Nat. Hazards Earth Syst. Sci. Discuss.,
https://doi.org/10.5194/nhess-2019-67-AC2, 2019

Natural Hazards and Earth System Sciences
Discussions

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.

Matty Sharon et al.

asagy@gsi.gov.il

Received and published: 7 August 2019

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) "I find nothing new in terms of methodology."

Printer-friendly version

Discussion paper

Author's response: The reviewer is right that seismo-tectonic criteria for categorizing faults were previously applied during seismic hazard analyses. However, in addition to classifying hazardous faults by the recency of faulting or their recurrence intervals: a) We design a seismicity-based criterion that use the distribution of two parameters: the Earthquake Kernel Density and the Seismic Moment Kernel Density. The success of this selection is further reinforced by the match between the geological-categorized faults and the seismicity criterion (Fig. A3). b) Seismic sources for ground shaking maps are considered only faults that are satisfied both geological and seismological criterions. This is significant when slip rates are mostly unknown (as in Sec. 5.2). c) The internal hierarchic categorization of faults, in both maps enable weighting different faults when hazard analysis is applied.

We added a section summarize the above points to the discussion (Sec. 7.1, Please see our response to reviewer 1).

2) "If the goal of this research is to describe a new approach for seismic hazard assessment for critical facilities, this goal is not achieved"

Author's response: We agree and following the comment of the Anonymous Referee #1, we have already changed the title of this paper, so it is no longer "assessment of potential seismic hazard".

3) "First of all, the manuscript deals with Israel region, and I do not see how this approach can be exported to other seismo-tectonic settings."

Author's response: We now specifically discuss the universal aspects of our analysis in Sec. 7.1 (Please see our response to reviewer 1.

4) "Even for the Israel region, the manuscript does not address the most critical issue , that is the potential for M>6 earthquakes and accompanying surface faulting in the areas that are not close to the Dead Sea Transform, such as the Sinai peninsula and the coastal region along the Mediterranean Sea. This topic should be discussed based

on the data presented in the manuscript. Several critical facilities in the Levant region are located, or are in the process of being located, relatively far from the DST. The reason is obvious, the seismic hazard along the DST is clearly very high, and whenever this is possible sites along the DST are immediately discarded during any process of siting for high risk plants and infrastructures. The manuscript should be revised in other to take into account ground motion and ground rupture hazard evaluation in the less active areas."

Author's response: The potential of capable faults, which are not part of the main seismic sources, is indeed not discuss in this paper. The aim of this paper was to separate the capable faults from other faults and categorize them. The next step should be generating statistic and/or deterministic methods for defining the safety distances for any specific siting. This is beyond the scope of the paper.

5) "Moreover, the criteria used for interpreting Quaternary faults as capable faults are not very clear. Some marginal fault of the DST is interpreted as "source of M>6 earthquakes", some other as "capable fault". This is misleading. If the definition of capable fault is "a fault with significant potential for earthquake surface faulting", a fault capable of surface faulting is by definition a source for M>6 earthquakes; of course, assuming that hypocentral depth is shallow crustal, as clearly stated in Wells and Coppersmith (1994).

Author's response: The faults in the different maps (Figs. 5, 7) are all capable to generate large earthquake (M>6), however the time frame, slip rates and seismological activity are different. Specific definitions are presented and explained in the beginning of Sec. 5 and Sec. 6.1 "Framework and principles".

6) "If the problem is the probability of surface faulting events, there should be a discrimination in terms of seismo-tectonic setting. Along the DST, that is a very active structure, the time window to be considered for capable faults should be relatively short, like the Holocene, or 13 kyr BP (the Lisan Lake shoreline criterion used in the regulatory

framework for Israel). For the Sinai region, the Quaternary criterion is much more reasonable. The choice of different time-windows for fault capability takes into account the regional plate tectonic setting of the Levant. Using the Quaternary time windows for the whole region does not."

Author's response: Basically, we think that using longer time intervals for defining capable faults as the distance from active sources increase can be misleading. Even using the "earthquake cycle" period, for defining capable faults, as suggested by Machette (2000), might be sustained only when large regimes are compared. We (see Sec. 6.1) suggests that the combination of the tectonic regional field (stress field orientation, displacement rates) and the level of the geological information (stratigraphy, map resolutions) should determine the relevant time frame for capable faults.

7) "In fact, from the historical seismicity perspective, all along the Dead Sea Transform you have a sequence of large events with epicentral intensity X or XI in the MM scale. This implies that virtually every fault along the DST might have been reactivated by coseismic surface faulting in the past 2000 years or so. This macroseismic evidence should be properly taken into account."

Author's response: The estimated Intensity of past earthquakes is translated into magnitudes. We already considered the interpretation of historical earthquakes for estimating the maximum magnitude at the end of Sec. 5.1: "Previous analyses of maximum earthquake magnitude based on historical earthquakes or on background seismicity predicted magnitudes of $\leq$ 7.8 Mw for the largest segments (e.g., Stevens and Avouac., 2017; Klinger et al., 2015; Hamiel et al., 2018a)."

We think that these references and the related slip rates are sufficient for this paper purpose.

8) "In Figure 7 from the manuscript, there is no Quaternary fault East of the DST, and very little West of the DST. Is this a real feature, or is controlled by the completeness and resolution of the instrumental and geological database?"

Author's response: Indeed the Capable fault map not include faults in neighboring countries. We now clearly declare in Sec. 6.1 "Finally, because of the limitation of our database, mapped capable faults (Fig. 7) are limited to Israel region, unless their continuations spread to the neighboring countries." ; also see our geological database in Sec. 3.

9) "The manuscript describe and discuss the available instrumental earthquake catalog. No discussion and description is available about the historical catalog. Integration between instrumental and pre-instrumental datasets is fundamental for seismic hazard assessment. Please discuss."

Author's response: We regard the information of historical earthquakes for estimating the maximum magnitude. Further considerations are beyond the scope of this paper. We now changed the title of our manuscript so it is no longer "seismic hazard assessment".

10) "A few papers cited in the text are not included in the list of references; find this in the attached annotated manuscript."

Author's response: Fixed

11) "Please also note the supplement to this comment: https://www.nat-hazards-earth-syst-sci-discuss.net/nhess-2019-67/nhess-2019-67-RC2-supplement.pdf"

Author's response: We responded to the comments in this pdf file, and clarify associated issues in our new version of the manuscript.

Please also note the supplement to this comment:
https://www.nat-hazards-earth-syst-sci-discuss.net/nhess-2019-67/nhess-2019-67-AC2-supplement.pdf

Interactive comment on Nat. Hazards Earth Syst. Sci. Discuss., https://doi.org/10.5194/nhess-2019-67, 2019.