Dear Referee,

Thank you very much for your constructive questions and comments that helped us improved this article to a great extent. In particular your comment on the maximum magnitude possible on the faults lead us to realize an error was made when calculating the maximum magnitude. We updated the magnitudes and ran the hazard calculation for the whole logic tree. The new hazard levels differ slightly from the former ones but our main conclusions remained unchanged.

You will find here the responses to your questions and the changes we made in the article.

In general the manuscript is simple and it cited too many times the companion paper (Part A, submitted to the same special volume by Jomard et al.). Part A describes the transformation of an active fault database in a fault-based seismic hazard model, C1 Part B explore the impact of the fault parameter uncertainties in the estimate of the hazard. Even if I did not read in detail the companion paper, in my opinion the two manuscript could be merged in a single, more robust and interesting paper. But this decision pertains to the editor.

Part A describes how the French active fault Database was built and how it can be used for seismic hazard assessment and Part B uses this information to run a seismic hazard assessment for one specific site focusing on how the uncertainties on fault parameters affect the result. We think that each paper reaches different communities: Part A reaches to geologists whereas Part B reaches to hazard modelers. However, joining them as the Part A and B of a larger ensemble can help to fill the gap between these two communities. We tried to make each article self-supporting and avoided the redundancy as much as possible for the special issue. We will wait for the editor's decision on this matter.

The main goal of the manuscript is to describe how the determination of the parameters of the active faults can modify the seismic hazard for long return period. So, it's almost surprising that the first comparison proposed is between 4 GMPEs, not the most recent GMPEs available in literature (probably authors used those GMPEs implemented in CRISIS software). In my opinion the adoption of several GMPEs could be source of confusion for the readers with the respect to the impact of the geological information.

Using several GMPEs allowed us to show that the fault parameters can lead to variability in the result in the same order of magnitude of even greater than the choice of GMPE, which is often presented as the greater cause of variability on the seismic level calculated using PSHA. Because of your comment, we realize that this conclusion wasn't clear in the first version of the manuscript, we hope that the changes made (P5 R32) can help the reader to appreciate this better.

P5 R32: In many hazard studies, the selection of GMPE is the largest source of variability of the hazard level (Bommer et al., 2005). However, in this study the slip-rate of the Rhine River fault induces a variability of the result of the same order of magnitude or even higher.

About single points in the paper, my remarks are the following:

- Page 2, row 20; for the use of background sources and fault sources in fault-based approach some reference to application in PSHA could be useful for users;

Reference to Fujiwara et al., 2009, Valentini et al., 2017 (this issue) and Wang et al., 2016 have been added as examples.

- **page 3, row 2; in the sentence "The maximum possible magnitude that each fault segment can release is then determined based on the mean value given by the Wells and Coppersmith (1994) empirical scaling relationship" is not clear what is the mean value since they have one area value for each fault and a single slip type; the authors mean the value proposed by the regression without considering the standard deviation**?

We have clarified this sentence in the text.

P2 R31- "The maximum possible magnitude that each fault segment can release is then determined with the Wells and Coppersmith (1994) empirical scaling relationship, hereafter WC94, using the mean value of the a and b coefficients for normal faults (Table 2A of Wells and Coppersmith, 1994). The surface area of each fault segment is used to calculate the maximum magnitude."

- **Page 4, row 1; I don't agree with the sentence "the MFD is defined between a value Mmin below which earthquakes are considered as non-damaging. . ."; the seismic hazard is not only for defining damaging levels that moreover depend on vulnerability, not only on magnitude**;

Modification have been made P2 R22-28 concerning this comment. The Mmin of 5.0 concern the Mmin of the background seismicity and is commonly assumed that earthquake of lower magnitude won't be damaging for nuclear installations.

P2 R23: "The Mmin is fixed at 5.0 in this study, as it is commonly assumed that earthquakes below magnitude 5.0 are not damaging for nuclear installations (Bommer and Crowley 2017). The maximum magnitude for the background is fixed at 5.9 since M>=6.0 events are assumed in this exercise to occur on faults only."

P3 R24: "In the GR hypothesis, the MFD is defined between a value Mmin of 6.0 below which earthquakes occur in the background and a value Mmax which is the maximum magnitude possible on the fault."

- **Page 4, row 28; "These equation use different distance metrics"; I would like know how the authors handled this very important aspect for the computation. Are the distance metrics managed by the software or the authors had to modify some parameter that describes the fault geometry**?

