

RESPONSE TO THE ATTACHED PDF

Dear Joao Fonseca PhD,

We thank for their constructive and valuable suggestions. We believe that the quality of this manuscript has improved considerably after your review. We have carried out an exhaustive revision of our manuscript following your suggestions. We have succeeded in synthesizing and improving the content of the manuscript. All changes made are included in the attached revised version.

Comments:

Line 1: The title of the manuscript

Reply (R): We have removed the phrase "Review article" from the title.

Line 15: Evidence of submarine long-strike strike-slip fault systems

R: The sentence was removed.

Line 16: Redundant , evidence?

R: The phrase has been reduced to "This activity has caused moderate to high magnitude earthquakes and that may have triggered tsunamis either directly due to seabed elastic deformation or indirectly by triggering submarine landslides."

Line 18: explain why this is needed

R: The following sentence has been included to explain why this is needed "Tsunami risk in the area is significant and increasing mainly because of the growing economic and social pressure on the coasts. Although seabed deformation after earthquakes in tsunami hazard has a de facto standard study approach, seismicity and submarine landslides are not well considered amongst different initiatives. To understand tsunamis caused by landslides, we need to consider both geomechanical properties and the spatial distribution of PGA (Peak Ground Acceleration) as a triggering mechanism."

Line 20 to 26: several comments

R: This paragraph was completely rewritten.

Line 29 to 39: several comments

R: This paragraph was synthesized and rewritten.

Line 40 to 57: several comments

R: This paragraph was synthesized and rewritten.

Line 59: unclear

R: The sentence was rewritten to read as follows “The test area in this work has not been addressed in seismic hazard studies recently despite its significant record of earthquakes, submarine landslides and tsunamis (Rodriguez et al., 2017; Vázquez et al., 2022b).”

Line 75: what is the reference for the original version?

R: The reference has been added in the text.

Line 80: identification of sources is only a part of the hazard assessment, why is the full exercise needed?

R: This sentence was removed.

Line 84: All the geographic references and fault names mentioned here must be clearly shown in Figure 1. It may need a "geology" picture without seismicity, to be readable. Maybe split into A) and B)?

R: Fig. 1 has been updated according to the toponyms indicated in the main text. Thanks.

Line 101: it is not clear what this means

R: The sentence was rewritten as follows “This area is highly active geologically, with moderate to low-moderate seismic activity. Historical cases have demonstrated the occurrence of such hazards in the region (Vázquez et al., 2022a)”.

Line 105: the figure is difficult to read. Maybe split in a) geology and faults, and b) seismicity.

R: The seismicity has been removed from Fig. 1 to make it clearer to read.

Line 115: According to Custodio et al. 2016, "Some offshore earthquakes occur at moderate depths of 40–60 km but do not delineate a Benioff zone. These earthquakes have been interpreted as evidence that the old and cold oceanic lithosphere is brittle through the upper mantle (Grimison and Chen, 1986; Stich et al., 2005b)." Depths of 10km and 33km in the catalogs are usually fixed by the location program, because they cannot be determined from the data.

R: Thank you for this comment. We have adjusted the depths and added the reference. The new sentence is as follows “ This tectonic configuration makes seismic activity in the Gulf of Cádiz significant, with moderately deep earthquakes ($h < 40 - 60$ km), but no subduction zone has been clearly marked (Custódio et al., 2016).”

Line 119: references needed

R: References have been added.

Line 125: references needed

R: This sentence was removed.

Line 130: show location of all structures in Figure 1

R: The location of all structures are shown in Fig. 1. Thanks.

Line 136 to 149: several comments

R: This paragraph was removed.

Line 154: this is in conflict with the mention of $h < 30\text{km}$ in the gulf of Cadiz, made above

R: The reviewer is right. With the correction made on line 115, the conflict between earthquake depths has been resolved.

Line 165: explain why the DTM is needed for hazard assessment

R: The need to use DTM for hazard assessment has been explained with the following sentence “The vertical component incorporated by the DTM in the point over which the hazard is assessed is exploited in the estimation of the relative distances, from the site to the seismogenic source, that some of the GMPE use.”

Line 202: why is this a good criterion?

R: We have rewritten and clarified the sentence. It now reads as follows “ These models were chosen because the ZESIS model has been used in the SHA for Spain and the NAF is the most recent model for the North African area. Additionally, both models cover geographically and almost entirely overlapping the study area of this work.”

Line 222: unclear

R: We have rewritten and clarified the sentence. It now reads as follows “The complementarity and practicality of the DSHA in submerged areas with uncertain and difficult to obtain information are two of the reasons why this work has been chosen as a preliminary SHA alternative to other more complex and data-intensive hazard assessment methods.”

Line 225: median of ground motion doesn't make sense.

R: Deleted.

Line 226: not clear

R: The passage has been clarified as follows “simple earthquake information and ground motion attenuation relationships”.

Line 229: unclear

R: The passage has been clarified as follows “statistical earthquake (size, time and location distributions)”.

Line 234 to 239: several comments

R: This paragraph was removed.

Line 241 to 259: several comments

R: This paragraph was synthesized and rewritten.

Line 260 to 275: several comments

R: This paragraph was removed.

Line 282: rewrite

R: The sentence was rewritten as follows “However, there are other distances also considered in the GMPEs catalogue formulations where the terms of Eq. (1) involving R distance are given as a function of depth (i.e., RRUP)”.

Line 286: is it not sufficient to know the elevation of the site?

R: Elevation refers to altimetry and bathymetry.

Line 290: why this reference here?

R: Deleted. Thanks.

