Natural Hazards and Earth System Sciences
Discussions

Nat. Hazards Earth Syst. Sci. Discuss., referee comment RC1
https://doi.org/10.5194/nhess-2022-126-RC1, 2022

Comment on nhess-2022-126

Anonymous Referee #1

Referee comment on "Characteristics of consecutive tsunamis and resulting tsunami behaviors in southern Taiwan induced by the Hengchun earthquake doublet on 26 December 2006" by An-Chi Cheng et al., Nat. Hazards Earth Syst. Sci. Discuss., https://doi.org/10.5194/nhess-2022-126-RC1, 2022

Review of paper 'Characteristics of consequtive tsunamis and resulting tsunami behaviors in southern Taiwan induced by the doublet earthquakes on 26 December 2006' by Cheng and co-authors

This report gives a review of the manuscript entitled 'Characteristics of consequtive tsunamis and resulting tsunami behaviors in southern Taiwan induced by the doublet earthquakes on 26 December 2006' by Cheng and co-authors. I found the study interesting as it digs into previously sparsely investigated phenomena of earthquake doublets and tsunami wave trapping, using spectral analysis of the waveforms to analyse the wave trapping. Based on my reading of the paper, I still found a number of items that needs improvement, these are listed in the line-by-line comments below. Moreover, some more overarching shortcomings also appeared. Hence, the paper cannot be accepted in its present form, and would in my opinion need to address the below comments before it can be considered for publication:

General comments:

The paper presents a relatively simple and transparent approach which make the reasoning mostly (see further comments below) easy to follow. On the other hand, the authors present a limited number of numerical analyses, and do not investigate uncertainty and variability in the sources and bathymetry much. Using only two different bathymetric sources and earthquake sources is very limited given the uncertainty present in the data behind. The lack of fit of the tsunami observation, given the under sampling (see line-by-line comments below), also opens some questions, as one would expect overestimation of the badly sampled signal in the numerical model, but the paper presents

the opposite. To this end, I think the sensitivity aspects of the analysis is not sufficiently discussed. The authors could easily have broaden this by for instance including a set of heterogeneous slip scenarios. The manipulated bathymetry probably exaggerate a rather hypothetical situation compared to existing data, and one could think of scenarios in-between. In general, I would like these aspects to be discussed much more, and in a more critical way. I leave it to the authors to suggest if additional analysis would be needed in addition to better shed light on parameter sensitivity.

There are too little details related to convergence tests and the numerical mesh resolution used. The authors must as a minimum present numbers that back up the numerical accuracy of their analysis, for instance through mesh resolution tests.

The paper is mostly easy to follow, but the English writing and clarity should clearly be improved. I made some remarks (see below) but I could have added further corrections. I suggest that the authors go more critically through the their text and tries to improve clarity and spelling as much as possible.

Line-by-line comments:

Line 15: Please remove 'for the first time'

Line 44: I suggest putting in a reference to Figure 1 already here.

Line 51: The Lay and Kanamori refence is general but the way the sentence reads it sounds like the paper refers to this event. Please rephrase, and include a specific refence work (e.g. from seismology) that consider the 2006 event in particular.

Line 51: 'Casualities', do you mean 'fatalities'? The former also refer to injuries, the latter only to loss of life.

Line 57: 'propagated toward' à 'propagated towards'

Line 60: Rephrase sentence, my suggestion 'as it was rare because it was generated by earthquakes in short sucession'.

Line 62: 'heightens' à 'increased'

Line 65: Several repeats of the above in this paragraph, I suggest shortening.

Line 67: Please delete sentence starting with 'It has been common understanding…'. This can certainly be disputed and the scientific community is definitely aware that later wave arrivals can be larger than the first.

Line 71: 'prolonged'? Prolonged compared to what?

Lines 80-81: Something is missing in these statements, please rephrase so the meaning is more apparent.

Line 91: 'justify' à 'hindcast'

Line 99: Please delete 'In general', and replace the statement 'possible method to study' with 'one source of information we can use to study'. The point is that it can only be supplementary to other methods, it is usually not enough by itself.

