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Comment on nhess-2021-77

Anonymous Referee #2

Referee comment on "Rapid tsunami force prediction by mode-decomposition-based surrogate modeling" by Kenta Tozato et al., Nat. Hazards Earth Syst. Sci. Discuss., <https://doi.org/10.5194/nhess-2021-77-RC2>, 2021

Real-time Tsunami Force Prediction by Mode Decomposition-Based Surrogate Modeling

By K. Tozato et al. (<https://doi.org/10.5194/nhess-2021-77>)

This paper examines how tsunami impact can be predicted rapidly using mode decomposition of the results from 2D (shallow-water) propagation modelling coupled with 3D (Navier-Stokes) inundation modelling. The surrogate model with mode decomposition reproduces quite well the time-series and maps of run-up and impulses. The mini workflow of how the mode decomposition surrogate model is clearly presented in Figure 1. What is a little more unclear to me is the overall workflow and purpose of the work. The title uses the term "Real-time" which, in my world, is reserved for urgent or situation computations where the process is initiated by a real-world trigger (observational data or human intervention) and that the computations are running against a real-world clock. Is this the case? Otherwise, "Rapid" is probably a better term – that indicates fast computation.

With regards to the total workflow, is it the intention that the full numerical simulations are calculated beforehand and the surrogate model saved for application when a new tsunami event occurs? Or are all the calculations performed in a new event and the surrogate model used to interpolate the outcome to different parts of the parameter space to those calculated in the 2D/3D simulations?

In any case, there will be a significant variability of the tsunami impact as the source parameters vary (c.f. Table 1) – how is the decision made as to which are the appropriate parameters to be looking at when interpolating the predicted impact using the surrogate model? Is it by real-time comparison between observations and predictions?

Answering the above questions in the paper would help enormously in making the context of these calculations clear.

What exactly do the "data vectors" in Equation (8) contain? ("data arranged according to a certain rule") – is it wave heights at the different grid points? Velocities? It would be useful to know which values are stored for each grid point (h, u_x, u_y ?)

Can you comment on the boundary between the 2D analysis and 3D analysis?

It is typical to specify a given water depth at which the 3D-analysis would take over but the line indicated in Figure (6) cuts across a bay very close to the inundation area with very shallow water on each side. How does the transition from 2D to 3D happen on such a boundary? Would it have been feasible to take the boundary further out to sea?

In Figure 8, it would be helpful to have an indication of scale on each of the panels. Is each panel a zoom-in of the previous panel? Does Figure 12 show us something fundamentally different to Figure 8? If so, it would be very valuable to know what is fundamentally different. It looks like there are triangular elements in Figure 12 but not in Figure 8. Is this significant?

In Figure 7, the colour scheme is a little unfortunate with low-lying areas coloured in blue. Whenever I see this Figure, I assume that I am seeing tsunami inundation with the blue areas representing the region with inundation. Would it be possible to have blue at sea level and below and non-blue for the region above land – or at least a clear line indicating the pre-tsunami coastline?

The confusion continues into Figure 9 where I guess it is the white which represents the inundation.

It would be nice to have the link to the inundation height observations in the caption to Figure 10. This is for the journal to decide I guess.

Is the data matrix X in Equation (19) the same as the data matrix X in Equation (8)? I am guessing not as I see the matrix in Equation 8 being a spatial discretization of simulation parameters (time-dependent or not time-dependent?) Is the matrix X time-series for a single metric at one point evaluated for different slip and rake as a function of time? What about the X in Equation (8)? This is something evaluated for many points. I think all of this needs clearing up.

What is the quantity we are seeing in Figure 13? It goes from 1 to -1 – it is a fully-normalized data vector? So there is no direct physical interpretation of these numbers? This should be made clear in the figure caption.

There are very many figures and I think a lot of care needs to be taken to make it clear in the caption what is different for each figure from similar figures. (e.g. Figure 17 has a map with the locations of evaluation points and we do not see until Figure 26 where these are applied. There are 29 figures in total and I would ask as to whether all are necessary. The reader struggles to understand the significance of each of them. (e.g. Figure 28 and 29 are almost identical – we get the point.)