The same parameters describing the geometry of the fault are given to the CRISIS software independently of the metric used by the GMPE. The software will compute the appropriate metric itself.

- **Page 5, row 2; "The UHS hazard level strongly depends on the GMPE used". This is a well-known issue (even if the hazard depends on all the parameters, for the faults-based models depends strongly on the maximum magnitude for long return periods), but not confirmed by your exercise: in figure 7 you show that the uncertainty related to the slip rates is comparable (if not greater) to that relate to GMPEs**.

As addressed before, to our opinion this is one of the interesting results of this study: the fault parameters (especially the slip-rate on the Rhine River fault) can lead to large variability in the hazard level of this site and their exploration should not be neglected in future hazard studies. We hope the changes brought to (P5 R32) helps the reader to better understand this point.

P5 R32: “In many hazard studies, the selection of GMPE is the largest source of variability of the hazard level (Bommer et al., 2005). However, in this study the slip-rate of the Rhine River fault induces a variability of the result of the same order of magnitude or even higher.”

- **Page C2 5, row 5; “PGA dispersions differ from one GMPE to the other due to their different sensitivities to the parameters explored, in particular the geometry of the faults”. As for a previous comment, the problem is the geometry of the faults or the distance metrics adopted by the GMPEs?**

The impact of the modification of a parameter will affect the hazard level in a different manner depending on both the metric used and the formulation of the GMPE. However, we realized that our sentence was generalizing based on only one observation and choose to modify the text to: “An increase in seismogenic depth and a reduction of the fault dip both lead to an increase of fault surface area hence an increase of the earthquake rates modeled on the faults (see Equation 5). Figure 5b shows that the increase in seismogenic depth increases the UHS by 5%.”(P5 R15)

- Page 5, rows 12-20; the comments of the disaggregation plots by the authors is about the faults’ contribution to the large return period estimates. The contribution comes from the large magnitudes, which in your model is modeled with faults, but the result is not different by using area sources;

We agree with this comment. In any PSHA, the influence of large magnitude earthquakes will grow when looking at greater return periods. We want to point that in our model, these large magnitude earthquakes are generated by the faults. To clarify this point we added “… in our model” at P4 R40.

- **Page 5, section 5 Sensitivity study; You start with “In order to quantify” but not for all parameters is presented a quantification**;

Thank you for your comment. Quantifications have been added where they were missing. With the updated calculations variability induced by the slip-rate uncertainty in on the same order of magnitude as the variability induced by the choice of GMPE. Please see the changes in the text.

P4 R23: ”The use of four GMPE affects the UHS level strongly, inducing an uncertainty in hazard levels ranging from 30 to 40% depending on the spectral frequency (Figure 2a).”

P5 R9: “The characteristic earthquake MFD leads to a spectral acceleration around 5% lower than the GR MFD for this target probability level, the site of interest and the fault's characteristics considered in this exercise (Figure 5a).”

P5 R15: “Figure 5b shows that the increase in seismogenic depth increases the UHS by 5%.”

- **Page 6, row 4; the sentence "The reduction of the fault dip leads to a 10 to 15% increase of the UHS" is not consistent with the result presented in figure 5c, where higher UHS are for bigger dip. Probably in figure 5c the legend is wrong**.

There was a mistake in the legend it has been corrected.

- **Table 1; the maximum magnitude derives form rupture area, but the table reports the length. Can you explain why FR3 and FFN3 faults have the same Mmax (6.3) with a so different length**?

Thank you for your comment, it made us realize that an error was made when calculating the maximum magnitude. We corrected the error and re-ran the calculation on the whole logic tree. We updated the tables and figures. The corrected maximum magnitude are larger than the previous ones. This increase in the Mmax lead to a decrease of the earthquake rates on the faults and thus to an overall slight decrease of the hazard level at 10,000 years as the hazard is mostly controlled by magnitude 6 to 6.4 earthquakes (see Figure 3). The new calculations do not change our conclusions.

For a greater transparency, we chose to disclose in an annex the input values for all the faults and the way they are calculated as well as the results for the whole logic tree.

- Figure 1; the logic tree scheme is not clear with the graphics you adopted;

A new representation is used. We hope you will find it easier to read.

- **Figure 2, 4, 5; the figures are made by panels with letters a), b), etc. The letters are not report in the captions, but I think that the letters will help the reader**.

Letters have been added in the figures and captions.