Line 112: 'represent the duration' à 'represent the observation' (duration written twice in sentence)

Line 113: Remove 'of observation'. 'duration' à 'durations', and 'was' à 'were'

Line 127: 'The' Fourier analysis …

Line 137: 'the' wavelet analysis …

Line 144: The first sentence in the paragraph is somewhat misleading. I would rather say

it is a computer based method describing the equations of motion for the tsunami wave propagation. You could also add that there are various methods, but that the shallow water model is most used, although dispersive models are more and more used as well.

Line 149: I would say that TUNAMI also cover far-field tsunamis, with limitations of course.

Line 155: You do not describe mesh refinement anywhere. How do you ensure convergence? What is your grid resolution, and what exactly is the CFL number? It should be a minimum to test convergence at least with two different (optimally three) mesh sizes.

Line 160: You have stated this before. I suggest to delete this sentence that only repeats what is already written in the intro.

Line 168: Are you simulating with uniform slip? Could you gain anything with adding non-uniform slide and simulate different realisations of the slip distribution? This deserves to be discussed more.

Line 186: 'horizontal effect' à 'horizontal deformation contribution to tsunami generation'

Line 191: Why could this not have been caused by landslides? Please elaborate / substantiate, or otherwise skip this statements if you cannot back it up more explicitly.

Line 193: Add 'simulated' before 'initial'.

Line 203: You may need to elaborate what you mean by 'two bathymetric scenarios'. You probably mean tsunami simulations applying two different bathymetries. You may motivate your work by mentioning how wrong the open source bathy was for 2018 Palu. Similar for 2018 Anak Krakatoa (e.g. Zengaffinen et al., 2021).

Line 207: Both are scenarios in a way. I would rephrase, and rather say 'manipulated bathymetry' rather than 'hypothetical scenario'.

Line 211: You only investigate two different bathymetries, and this might be a bit thin to conclude in general. I suggest that the uncertainty related to the bathymetry is discussed

more.

Line 231: Please rephrase 'different mechanism of tsunami waves was' à 'different propagation effects were'

Line 237: The aspects of the wave recordings should be move more up front, at least withing this subsection, it is important background.

Line 254: You say 'abnormally long', but compared to what?

Line 271: What does the background spectra contain? Are they de-tided? Please clarify.

Line 293: I think this is stating the obvious, and it could perhaps be skipped?

Line 329: 'determined'à 'estimated'

Line 372: I would say it is the opposite: The data can be used to validate the numerical simulations.

Line 377: If there is undersampling, you would normally expect the numerical simulations to overestimate the wave measurements, because the measurements would miss out on larger amplitude waves. Here it seems to be the other way around, implying that the simulations are lower than you would expect from the measurements. The authors need to elaborate on this. For instance, why was not alternative scenarios or random / heterogeneous slip investigated with several scenarios?

Line 388: Replace 'It is commonly understood that' with 'The longest wave component'. Then add an 'a' ahead of 'velocity'.

Line 390: Add 'through diffraction' after 'wave direction'.

Line 391: 'of the' à 'using'

Line 395: I found it difficult to follow the authors in this paragraph. I suggest that the authors review the text and try to rephrase it, at least the first 6-7 lines.

Line 422: I suggest to comment on previous studies investigating fits and misfits using open source bathymetry and topography data, e.g. Griffin et al., (2015).

Line 426: The sentence starting with 'These results further confirmed …' I found was formulated too conclusive. The number of investigations are rather limited, and there should be room for additional investigations to strengthen the conclusion related to wave trapping.

Line 439-441: What the authors write here is not clear from the figures. If there is additional not shown that back this up please state this explicitly.

Line 482: 'characterized' à 'analyzed'

References:

Griffin, J., Latief, H., Kongko, W., Harig, S., Horspool, N., Hanung, R., ... & Cummins, P. (2015). An evaluation of onshore digital elevation models for modeling tsunami inundation zones. *Frontiers in Earth Science*, *3*, 32.

Zengaffinen, T., Løvholt, F., Pedersen, G. K., & Muhari, A. (2020). Modelling 2018 Anak Krakatoa Flank Collapse and Tsunami: effect of landslide failure mechanism and dynamics on tsunami generation. *Pure and Applied Geophysics*, *177*(6), 2493-2516.