

Answers to Referee #1

<p>... the title of section 6 Results, should be renamed 6 Results and Discussion</p>	<p>It will be renamed as suggested</p>
<p>When comparing to previous results in the Pyrenean and Alicante areas, the authors state: “This suggests that the zonation needed in order to capture correctly the seismic hazard requires very small zone dimensions, which cannot be characterised adequately with the seismic information available.” The use of “correctly” is wrong here, you are just comparing the results from two different approaches. What the authors may want to say here is that to have similar results (comparing zoneless and zoned methods) the zones should be smaller, and that may be problematic in some areas for deriving a reliable magnitude-frequency relationship.</p>	<p>Instead of focusing on the hazard results, it is probably better to refer to the seismic activity rate. How this activity rate is represented is the main difference between the two methodologies: in the traditional approach the activity is uniformly spread over (small-medium-large) zones, while in a zoneless approach the activity rate follows more closely the actual observations.</p> <p>The sentence can be reworded as follows: “This suggests that the spatial gradient of the activity rate in these areas is high, so the zonation needed in order to represent this seismic activity rate would require small zone dimensions, which might be difficult to characterise, in terms of magnitude-frequency relationships, with the seismic information available.”</p>
<p>And then: “This conclusion is also supported by the observation of recent seismicity around this area, specifically the recent Lorca earthquake (11 May 2011, Mw = 5.1, 1.5 km depth), one of the strongest in recent Spanish seismic history (maximum felt intensity of VII and a recorded PGA of 0.36 g a few kilometres from the epicentre) ...”</p> <p>The Lorca earthquake is known to have shown a very clear directivity effect: a conspicuous spike in a rather low amplitude accelerogram. Lorca is sited on the top of the causative Alhama fault. For this reason PGA of Lorca earthquake may not be the best parameter for comparing PGA from seismic hazard estimations that have not taken into account this effect. I think it is incorrect to use this example for supporting zoneless methods against zoned methods.</p>	<p>After some internal discussion amongst the authors, we think that the best option is to omit this example.</p>
<p>For some reason the paper turns from a good scientific work to a defense of zoneless methods. That is not the point. The zoneless methods are appreciated and actually used in seismic hazard mapping. They are not</p>	<p>Although the comment is very generic, the authors agree that the defence of zoneless methods is not a primary purpose of the paper. That said, it is worth noting that zoneless methods are more recent and less common,</p>

<p>better than zoned methods, as zoned methods are not better than zoneless ones. Both are complementary, and this is known by the community as they are usually combined in logic tree schemes.</p>	<p>hence some expression of support may be warranted, especially when they are seen to perform well. The authors would not generally subscribe the value judgement that zoned and zoneless methods are just as good as each other; this depends on the severity and other characteristics of the seismic environment studied and, particularly for areas of low to medium activity such as the Iberian Peninsula, where establishing associations between seismicity and geological structures can be challenging, zoneless methods introduce less subjective and questionable judgement.</p>
<p>Then, later on, in section 7 Conclusions, it is said: “..this fact suggests that the zonation needed to capture seismic hazard in these areas requires very small zone dimensions which cannot be characterised adequately with the seismic information currently available. This conclusion is also supported by recent activity in the south-east of Spain”.</p> <p>This paragraph should also be changed before admitting the paper for publication.</p>	<p>As in previous comment, the paragraph can be replaced by: “..this fact suggests that the spatial gradient of the activity rate in these areas is high so the zonation needed to represent this seismic activity rate would require small zone dimensions, which might be difficult to characterise with the available seismic information.”</p>
<p>Please, find below a list of errata found during my reading of the paper. Some points for discussion are also shown:</p>	
<p>Title: I SUGGEST TO CHANGE seismic hazardS FOR seismic hazard</p>	<p>We agree, our initial submission did not have the “s”, which was inadvertently introduced in the final version.</p>
<p>Abstract: Please, refrain to use "law" when talking about ground motion prediction equatios, use relationship, equation, model,...</p>	<p>Ok, noted, all references to “law” will be changed as suggested.</p>
<p>1.Introduction page 3764 line 21 NCSE-02 refers to the whole of Spain, including overseas territories. Please, change the phrase... "referring just to.."</p>	<p>Yes, true, we were trying to point out that it does not include Portugal. The paragraph will be reworded as follows: “In Spain the official information for reference in this respect is the seismic hazard map included in the Spanish seismic code NCSE-02 (Ministerio de Fomento, 2003), already about a decade old and referring only to the Spanish territory.”</p>
<p>page 3766 line 6 ADD the reference for the new seismic hazard maps of Spain, they are already published by IGN.</p>	<p>Yes, we can add it now. They were not published when we initially submitted the paper.</p>
<p>2.Methodology page 3766 line 18 Please, CHANGE "Later on, Woo .." FOR</p>	<p>No problem, we can make the reference there instead of at the end of the</p>

