

# ***Interactive comment on “Assessment of potential seismic hazard for sensitive facilities by applying seismo-tectonic criteria: an example from the Levant region” by Matty Sharon et al.***

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We would like to thank the unanimous reviewer for his/her in-depth review of the manuscript and his/her constructive and important comments. Following the comments, we have thoroughly revised the article. The manuscript title, introduction, discussion and conclusion chapters were rewritten. We provide below detailed replies to the reviewer's comments and indicate how and where changes were made in the revised manuscript.

“1- The title is irrelevant as I could not see a comprehensive seismic hazard analysis, unless the author consider defining the active and capable faults (seismic source

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model) is a complete hazard assessment process. It is very important component in any seismic hazard study, but it is not the entire process."

Author's response: We accept this comment. We have changed the title of this paper. New title: "Assessment of seismic sources and capable faults through hierachic tectonic criteria: implications for seismic hazard in the Levant"

"2- Regarding the exclusion of a very important event Md 5.8 1993 due to unreliable location, please show how much the location is uncertain. Compare this with the clear uncertainty in location around the Gulf of Aqaba."

Author's response: The event Md 5.8 1993 is indeed important, but we note that it occurred in the most seismically active zone of the Gulf of Elat (Aqaba), in such distance from the inland mapped faults, that it would not have any impact on the current results of the mapped fault. Since the focus in this paper is the mapping of faults, we think that adding further details such as error issues of a specific earthquake, which has no impact on the mapping of any fault, is irrelevant. We now clarify this though.

Author's changes in manuscript (lines 189-190): "large location errors (including the  $M_d=5.8$  1993 event in the Gulf of Elat, which anyhow does not affect the marking of faults in this paper since it was nucleated outside our high-resolution geological data)."

"3- Please show how many circles are included in your calculations and the weight of each circle"

Author's response: There 'circles' were given as an illustration, as mentioned in the text. However, we now see this illustration might be confusing, so we rephrase:

Author's changes in manuscript: "This circular-shape based approach prevents any directional bias."

the continuation of the last comment: "and why did you select (calculate) such weight."

Author's response: see lines 213-218:

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“The 6-km limitation, the Gaussian function and its standard deviation of 2 (for the kernel estimation), were tuned and chosen to: a) capture different seismic patches along active faults; b) be significantly larger than the location horizontal median error (~1.2 km; Wetzler and Kurzon, 2016); c) assign higher weight to events closer to the evaluated grid-point; d) include as many events as possible for achieving statistical significance at each of the grid-points. “ “4- It seems that the catalog contains the aftershocks of large earthquakes, please show the role of these aftershocks as they are not due to primary tectonic movements. What is the situation if these aftershocks are removed from the calculations of earthquake kernel density distribution?”

Author’s response: Indeed, the catalog contains the aftershocks of medium to large earthquake. As already mentioned, the focus of this paper is the mapping of faults, based on the suggested methodology of hierachic seismo-tectonic criteria. Showing the exact role of the aftershocks, and the situation if they are removed from the calculation, is a different topic. We also note that aftershocks may be also associated with reactivation or even surface rupture, so they should not be neglected in a seismicity-based criterion for a capable fault map.

“5- For many faults the slip rate is provided based upon geologic or GPS surveys. Such slip may contain a creep component in addition to the seismic one. The role of creep should be addressed for all active faults as it could be a source of large uncertainty.”

Author’s response: We had already addressed the issue of evidences for a creep component: see discussion (lines 516-523) and Table 1 (lines 790, 794):

“5- With the large periods of quiescence observed frequently along many parts of DST, 35 years of instrumentally recorded seismicity are very short to reflect the active tectonics accurately. This period should be extended using robust historical records.”

Author’s response: We regard the information of historical earthquakes for estimating the maximum magnitude (lines 316-318):

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“6- Although the seismicity and earthquake kernel density distribution show high seismicity to the east of the Gulf of Aqaba, neither active nor capable faults are inferred at this area.”

Author’s response: As we already noted (see response to reviewer 2), the capable fault map, except a few exceptions (see Sec. 3; 6) does not include the the neighboring countries. Specifically, we mapped a few faults within the Gulf of Aqaba that we define as ‘main seismic sources’ (see Sec. 5). This is sufficient for our purposes, which we now describe more clearly through the paper.

“7- Abbreviations should be explained at their first appearance in the text (e.g. LRB). Some abbreviations has no explanation (QFMI).”

Author’s response: Corrected.

“8- Minor comments a) Line 54 contains two fullstops, please remove one of them. b) Arrange references in line 116 in a chronological order. c) Sentence in lines 147 and 148 needs reference. d) Change figure 4 into Fig. 4 in line 258. e) Change demonstrates into demonstrate in line 282. F) Change is represents in line 366 into represents. g) Rewrite lines 408 to 411 as it is really so difficult to be followed. h) Remove many in line 454. i) Sea of Galilee should be shown on a map. j) ARF is repeated in Fig. 7. k) All the maps lack to the North Direction Indicator.”

Author’s response:

Two full-stops are now removed in all parts of the manuscript. Corrected (now in line 119) Author’s changes in manuscript: “(e.g. Amit et al., 2002; Marco et al., 2005; Marco, 2008).” We now add a new reference (now in line 185): Author’s changes in manuscript: “Moreover, the boundary Pleistocene-Pliocene (Neogene-Quaternary) was shifted in 2009, from  $\sim 1.8$  Ma to  $\sim 2.6$  Ma (Gibbard et al., 2010)”. Corrected (now in line 267): Author’s changes in manuscript: “[...] is shown in Fig. 4” Corrected (now in line 274): Author’s changes in manuscript: “faults that demonstrate slip rates [...]” Cor-

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rected ("is" is deleted, now in line 375): Author's changes in manuscript: "The regional stress state within the Quaternary period represents well the current stress field" We rephrased (now in lines 416-419): Author's changes in manuscript: "The polygons are defined by a threshold value, so that each of them is the smallest to cover continuously the whole length of the most active tectonic feature in the region. In this case study, this feature is the DST, but we exclude the relatively silent northern section of the Jordan Valley segment" Already removed due to comment by Anonymous Reviewer #1 We added marks for the Dead Sea Basin (DSB) and for the Sea of Galilee (SG) to figure one. Fixed. All our maps are orientated such that the north is directed upwards. We do not think that north arrow is necessary.

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