Nat. Hazards Earth Syst. Sci. Discuss.,
https://doi.org/10.5194/nhess-2019-285-AC1, 2019

Natural Hazards and Earth System Sciences
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Discussions

Interactive comment on "Lituya Bay 1958 Tsunami – detailed pre-event bathymetry reconstruction and 3D-numerical modelling utilizing the CFD software Flow-3D" *by* Andrea Franco et al.

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Received and published: 11 December 2019

The present authors' comment, referring to the discussion paper titled "Lituya Bay 1958 Tsunami – detailed pre-event bathymetry reconstruction and 3D-numerical modelling utilizing the CFD software Flow-3D", is aimed at the comment of anonymous referee #1, published on 11 November 2019.

Dear referee, we thank you very much for the time spent in reviewing our work and for the very good advices to further improve the manuscript. We will take care of your comments and provide improvements as suggested. The authors comment on the referee advices as follows:

(1) Referee: Reference cited in l10 correspond to the year 2019, not to 2018.

Authors: Thank you for this notice, we will provide the correction.

(2) Referee: My point here is the concept of what is called "denser fluid". As it's recalled in the paper, Pararas Carayannis classify this slide as a "subaerial rockfall" while Miller describes it as a slide in a midway between a landslide and a rockslide. The use of a "denser fluid" to recreate the slide is an approximation to the modelling of this event, nevertheless it should be remarked that the authors modelling is nearer to the Miller and Fritz approximation as a landslide.

Authors: We will remark this important information, where we will state that our sliding model concept is, as you highlight, nearer to the slide model described by Miller and Fritz.

(3) Referee: In this sense, as authors remark, the used model is limited as authors must add a virtual wall on one side to avoid the spreading of the sliding mass during the landslide. Is there a remarkable difference if this wall is not considered?

Authors: In this work we focus on the wave dynamics, where the sliding fluid volume represents the trigger process to initiate the wave generation and propagation. So, since we are not interested in perfectly reproducing the physics of the rockslide (evolved in a rock avalanche, as stated in p10, l1) with its rheology, we adopted the simplified concept of the "denser fluid" compared to the sea water to recreate a sliding mass on a slope with a comparable impact behavior, with the possibility to adapt its shape according to the topographic surfaces. The use of the virtual walls and their effects has been analyzed in the preliminary simulations (section 4.1). The absence of the walls allows the fluid mass to spread during the collapse process, while the presence of the walls constricts the fluid mass until the impact into the sea. This mostly influences the wave features during the propagation phase and the further run-up on the opposite slope respect the slide source. In the case of the simulations with the topographic surface, on the SE border of the sliding mass the topography acts like a natural constriction for the dense fluid (fig. 8), while on the NW border the presence of the wall has been adopted as a simple solution to compensate the lack of topographic elements due to the presence of scars related to secondary rockslides not involved in the wave generation (fig. 2 in the manuscript). From our understanding almost all the main rockslide volume impacts the water body and generates the impulse wave. The presence of the virtual wall avoids the lack of part of the collapsing dense fluid volume to impact the water body, that would, on the contrary, spread and impact on the glacier, resulting in a decrease of the wave feature and thus on the run-up process. We will better describe in the manuscript why the virtual wall is set in the numerical model and which effects are achieved with it.

(4) Referee: As different roughness values are used I would like to see how this friction is parameterized in the model.

Authors: Surface roughness in Flow-3D basically consists of two components. The first results from the processing of the considered solid structures (stl-files) with the FAVOR-method during the preprocessing procedure. Depending on mesh structure and size, the computation geometry is delivered and it features minor divergences from the original solid structure. For the case that the mesh orientation does not perfectly fit with surface slope the computation geometry typically features a minorly rougher surface than the solid structure. Secondly, a roughness height can be additionally determined for every considered solid structure. It is defined as the equivalent grain roughness with the dimension of a length (m). In this case the purpose was to represent the roughness due to vegetation. In the revised manuscript we will provide more background information on the roughness in Flow-3D. Further we will provide a more substantial discussion on the influence of surface roughness on the modelling results. For it, further simulations are accomplished as well. Concerning the discussion of roughness in the review, reference is made also to issue (8) and to the authors comment on the review of referee#2.

