Natural Hazards
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Discussions

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Interactive comment on "An efficient two-layer landslide-tsunami numerical model: effects of momentum transfer validated with physical experiments of waves generated by granular landslides" *by* Martin Franz et al.

Anonymous Referee #1

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Comments for the Authors:

The present paper deals with the numerical modelling of landslide-generated tsunamis by using a two-layer model, based on the shallow water equations, and a novel (semi-empirical) momentum transfer approach based on the perfectly elastic collision principle. The topic addressed by the present paper is a relevant one in the landslide-generated tsunamis research field. The scientific quality of the paper is good. The paper is in general well written and structured, defining clearly the objectives and describing the methodology and the results. Nevertheless, few points need to be clari-

fied/discussed with more details. This Reviewer believes that the paper can be of interest for the Scientific Community after a minor review process, in particular more details and discussion should be provided in presenting methods and results (see major and minor points).

Please find enclosed a detailed list of major and minor issues.

Major Points:

-Point-0, L37-43 A more detailed discussion of more complex and time consuming numerical models (based on the RANS equations, e.g. Abadie et al., 2010; Clous & Abadie, 2019) is needed. This would help the Readers in comparing the approach proposed by the Authors with the ones available in the scientific literature (see also Point-1).

-Point-1, Abstract and L43-44 "However, the complexity of this phenomenon causes such models to be either computationally inefficient or unable to handle the overall process.", "The assessment of natural hazards requires predictive numerical models that are able to sufficiently reproduce the studied phenomenon while being efficient in terms of computational resources.". These sentences are quite subjective and are partially related to the previous point raised by the Reviewer. It is certainly true that a predictive numerical tool should be as "computationally efficient" (i.e. fast) as possible. Nevertheless, the first quality for a numerical model, to be considered a predictive tool to assess natural hazard, it should be related to the ability in reproducing adequately the complex phenomena at hand. Thus, the computational efficiency cannot be a strength of the model "per se". On the other hand, a good trade-off between a sufficient/good (but not perfect) reproduction of the phenomenon and a fast computational time is essential when real-time tsunamis early warning systems are considered (e.g. Titov et al., 2005; Cecioni et al., 2011).

-Point-2, Section 3.1.3 The perfectly elastic collision approach, although clearly not correct from a physical point of view, seems to be a clever one for modelling the mo-

mentum transfer, at least as a first approach. Nevertheless, few aspects need to be clarified and/or better discussed. First: the Authors claim that the traditional approach for modelling the momentum transfer (e.g. Kelfoun et al., 2010; Xiao et al., 2015) entail undesired user-defined coefficients; on the other hand, also in the proposed approach at least one user-defined calibration coefficient (SF) is needed. Thus, a deeper discussion, as well as more details on the advantages that this approach can bring if compared with the traditional ones, are expected. Second: Figure 2 is not completely clear (and, as a secondary aspect, this Figure has a very poor quality and resolution, please improve it). A discussion of these 2 panels, which likely represent a key aspect of the current approach, is missing in the text. Finally, a more clear description of the Figure (in the legend the Authors refer to "eq. 34", the curves +50 -50 are present in the legend but not described in the caption nor in the text, it is stated that the red line is not the best fitting curve but it is not clear how it has been obtained, etc.) is strongly recommended.

-Point-3, L235 Figures 3 and 4 are poorly described, please improve the description. A brief description of the tsunami generation, well represented by these Figures, can be of interest for the Readers.

-Point-4, L268-272 While describing Figure 5, the Authors point out that "the results from the numerical and physical models are on the same order of magnitude, which permits globally validating the different numerical models but does not allow discrimination between them". Which is certainly true. Nonetheless, one could wonder which parameter, among the landslide thickness (Figure 5a) and the depth-averaged slide velocity (Figure 5b), is more important for the proper momentum transfer modeling. A brief discussion on this would be appropriate.

-Point-5, L344 "We can underline that there is a better match with the runup height than with the wave amplitude" please provide a quantification of the discrepancies between numerical and experimental runup heights and wave amplitudes.

C3

Minor Points:

L20-42: please add some missing references (e.g. Lynett & Liu, 2005; Panizzo et al., 2005; Abadie et al., 2010; Løvholt et al., 2015; Clous & Abadie, 2019)

L59: "wrong", please choose another word or rephrase the whole sentence.

L163: "ultrathin layer of water", please provide more details also considering the option to add a figure with the numerical setup.

Figure 3: Numbers and symbols on the colormaps are too small, please improve it.

Figure 4: please provide more details of the considered numerical simulation in the caption. L299: "more distantly", please change.

References

Abadie, S., Morichon, D., Grilli, S., & Glockner, S. (2010). Numerical simulation of waves generated by landslides using a multiple-fluid Navier-Stokes model. Coastal Engineering, 57 (9), 779–794.

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