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Comment on nhess-2021-58

Anonymous Referee #1

Referee comment on "The M_w□7.5 Tadine (Maré, Loyalty Islands) earthquake and related tsunami of 5 December 2018: seismotectonic context and numerical modeling" by Jean Roger et al., Nat. Hazards Earth Syst. Sci. Discuss., https://doi.org/10.5194/nhess-2021-58-RC1, 2021

This paper presents an analysis of the Mw 7.5 earthquake and related tsunami occured on December 5th, 2018. The analysis included description of the source, field survey and tsunami numerical simulation.

My major concern is that the paper does not have a clear focus and it is difficult to find one main idea throughout the paper. Is the focus the earthquke? the tsunami field survey?, the numerical simualtions? validation of numerical modes? or the analysis of tsunami hazard? I recommend to focus on the tsunami behaviour in order to explain why a small event can generate a large tsunami. Then, the field survey, tide gauge data and numerical simulations can be used to explain that phenomenon. I do not believe that with one event you can make an analysis of the implication for tsunami hazard. It could be mentioned in the discussion, but as the paper is right now, it is not possible to include it in the title, unless the focus of the paper is the tsunami hazard. In that case, more information and state of the art on tsunami hazard in New Caledonia should be mentioned in the Introduction as well as your current contribution.

Another concern is related to tsunami numerical simulations. Only uniform slip distribution is used, but it has been demosntrated that uniform slip may underestimate the hazard. See for example Melgar et al 2019; Carvajal and Gubler 2017; González et al. 2020; Geist and
Dmowska 1999. This could be an explanation why simulated tsunami waveforms at tidegauges are not in agreement with tide gauge records Would it be possible to use a nonuniform slip distribution model? It would be desirable to propose some finite fault models of the earthquake by means of seismic records, thus seismic parameters such as strike, dip and rake are properly defined.

The paper does not have an introduction, and the main objective of the paper is not clearly described. In addition, the section 1 "General Setting" is too long to be an introduction. this section should be compressed and be part of a "Study area" section. It is very important to define the focus of your paper, then, define which information regarding

the tectonic setting is relevant.

The title mentioned the "implications for tsunami hazard", but none of the sections mentioned anything realted to current tsunami hazard analysis in the study area. If the focus of your paper is the implications for tsuami hazard, you should present the state of the art of tsunami hazard in New Caledonia, such that the scientific gap and your contribution are clearly described in the introduction.

Another minor comments are the following

- Figure 1. Please add a general map here, such as the left hand side map in Figure 3.

- line 46, it says "pressure gages", but in other places, such as line 425 it says "tide gauges". Use gage or gauge, but not both.

- section 1.1 and 1.2 report significant amount of information regarding past earquakes, but the point is not clear. Would it be possible to combine Figure 1 and 2 and summarize the important facts only?

- line 161 indicate a finite fault model from USGS. Why didnt you use this model? You only mentioned this model, but do not explain why it is discarded.

- Figure 3. It is difficult to read this figure. I recommend to improve it, for example, add also field survey data to this figure, and add the magnitude of the measurement (the number) and not only a color. Instead of a color, add insets with the tidegauge records, thus we could see maximum amplitudes and the tsunami behavior as a function of time.

- Section 2.2.2. All measurements and maximum amplitudes reported in this section should be listed in a table with longitude and latitude coordinates. In addition, measurementes should be indicated in Figure 3, as mentioned in a comment above.

- Fiure 5, please draw the coastline to see better the islands.

- line 292. Please explain how L=80km and W=30km were defined. The model from USGS used L=160km. How did you come up to 80 km? did you use a scale relationship? if so please explain which ones.

- lines 285 to 295. Several seismic parameters are presented here, however, in line 353 two strike anlges are mentioned, but they were not mentioned earlier. I suggest to add a table in section 3.1.2 with all seismic parameters used in the numerical simulations, including the two strike angles and depth.

- lines 336 to 340. You described a sensitivity analysis regarding the kinematic tsunami initial condition. I understand that you used a linear variation during 50s with time step of 1s, but previously you mentioned that the USGS model has 3 patches and it website shows a rate of moment release with 4 peaks during the 50 s. Therefore, it is inconsistent. Please explain why you made a sensitivity analysis. Why not simply using a static sea bottom deformation by means Okada formulation?

- line 353. Please explain why you used these two angles in section 3.1.2. In addition, in line 159 you mentioned several combinations of parameters according to different observatories, but later you select only one dip and rake ablges, and vary the strike angle. Please explain better the assumtions in section 3.1.2. from lines 291 I understand that you will use the GCMT parameters (312°, 36° and 90°) but then you also used 298° for strike angle.

- line 342. It says that simulations have a slapsed time of 3 h, but it may be short considering the distance from the source to the points of interest and resonance effects, as mentioned in line 250. Did you check any resonance effect?

- Figure 6. I suggesto to draw the trech in all figures in order to better sea differences between tsunami source models.

- lines 372-420. results here are only descriptives, and no analysis nor discussion on tsunami behavior is presented. Please, according to your results and analysis, explain why you have amplification (see lines 378, 379, 383, etc).

- lines 396 to 399. It says that the modelling is not able to reproduce the tide gauge record in terms of arrival time and amplitude, but no analysis nor discussion are presented in order to find possible causes. Please explain possible causes such as grid resolution, bathyemtry errors, fault location (fault model is closer to the tide gauge than the real rupture), uniform v/s heterogeneous slip, etc?

- Figure 8. only two hours of numerical simulations are shown. If you simulated 3h, please show the 3 h. It seems that the third wave in figure f is larger than the second, but it is not shown. In addition, adjust the vertical scale in figures g an h, thus the whole amplitude is shown in the plot.

- The paper needs a Discussion section, thus all results and implication in tsunami hazards are discussed. In addition, you can discuss whether the phenomena observed here (amplification, defocusing, resonance, etc) have been observed in other places, thus you can explain the tsunami bahaviour in the current event, and , hopefully, explain what could happen in future events.

- line 467-468. it says "to reproduce the tsunami correctly..." I am not sure whether your simulations allow to conclude this. I rather say this is in fair agreement, since most of your tsunami waveforms are not well reproduced. If you only compared maximum amplitudes, this analysis whould be included in a discussion section. You can also compare numericaly the simulated and measured maximum amplitudes.

- lines 469-470. Is the paper focused on the validation of MOST and SCHISM models? I am not sure if you can conclude this, due to the fact that arrival time and maximum amplitudes given by your simualtions do not show good agreement. Possible errors (epistemic and aleatory) are many, and you can also discuss about this in a Discussion section.

- lines 473-477. These statements are more suitable for a discussion section.

- Finally, the conclusions are very weak, since there is no Introduction section with clear objective and there is no Discussion section either.