"Later on, Woo (1996a,b)...".	sentence.
page 3769 line 18 CHANGE fortran FOR Fortran	Noted
3.Seismic Catalogue page 3771 line 23 It is said that the most ancient event with an assigned intensity dates back to 1948 WHICH I THINK MUST BE AN ERRATUM, I think the oldest event with intensity in the IGN catalogue is 1050 Orihuela (Alicante), or so.	Indeed, a typo, the 9 should be a 0, the correct year is 1048.
page 3773 line 19 This is just my opinion, but I think your window parameters, particularly distance, are too wide. For example, a M 5 earthquake (like Lorca) will remove all the seismicity 40 km around the epicenter, which is nonsense because the dimensions of a M 5 rupture are in the order of 3 km ² .	<p>We agree there is always a certain subjectivity in this point.</p> <p>We employed the values suggested by the referenced authors. In the original methodological formulation, similar values are proposed.</p> <p>Looking at the methodological approach, the distances are not set under tectonic considerations, but rather based on observations of groups of (generally accepted) dependent events. The relationships give an upper bound. It is usually the case that if the largest distance is measured for each series, it is lower than the maximum indicated by the relationship.</p>
page 3774 line 9 cite the IGN reference, please, it has been already published.	Noted, as in the previous similar comment.
4.Attenuation Model page 3776 line 13 I think Ambraseys et al (2005) does consider the magnitude dependence. You may be saying that you are not considering it in your calculations, for some reason. Rewrite the phrase to make it clear for the reader.	The requisite is "The functional form lacks either non-linear magnitude dependence or magnitude-dependent decay with distance". Ambraseys et al (2005) does not comply with this. It will be explained more clearly in the text.
5.Seismic Activity rate page 3778 line 20 Please, avoid the term "law", CHANGE FOR relationship,..	No problem, noted.
page 3779 line 14 CHANGE in the past FOR previously	No problem.
page 3781 line 8 CHANGE law FOR relationship	Noted.
page 3781 line 9 DELETE this is OR REWRITE THE PHRASE	<p>Yes, the sentence needs to be reworded as follows:</p> <p>"Figure 6 shows, for the south-west of the Iberian Peninsula, a contour map of the activity rate for earthquakes with magnitude above 3.5, which is consistent with the seismicity of this area. This plot constitutes the first type of intermediate results that can be produced."</p>

<p>page 3781 line 16 CHANGE ORDER OF THE PHRASE, AFTER assumptions ADD will be based, like the ...</p>	<p>The “will be based” is already at the end of the sentence. Maybe just adding some comas is enough: “However, here this is just a byproduct of the calculations, while in the traditional procedure it is a necessary step on which some assumptions, like the analytical shape of the correlation, will be based.”</p>
<p>page 3781 line 19 CHOOSE “fig.” or “figure”, but use it consistently across the document.</p>	<p>No problem, noted.</p>
<p>6. Results → CHANGE FOR Results and Discussion</p>	<p>No problem, noted.</p>
<p>page 3783 lines 5 to 12 Please REWRITE the following phrase: “It is also around this return period that the contribution to the seismic activity rate arising from geological considerations may start being significant; note that the first event in the catalogue dates from the fourth century BC, and the first quantified event from the fifth century AD. The explicit inclusion of geological data in SHA affects two aspects: the location where the activity rate is modeled, which concentrates around specific geometrical features (faults); and the activity rate itself, which is enriched with geological information that the seismic catalogue does not reflect.” COMMENT: I agree with your statement but I think it needs to be rewritten as a general reader would ask him/herself: On what grounds are you basing this statement? To support your statement you should consider these ideas: - that the slow convergence between Iberia and African plates determine that active faults in Spain are also slow and so morphogenic earthquakes (M>6) associated to them have recurrence periods of the order of few thousand years, which is longer than the length of the seismic catalogue, so it is important to enrich the catalogue with potential large (M>6) earthquakes that some of this faults could produce in the future. -Considering the frequency of these earthquakes, their impact in hazard assessment starts for return periods of the order of 1000 yrs and becomes dominant for return periods the same order more or less to the recurrence period, as it has been shown (as far as I know the only work in the region that specifically studies the contribution of active faults in probabilistic</p>	<p>The sentence can be enlarged as follows: “It is also around this return period that the contribution to the seismic activity rate arising from geological considerations may start being significant. Given the convergence rate between the Iberian and African plates it is expected that faults in the Iberian Peninsula are also slow, so morphogenic earthquakes (hence with magnitude above 6.0-6.5) have recurrence periods of the order of few thousand years, which exceeds the period covered by the seismic catalogue: note that the first event in the catalogue dates from the fourth century BC, and the first quantified event from the fifth century AD. The explicit inclusion of geological data would be carried out adding earthquakes that are representative of the characteristic magnitude of the fault and with an effective period consistent with the fault recurrence period. This inclusion affects two aspects: the location where the activity rate is modelled, which concentrates around specific geometrical features; and the activity rate itself, which is enriched with geological information that the seismic catalogue does not reflect.”</p>

