



Comment on nhess-2021-393

Stéphane Baize (Referee)

Referee comment on "Classifying offshore faults for hazard assessment: A new approach based on fault size and vertical displacement" by May Laor and Zohar Gvirtzman, Nat. Hazards Earth Syst. Sci. Discuss., <https://doi.org/10.5194/nhess-2021-393-RC2>, 2022

The paper presents a large compilation and analysis of high-quality bathymetric and seismic-reflection data, with the aim of providing classification and mapping of subsea faults that are potentially hazardous for installations. The region of concern is vast (120 x 40 km²) and corresponds to part of the margin of the eastern Mediterranean basin, off Israel. This margin is subjected to significant deformations of the most superficial layers (0 to 1-2 km) of Plio-Quaternary age. These deformations are largely due to the mobility of this sedimentary cover on the salt layer dating from the Messinian, amplified by the slope of the margin.

The paper fits the objective of the journal, presents relevant products for further hazard analyses (surface displacement maps, deterministic hazard map) and then deserves to be published. However, I think there must be major revisions, including formal improvements, additional analysis, and moderation in some interpretation.

We appreciate the positive evaluation of our paper and would like to thank Reviewer #2 for his helpful and comprehensive suggestions for improving it.

The major criticisms are as follows.

- Some figures are too small and labels and captions are barely visible.

Thank you, we will enlarge the labels.

- The authors should develop the data and methods section and provide more information on data availability and processing options (mainly seismic reflection).

The data are industrial data that are part of the database of the Geological Survey of Israel. Unfortunately, Data availability is limited. Details can be obtained from the Israel Ministry of Energy (<https://prime.energy.gov.il/>).

- The part of Section 2 concerning ancient (pre-tertiary) geology could be lightened, and the part concerning elongated Neogene. In addition, a paragraph is missing which links (or not) the structures observed with the tectonic faults known on land.

We will add a paragraph describing previous works about on-land faults in section 2.2, as also requested by referee #1. We will add on-land faults on the inset map of figure 1.

- Section 4 (Results) should be restructured to be consistent with the maps and figures produced. Some figures are barely commented and deepened, which is a shame.

Thank you. We will improve and clarify the fig. captions and the text describing the results.

- Section 5 (Discussion) needs to be improved. Most of the current content is a summary of previous sections, not a discussion.

Combined with the requirements of Reviewer #1, we'll add a chapter at the end of the discussion that will discuss how the following observations may be reconciled:

1. Surface rupture
2. Fault plane area of thin-skinned faults
3. Separation between Miocene faults that have apparently ceased to be active and the thin-skinned faults.
4. Earthquakes location- in depth (Miocene), or in the shallow part (salt-related faults).

This discussion leads to the question of whether the relationship between surface rupture and magnitudes as recognized from crustal faults is valid for shallow, thin-skinned, faults rooted in salt.

- The interpretation of seabed scarps, as evidence of coseismic ruptures, is in my opinion doubtful, even erroneous, if one considers the context of the development of structures on the slope of the margin and the occurrence of salt-related deformations. To demonstrate a relationship with earthquakes, the authors must provide more observations.

Large (tens of meters) surface ruptures are observed in an area with high sedimentation (1-2 m/ky) rates. This necessarily means that the displacement rate is greater than the sedimentation rate, otherwise, all fault scarps would have been buried with no seabed expression. The fast motion of the faults may be explained by seismic ruptures, but the earthquake catalog does not support $M \sim 5$ earthquakes predicted from the measured fault plane area of the big faults. Alternatively, the fast motion may express very fast creep (1-2 m/ky or more). This subject requires more research, which is out of the scope of this manuscript. However, in light of this comments, we will change the terminology from "seismic rupture" to "fast rupture", and add a discussion paragraph to clarify this enigmatic issue.

- There is a lack of analysis of the maps and displacement profiles produced (Figure 3 in particular), especially when comparing seabed scarp heights and Unit 4 throws at key locations, and/or for each fault identified.

All fault displacement values are projected on N-S profile. We will clarify this.

- It would be useful that the authors suggest ways of using the deterministic hazard map provided. Is this to be used to exclude any installation on «red» faults, or is it a decision tool for the engagement of further studies? Which of studies could be made to assess the hazard (probability of displacement)? What about the existing installations on "red", "yellow", "green" faults?

That is a major issue. We note, however, that the question of how to use this map is not in our field. We prepared this map for regulatory agencies and it is for them to define regulations. They may instruct infrastructure planners to choose a curvy route between faults; or to cross only "green" faults; or to require engineering solutions for sites crossing red faults. These decisions are not in the research field but in the regulatory field.

Specifically, in our case, the work was done with the support of the Ministry of Energy of Israel, and together with the Ministry of Environmental Protection and the Standards Institute will make decisions regarding the standards development.

- Finally, an important point is to state on the availability of original data (bathymetry, seismic profiles), developed tools (algorithm) and results (numerical files of fault maps, seabed scarps, displacement measurement points, etc.).
- The data are industrial data that are part of the database of the Geological Survey of Israel. Unfortunately, Data availability is limited. Details can be obtained from the Israel Ministry of Energy.

The details of the comments are available in the attached pdf file.

We appreciate the detailed comments that surely consumed time and effort. We will address them while correcting the manuscript. Thank you.

Stéphane Baize

Please also note the supplement to this comment:

<https://nhess.copernicus.org/preprints/nhess-2021-393/nhess-2021-393-RC2-supplement.pdf>