Comment on nhess-2022-121
Lucy Bricheno (Referee)

Referee comment on "Multi-hazard Analysis of Flood and Tsunamis on The Western Mediterranean Coast of Turkey" by Cuneyt Yavuz et al., Nat. Hazards Earth Syst. Sci. Discuss., https://doi.org/10.5194/nhess-2022-121-RC2, 2022

"Combined Hazard Analysis of Flood and Tsunamis on The Western Mediterranean Coast of Turkey"

Review 26 August 2022

This paper examines the multi-hazard risk from offshore tsunami and inland river flooding. Multi-hazards at the coast are little studied, and it is nice to see examination of this combination of disciplines being used on a practical application.

I have to say upfront - as my focus is marine numerical modelling I do not feel especially qualified to comment on the specific natural hazards (largely the earthquake modelling), however I will do my best to give a constructive review based on materials, methods, clarity and readability.

Lucy Bricheno

Summary

The authors use a monte-carlo method to generate synthetic earthquakes. They check that they have sufficient data to be representative. These are then assessed for
magnitude to assess if they will be tsunamigenic. Nami-Dance software is then used to simulate the tsunamigenic hypothetical earthquakes and calculate resulting tsunami wave heights at Fethiye coast. The methodology for Tsunami modelling (Nami-dance) seems sound. As amplification is not modelled (grid too coarse) they apply an empirical fit to calculate the local amplification right down at the coastal scale (1m water depth).

MIKE Flood is used for 1D and 2D hydraulic modelling (presumably this is river flood, though it is not explicitly stated in section 2?). Authors chose Q10 (return period of 10 years) for their analysis. They construct a MIKE 1D river network model based on surveyed streams. This model then informs the 2D inundation model, constrained by a 1m resolution DEM. Precipitation is not considered. The 1D and 2D models are run in simultaneously (coupled). The network model is then forced by the Q10 values for each of the 8 river catchments arriving in Fethiye region. The 2D model is constrained by roughness derived from a land cover map and DEM. There is no calibration or validation of the 1D stream model.

After the MIKE models have been run, the results of these and the tsunami generated flood are classified by hazard vulnerability following Smith et al. The extent of flood caused by river discharge is relatively small. The hazard generated by Tsunami dominates, however where fluvial flooding happens, it can be significant, doubling the inundation.

General Comments

The paper presents well the models and methods used, and the results it presents are clear and well presented. But to be published, I would expect a deeper investigation of the multi-hazards and their interaction. At least 1 or 2 experiments for example:

It would be interesting to rerun the model with a range of return levels (you mention 50-year and 100-year floods in your introduction)

In the model, you assumed that the river flood occurs just after the peak tsunami. I would like to see further experiments where you explore the sensitivity of the timing of the flood (with and without the sea levels change introduced to the hydraulic model by tsunami)

There is some good material here - and I appreciate the work that has gone into preparing the models and data. Performing some more experiments to explore the sensitivities to these multi-hazards would greatly inform the quality of the paper and scientific interest namely:
- experiments with river flood of different return periods (Q50, Q100)

- experiments with flood arriving with/without tsunami influenced sea-level

I recommend a major revision before this paper is acceptable for publication. Wish you the best in developing your interesting work
When you say 'flood' this is fluvial only? Not precipitation or coastal (wave/surge). You mention you are not considering hazard resulting from seismicity - but also explain if/why precipitation and coastal wave and surge floods are out of scope.

E.g. could you give a rough figure on how much % of freshwater flood is driven by river v.s. rain in this region to easily justify omission?

Turkey is at high risk from surge / coastal flood


(do you need Figure 1? Just taken from someone else's paper) Maybe just add a line in the text summarising Munich Re (2020)

Figure 2: consider showing epicentres of earthquakes in you scene-setting map. Highlight areas of flooding - this is a missed opportunity to share more info in the figure. Actually, this information is present in subsequent figures - therefore suggest you just cut figure 2 as well.

Gutenberg-Richter relationship is a key method. Introduced on p3 line 65, but not further defined. Please include the equation and a reference at this point - I presume it's this?? "Gutenberg, B., Richter, C. F., 1956. Magnitude and Energy of Earthquakes. Annali di Geofisica, 9: 1–15"
Technical corrections

Line 46-48 long sentence - not clear what you are saying. Is exceedance a specific statistical term?

"The exceedance of flood hazard is strongly likely depending on geological and meteorological circumstances, the hazard is included in the stochastic analyses conducted in this study as aleatory variability"

Figure 4: please label axes so that it is clear which magnitude is generated by which method (Gutenberg-Richter vs. normal) - currently they are both labelled as "Mw"

Figure 5: what are Sample 1,2,3 ? This is not explained

the legend of figure 6 is wrong (repeat of figure 5 legend)

line 178 : "The downstream boundary condition for a discharge of having 10 years return period of each stream is determined as water level. " Should this be 'determined as mean sea-level"?