<p>calculations is for the Murcia Region in García-Mayordomo et al., 2007).</p> <p>-It is important to consider that when faults control seismic hazard, this is in the vicinity of the fault itself.</p> <p>-The above is all based in the characteristic earthquake model, another discussion would be if a Gutenberg-Richter model is used for modeling faults</p>	
<p>. In the phrase “: : .concentrates around specific geometrical features...” ADD (faults)</p>	Noted, no problem
<p>Page 3784 CHANGE the title of section 6.4 FOR Comparison with previous studies and seismic codes</p>	Noted, no problem.
<p>Page 3784 line 12 I suggest to CHANGE really corresponds to... FOR corresponds, in fact, to...</p>	Noted, no problem.
<p>page 3784 line 15 CORRECT above results; I SUGGEST the results OR the results shown above</p>	Noted, no problem.
<p>page 3784 line 18 CHANGE rock for rock sites OR rock conditions.</p>	Noted, we can put rock conditions.
<p>page 3784 line 19 ADD , AFTER For Granada. REWRITE the difference in soil types (It does not sound good English), I SUGGEST this difference may result from the consideration of different soil types</p>	Noted, suggestion accepted.
<p>page 3784 line 24 CHANGE the present results FOR our results OR the results presented here</p>	Noted, we can say “the results presented here”.
<p>page 3784 line 26 CHANGE than reported FOR than the one reported</p>	Noted.
<p>page 3784 line 27 CHANGE but which is FOR but that is</p>	Noted, we can change it.
<p>page 3785 line 5 Please, refrain of using “correctly”. Calculating seismic hazard is always an estimation, regarding the method used. What is correct or incorrect in a seismic hazard calculation may be performing of the calculations; the results are always estimations that you may believe it or not. You may wanted to say in the text that the “zonation needed to mimic zoneless results would require smaller zones, which cannot: : :.”.</p>	See answers above that deal with this.
<p>page 3785 line 25 CHANGE zoneless FOR zoned</p>	It is probably line 15. The paragraph will be omitted as indicated above.
<p>page 3785 line 26 CHANGE assigned FOR estimated</p>	It is probably line 16. The paragraph will be omitted as indicated above.
<p>page 3785 line 14 “Events such as the Lorca one were not expected from hazard evaluations based on zoneless (zoned) methods: : :.” I do not agree</p>	Correct, it is the ground motion that we are referring to, no the event magnitude.

