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Interactive comment on "Tsunami run-up estimation based on a hybrid numerical flume and a parameterization of real topobathymetric profiles" *by* Íñigo Aniel-Quiroga et al.

Anonymous Referee #2

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General comments: This paper presents a method for quickly assessing tsunami run-up for different tsunami wave shapes and bathymetries. The method is build on a hybrid approach, where the Non-Linear Shallow water model COMCOT is used for the deep-water propagation and a RANS models is used for the near shore processes. The results from this hybrid model, then enters an interpolation model, which can be used to assess run-up. The approach is novel and innovative, and I especially like adding a fast interpolation model. I have however, a few major concerns. The actual implementation of the hybrid model is not well described and I think the coupling between the two models can pose big problems. Further, the hybrid model is not validated on its own in a controlled environment.

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Major comments:

1) Parts of implementation and usage of the hybrid model is not well described.

a. What are typical grid sizes in the RANS model? Are these sufficient to handle the processes, which NLSW models cannot handle? Like wave breaking.

b. What are typical L_x lengths?

c. How are the boundary conditions for the turbulence mode?

d. It is unclear how x_{cut} is determined. In the paper two criteria is given. One is to maximize the area of the IH2VOF domain and the other is to ensure that flooding does not exceed the inland end. Regarding the first criteria, letting IH2VOF cover the entire numerical flume would achieve that, but that is clearly not what is being done. Regarding the latter, I cannot see how the end position of the IH2VOF domain influences the position of x_{cut}.

e. One of the advantages of the hybrid model is that the RANS model can handle processes that the simpler COMCOT model cannot. One of such processes is the wave splitting into an undular bore, which can happen when the wave travels long in shallow water and this has been witnessed in many real life tsunamis. To be able to capture this effect x_{cut} needs to be positioned sufficiently off shore. How is this ensured?

f. To avoid reflection, the numerical flume of COMCOT is altered, to properly access the incoming wave. I have a problem with this approach. In reality, especially in cases with steep slopes, there will be significant reflection from the beach which will and should affect the incoming wave. This effect cannot be captured with the current approach. Further it is also unclear what would happen when the reflected wave from the IH2VOF domain meets the hard boundary between the two models. Will this cause additional reflections in IH2VOF domain?

g. The calculations of L does not match Fig. 4. E.g. L_i is given as L_i=1/50 $\tan(\beta_0)$.

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This will result in a very low L_i. Further L_{off} is given as $L_f + x_2$, but according to Fig. 4 it should be $L_{off} = L_f + x_2 + x_1$. Finally, there is no need for δX in the calculations of L_f as it is present both in the denominator and the numerator.

h. How is the run-up height determined in the IH2VOF model? In a VOF computation, the interface can span across several cells.

2) The first validation case is performed by comparing the interpolation model to the hybrid model. This is an important and satisfying validation case, but I am lacking validation of the actual hybrid model. How will the model perform using the approach outlined in the paper e.g. in cases with both breaking and non-breaking waves running up a constant slope.

3) The performance of the iterative solver is compared to the Synolakis formula. I do not believe this is a fair comparison, as it is created for the run-up of a solitary wave, which as highlighted by the author does represent a real geophysical tsunami event. A more relevant comparison could be to the analytical model proposed by Madsen and Schäeffer (2010), as also highlighted by the authors in the introduction. (The Synolakis formula require a proper reference).

4) The periods are estimated as the time between the first two zero crossings for positive heights. Does this mean that the model cannot differentiate between tsunamis having only positive surface displacement and e.g. a leading depression?

5) With this approach of estimating period and wave height, I see a potential problem in the case where the leading wave is not the largest. Can you please elaborate on this?

6) One of the main points off this work is to be able to quickly access tsunami run-up without doing long complicated simulations. Therefore for this work to fulfill this, it would be beneficial is the TRD database was made available to engineers. Are there any plans regarding this?

Smaller comments:

1) Page 1, line 8: It is stated that Run-up is accurately calculated by means of numerical models. This is a rather strong statement. I would prefer it rewritten as: can be accurately calculated

2) Page 1, line 14. The models here, and several other places are referred to as schemes. They are however not schemes, but models. Please change the formulations.

3) Fig. 5. It is stated that only the COMCOT model is used with the altered domain. If this is indeed the case, then please remove the IH2VOF domain from the figure, as it is causing confusion.

4) Fig. 6 units and legends are missing on the colorbars. Please add these.

5) Page 14, line 2. It is stated that $d_2 - d_1$ was always shorter than 2200 m and x_1 shorter than 210 km. How does this correspond with table A1 where $d_2 - d_1$ is always larger than 2200 m?

6) Fig 8. Many of the axis are missing units. Please add these.

7) Fig 10. Please add missing units to the axis.

8) Page 19, line 6. It is stated that T corresponds to the time between the first two zero crossings for positive heights. However in Fig 11. It looks as if the second zero crossing has not occurred within the shaded area?

9) Page 24. It is described how low values of $\tan(\beta_2)$ gives lower run-up height due to friction. From Fig 13, it can however also be seen that the run-up heights reduce with large values of $\tan(\beta_2)$. Please elaborate on this.

10) It is unclear exactly what Fig 15 is describing. Please rewrite the description for clarity and add units to the axis.

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