Line 295: rewrite

R: The sentence was rewritten as follows “Recent tectonic classifications (Chen et al., 2018; Poggi et al., 2020; Hasterok et al., 2022) describe much of the study region as a Variscan-Hercynian zone in an active shallow crust region (ASCR).”

Line 300: reference needed

R: Reference Vilanova and Fonseca (2012) have been added.

Vilanova, S. P. and Fonseca, J. F. B. D.: Ground-Motion Models for Seismic-Hazard Assessment in Western Iberia: Constraints from Instrumental Data and Intensity Observations, *Bull. Seismol. Soc. Am.*, 102, 169–184, <https://doi.org/10.1785/0120110097>, 2012.

Line 303: with equal weights in different regions?

R: with the same set of GMPEs and weighting coefficients applied in the logic tree scheme for the whole study area.

Line 305 to 330: several comments

R: These paragraphs have been deleted.

Line 331 to 338: several comments

R: This paragraph was synthesized and rewritten.

Line 335: using what as comparison?

R: used as benchmark points with testing values from previous published works. (Table 3)

Line 339: MCEs are not "types of strong motion"

R: This sentence was removed.

Line 364: unclear

R: The passage has been rewrite as follows "with $MCE > 5$ as magnitude threshold".

Line 365: these references pertain to the models applied in this study?

R: Yes, belong to the GMPs used for deep seismogenic zones.

Line 372 to 380: this kind of theoretical framework should be given at an earlier stage.

R: This paragraph was moved to the introduction section.

Line 381 to 393: several comments

R: This paragraph was synthesized and rewritten.

Line 394: unclear

R: This paragraph was removed.

Line 400: too late for general statements like this

R: This sentence was removed.

Line 406: unclear

R: The sentence was rewritten as follows “(ii) Assign the seismic potential to each source SS_j with its MCE_j and the prevailing focal mechanism (normal, thrust or strike-slip).”

Line 412: undefined

R: This is undefined because it is really an unknown to be solved for the arbitrarily selected probability of exceedance (left hand side of the equation).

Line 414: for what pdf?

R: As has been explained before, if Y is the variance of the uncertainty assumed as a Gaussian random variable acting over the random dispersion of the model GMPE, so the pdf is a Gaussian distribution.

Line 419: what if it is not?

R: Instead of the DSHA using only the control seismic source we will be the DSHA solving the nonlinear problem of the maximum probability distribution.

Line 423: this is the median, not the mean!

R: In Gaussian distribution, as has been commonly assumed for the error model, mean and median are the same.

Line 428: th-percentile

R: notation is correct.

Line 433 to 437: several comments

R: This paragraph was removed.

Line 438 to 440: several comments

R: This sentence was removed.

Line 470: arbitrary, correct or uncertain?

R: The reviewer is right. The word "correct" was deleted.

Line 482: what are these?

R: This sentence was removed.

Line 491: what is the basic scheme?

R: Thank you for this comment, the word is incorrect. The correct word is “classic scheme”.

Line 492 to 504: several comments

R: These paragraphs have been deleted.

Line 505 to 509: unclear

R: The paragraph was rewritten as follows “The logic tree used in this study incorporates a combination of seven selected GMPEs to estimate the PGA at the site. The weights assigned to each GMPE in the tree are based on their suitability for different depths of seismic sources. The GMPEs used in this analysis are derived from studies conducted by IGN-UPM (2017) and Poggi et al. (2020) and take into account the specific rupture mechanisms associated with each source. Fig. 3b illustrates the use of our logical tree with various MCEs from sources at different depths.”

Line 551: unclear

R: This paragraph was removed.

Lines 565 and 566: for DSHA only

R: This sentence was removed.

Line 570: no information on this sentence

R: The sentence was rewritten as follows “The maximum expected MCE or magnitude of a seismic source is considered to be the upper limit, assuming that no earthquake generated by that source will exceed this magnitude (Joshi and Sharma, 2008).”

Line 576: what is the value of R taken for the MCE of each zone, and how is it determined?

R: R is determined as in classic DSHA procedure: the shortest relative source-site distance. Some GMPE uses planimetric projected distance, others include also vertical depth distance.

Line 615: rewrite

R: This paragraph was removed.

Line 622: unclear

R: We see no error. The passage is clear and correct.

Line 623: movement?

R: Thank you for your observation. The correct word is "motion".

Line 640: code here is unexpected

R: The code was deleted.

Line 679: median, not "average"

R: Corrected, thanks.

Line 687 to 696: several comments

R: These paragraphs have been deleted.

Line 700 to 733: several comments

R: These paragraphs have been synthesized and rewritten.

Line 736 to 752: several comments

R: This paragraph was synthesized and rewritten.

Line 757: Credible

R: Corrected, thanks.

Line 759:

R: Corrected, thanks.

Line 768: unclear

R: This sentence was removed.

Line 775: unclear

R: This sentence was removed.

Line 783: what is the control earthquake of a source? Where is it located?

R: Thank you for your observation. The correct phrase is “according to the MCE of each source”.

Line 784: the blue symbols for $R > 60$ km are hidden, use other type of marker

R: No, they are not hidden, blue markers are overlapped by red ones. overlapping (i.e. negligible DTM effect) are for sources with 100 km distance.

Line 785: unclear. The point being?

R: This paragraph was removed.

Line 792 to 807: several comments

R: This paragraph was synthesized and rewritten.

Line 812: The values mean different things and should not be compared. The PSHA is associated with a return period (not specified in the comparison by the way)

R: This sentence was deleted during the revision and synthesis of the manuscript.

Line 969:

R: This paragraph was revised, synthesized and rewritten.

Line 1004:

R: This paragraph was revised, synthesized and rewritten.