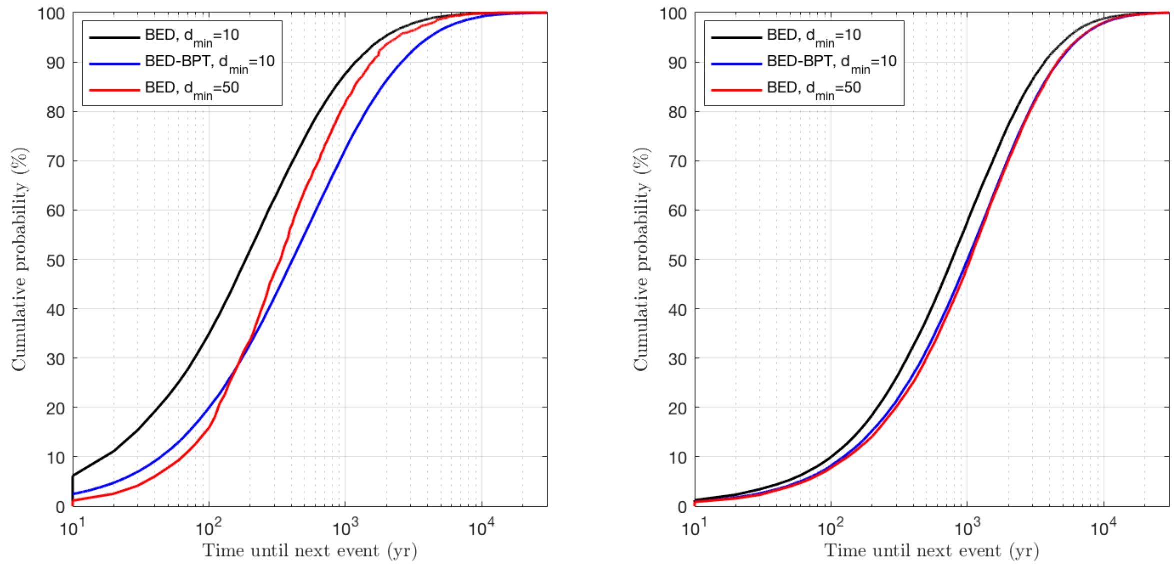


Figure 1: Posteriors of next earthquake time for Fiamignano (left) and Frattura (right) with BED run using $d_{min} = 10$, $d_{min} = 50$, and with the standard BPT distribution with $T_{mean}$ and $CV$ from the MCMC samples obtained from the BED run using $d_{min} = 10$.

4) ...without an application in terms of probabilistic seismic hazard maps (or curves) is not easy to understand the impact of the proposed methodology.

It is beyond the scope of the paper to produce hazard maps as there are many different ways to attenuate shaking with distance in the literature, and we do not want to restrict our attention to a particular one. Instead, the reader is provided with enough information to make their own seismic hazard map from the results produced by our method. The method is applied to individual faults and the probabilities for the next event time can be integrated into creating probabilistic seismic hazard maps in the same way as standard BPT based methods.