

Nat. Hazards Earth Syst. Sci. Discuss., author comment AC3  
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## Reply on RC3

Francesco Visini et al.

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Author comment on "An updated area-source seismogenic model (MA4) for seismic hazard of Italy" by Francesco Visini et al., Nat. Hazards Earth Syst. Sci. Discuss.,  
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Dear Referee 3,

Thank you for your useful suggestions and comments. We appreciated the detailed review and we will modify the text according to your comments.

In the following we answer point by point to your comments.

**REF:** The manuscript is well organized, clearly written, the results are sound and supported by the data, the references are adequate and most figures are clear. However, the manuscript is rather technical and relatively short, allowing only a superficial analysis. In addition, there are several issues that need to be improved or clarified:

- At some points, the text is too concise to fully understand, for example:
  - 2.4 "We also considered the regional strain rate fields ... and the ...  $S_{hmax}$  orientation to qualitatively check the homogeneity of the strain rate values within the area sources": it is not clear how this is done, perhaps it could be shown in a map in the electronic supplement.

**ANSW:** We agree with the Reviewer that this part should be better discussed. We will include a new appendix with all the maps and data used to build the sources and a description of how the borders have been defined.

**REF:** §3.1, e) "be consistent with the CPTI15 earthquake catalogue": how specifically?

**ANSW:** We would refer to the spatial pattern of seismicity. We would be sure that zones whose borders were drawn using faults were not across a group of earthquakes attributed to the same faults. The non-precise correspondence between faults and earthquake is due to the fact that earthquakes occurred before the 1950 are parametrized using macroseismic data, then a shift between the possible causative faults and the epicentre can occur.

**REF:** §3.2 “We considered only the earthquakes that can be related to active crustal seismicity based on the crustal models by ...”: it is not clear which (types of) events are rejected

**ANSW:** We will specify better in the text that the we used crustal model to identify earthquakes whose depth is shallower than the moho.

**REF:** §3.3 “in each source zone we obtained a representative moment tensor”: how was this done?

**ANSW:** We agree and we will better detail the procedure, instead of simply refer to Pondrelli et al (2020).

**REF:** The description of methods iv and v to calculate seismic rates in §3.4.3 is too concise.

**ANSW:** We will detail the description. We will include the range of magnitude for which methods are applied and all the necessary information to reproduce the approaches.

**REF:** The introduction is actually a summary of the various seismic hazard models in Italy and their evolution during the past 2 decades. Considering the numerous abbreviations, a sketch depicting the model hierarchies and histories would be useful.

**ANSW:** We thank the reviewer for this suggestion. We will include a new figure with a sketch to depict hierarchies and histories of ZS4,ZS9, ZS16, MPS04, MA4 and MPS19.

**REF:** Declustering of earthquake catalogs is an important issue in modern, state-of-the-art probabilistic seismic hazard assessments, but is not really investigated in this study. Although many different methods are available, only a single one is used. It is not clear to me why this would be less important than for instance the different methods to estimate the completeness. The latter are captured in a branching level of the logic tree, but declustering is not.

**ANSW:** The earthquake catalogue used to evaluate seismic rates was furnished by the Italian project of MPS19. We agree that also the declustering approach should be part of a logic tree exploration, however, this was not done in the framework of the MPS19 project. We will add a point to discuss this part.

**REF:** The logic-tree structure used to calculate the ERFs is described at the beginning of §4 (seismic hazard calculation), but I would prefer to move this to §3.4, as it provides the rationale for the choices made in the subsections of §3.4.

**ANSW:** We will modify the structure of the manuscript according to this suggestion.

**REF:** Figures 9 and 10 show hazard results for 3 selected sites, but there is no discussion about what we can learn from the differences between these sites.

**ANSW:** The 3 sites were chosen only as examples for relatively low-to-high seismic hazard levels in Italy.

**REF:** I have not been able to understand the analysis of ERF and GMM uncertainties at the end of §4 and in Fig. 13. According to the text, the curves grouped by GMM are used to analyse the ERF uncertainty, whereas I would think that these curves show the differences in uncertainty among the different GMMs (e.g., there is a clear divergence for the Bindi et al (2012) GMM at low APOE in L'Aquila and Siracusa). Furthermore, it is not clear to me how we should compare the other set of curves (with marker symbols) with the ones grouped by GMM, considering that the former represent 3 branches and the latter 20 branches. It may be a misunderstanding on my part, but I think it would be more useful to also group these curves by completeness model, by Mwmax model and by AR model. This would also reduce the number of curves in Fig. 13. If this is not what the authors intend to show, then a more clear description will be needed to understand the conclusion that "there is a clear trend that ERF uncertainty gives larger CoV than GMM uncertainty". Figure 13 is too dense: it shows 24 curves with different colors, line styles and marker symbols, but many of them cannot be properly distinguished.

**ANSW:** We will simplify figure 13 according to the suggested procedure. We think this will help to better visualise and describe the uncertainty due to ERF and GMM.

**REF:** There is no caption for the tables in the electronic supplement.

**ANSW:** We will include captions.

**REF:** Detailed comments. I have annotated a number of minor comments, corrections and suggestions in the attached PDF. The easiest way to view these is by opening the Comment side panel in Adobe Acrobat Reader.

**ANSW:** We opened the pdf. We thank the Reviewer for the detailed comments that we will take into consideration. We will modify the text according to the suggested comments.