<p>with your statement here. In Gaspar-Escribano et al., 2008 you can see that the controlling earthquake for a 475 yr RP in Lorca area is a Mw 5.0, which it is very similar to M 5.2 of Lorca. A different question is the estimated PGA related to that event. Not just what the GMPE predicts, as well as specific soil and near-source effects (Lorca was on top of the Alhama fault responsible of the earthquake). It has been shown in different works that PGA in Lorca was originated by a directivity effect. Please, rewrite your statement accordingly. There are so many variables involved in ground motion shaking (uncertainties) that should prevent to make statements like that one of your paper. Zoneless methods perform well and are an excellent approximation to assess seismic hazard when combined with zoned methods, but they are not the final-solution.</p>	<p>As indicated above, this example will be omitted.</p>
<p>7.Summary and conclusions</p>	
<p>page 3788 line 16 CHANGE catalogue has had to FOR catalogue had to</p>	<p>It is page 3787. For consistency with the rest of the section, we prefer to keep the present perfect rather than the past tense. If you prefer we can say “the IGN catalogue has been supplemented ...”</p>
<p>page 3788 line 9 I do not agree with “: :this fact suggests that the zonation needed to capture seismic hazard in these areas requires very small zone dimensions which cannot be characterised adequately with the seismic information currently available. This conclusion is also supported by recent activity in the south-east of Spain.” As commented before, you should say the zonation needed to get similar results to the zoneless method implies the use of smaller zones, which are difficult, sometimes, for obtaining a good G-R relation. Additionally, I do not think that this has nothing to do with the Lorca earthquake..</p>	<p>This has been commented above.</p>
<p>8.References Add the IGN reference and check for missing references</p>	<p>Noted.</p>
<p>TABLES Table 1 CHANGE on land AND at sea FOR onshore AND offshore RESPECTIVELY</p>	<p>Noted, no problem.</p>
<p>Table 2 CHANGE Reference years FOR Reference years of catalogue completeness</p>	<p>Reference years are not completeness years. The periods of completeness are considered and the probability of detection they are assigned is 1.0 (see eq. 10).</p>

FIGURES Fig. 2 Put epicentral in capital letter: Epicentral and write Peak Ground Acceleracion. Otherwise use abbreviatures in both axis, PGA and Repi.	The PGA is already described in the text, but epicentral distance is not; that is why we employed it here instead of the complete label. We do not see a problem in combining PGA in the y-axis with epicentral distance in the x-axis (as they could be combined in the same sentence). We did not use capitals in any axis labels (except for abbreviations). Unless the style of the journal requires otherwise, we prefer keeping the lower case.
Fig. 3 Y-axis should read "Spectral Acceleration" AND X-axis should read "Period". If you prefer the abbreviatures then use SA and T, consistently.	The y-axis should be T(s) to be consistent with the subsequent plots. The text makes it evident that T refers to period. For the x-axis we will employ SA (g) and will mention it in the text.
Fig.4 Move the legend inside the graph to avoid wasting space. X-axis, CHANGE magnitude FOR Magnitude	We did try that option but abandoned it because at first glance the blue star in the legend appears as part of the plot itself.
Fig.5 Footnote: This is not clear for the reader, which are the low seismicity areas, indicate; and what do you mean with higher values? in relative or absolute sense? "... the higher values....similar size."	It can be reworded as follows: "Fig. 5. Distribution of the bandwidth parameter c; the higher values (red and purple) that appear in low seismicity areas (Central Peninsula and Balears Islands) indicate a greater distance between events of similar size"
Fig.6 Footnote, CHANGE will be FOR is	Noted, no problem.
Fig.7 Titles in x and y axis should start with capital letter. CORRECT km 2 for km ² . Footnote, REWRITE straight line (sounds too colloquial)	See similar comment above. Noted the km ² . We can say "the relation is approximately straight"
Fig.8 Footnote, CHANGE would be FOR is	Noted, no problem.
Fig.9 Please, try a larger font size for the isolines labels. Footnote, AFTER 475 yr ADD return period.	Noted, we will see with the editor the final size of the figure, and if it is not wider (and hence bigger fonts) we will create a new figure. We will add return period.
Fig.10 Please, try a larger font size for the isolines labels. Footnote, AFTER 2475 yr ADD return period.	Noted, we will see with the editor the final size of the figure, and if it is not wider (and hence bigger fonts) we will create a new figure. We will add return period.
Fig.11 Please, try a larger font size for the isolines labels. Footnote, AFTER 475 yr ADD return period.	Noted, we will see with the editor the final size of the figure, and if it is not wider (and hence bigger fonts) we will create a new figure. We will add return period.
Fig.12 Please, try a larger font size for the isolines labels. Footnote, AFTER 2475 yr ADD return period.	Noted, we will see with the editor the final size of the figure, and if it is not wider (and hence bigger the fonts) we will issue a new figure.

	We will add return period.
Figs. 14 and 15: The art work is not good. Improve the quality of the image or change the graph lines and marks for better resolution. Y-axis should read "Spectral Acceleration" AND X-axis should read "Period". If you prefer the abbreviations then use SA and T, consistently.	We will make these figures consistent with Figure 3. We will replot the results with thicker lines.