(5) Referee: In this section and later, authors describe the computation time that takes

the different simulations. Although it's a useful relative value if we compare the different computation times described along the paper, I would like to know what computational resources are used in order to imagine the real computational effort needed to reproduce these experiments.

Authors: Please find in here the requested information on computational resources that will be added to the manuscript: - Processor: Inter® Core™ i7-3820 CPU 3.60 GHz - RAM: 32.0 GB - System type: 64-bit Operating System - Graphic card: GeForce GTX 6602 (Integrated RAMDAC, total available memory 4096 MB)

(6) Referee: Again, in p13, l9-10 authors speak about computational time. With the same computational resources as before? . . . Again, same question about computation times in p14, l17-18.

Authors: For all simulation the same computational resource has been used (for details see issue (5)) As well we are going to clarify this in the manuscript.

(7) Referee: To my view, the discussion presented in p15, l15-24 makes no much sense as the modelling process is approximating a rockslide or a landslide-rockslide by a landslide by means of a "denser fluid". If you don't want to remove this paragraph I would suggest remarking that this simulation of the submerged propagation of materials would not valid for the Lituya Bay event unless it would be considered as a pure landslide event.

Authors: In this section we present the propagation of the sliding fluid on the bay floor as an application available in Flow-3D to observe the mixture process between two fluids with different density, an application that can be adopted also to observe natural phenomena. We fully agree that it is not correct to state that we are observing the propagation of the rockslide material along the bay floor. We are analyzing the mixture process of two fluids with different densities. We will clarify this aspect in the manuscript and consider being consistent with terminology. We will use the term "rockslide" when referring to literature and to the observed processes. The terms "sliding fluid” or “denser fluid” and “fluid mixing process” are used when referring to the current modelling approach. We thank you for this critical and useful notice!

(8) Referee: In p17, l3-8, authors discuss that they don’t find differences nor in inundation neither in the trimline with different roughness values from 0-3m. I can understand these results around steeper areas, but are there no differences in the Fish Lake area? What about around the Eastern flat area around the Paps? I cannot understand how the model doesn’t provide larger inundation areas around flat areas when the roughness values go to zero.

Authors: We thank you very much for this important note. Discussion of your comment and re-analysis of our models set-up and results finally led to the fact that we could identify a (user) mistake in the parameterization of the roughness in Flow-3D. We will fully consider this during the revision procedure and update the results of the analyses of different values for roughness on inundation. Concerning this aspect reference is made also to the authors comment on the review of referee#2 (issue (18)). Having a look to some first outputs of further simulations with a correct setting for the roughness parameterization, we can appreciate better results and also identify the influence of the roughness value. As an example the attached figure 1 shows the difference in inundation area resulting from two simulations of the entire bay with two different values of the equivalent grain roughness. These simulations are related to the coarsest grid resolution of 20 m uniform cell size.

SEE ATTACHED FIGURE 1

Attached Fig. 1: Simulation of wave generation and propagation in the entire bay – comparison of simulation results in terms of inundation areas for different roughness conditions; red line: observed trimline; blue area: inundated area resulting from simulation with 20 m uniform cell size, value representing equivalent grain roughness = 0 m; turquoise area: inundated area resulting from simulation with 20 m uniform cell size, value representing equivalent grain roughness = 2 m

Based on these simulations and further with finer mesh grid resolution we will revise the analysis and discussion of the influence of roughness accordingly.

(9) Referee: p18, l30-34. Please, remark that these conclusions should be valid for landslide simulations. In the case of rockslides, Flow-3D can offer good approximations but with the limitations of the physics included in the numerical model. . . . Just to change chapter by section in l37.

Authors: We totally agree with these considerations and we will adopt changes in the conclusions where we more specifically focus on a correct use of terminology (see issue (7)) and a discussion of the limitations of the chosen modelling concept with regard to the representation of the physics of the landslide process. Thank you, we change “chapter” to “section” in l37.

Interactive comment on Nat. Hazards Earth Syst. Sci. Discuss., https://doi.org/10.5194/nhess-2019-285, 2019.

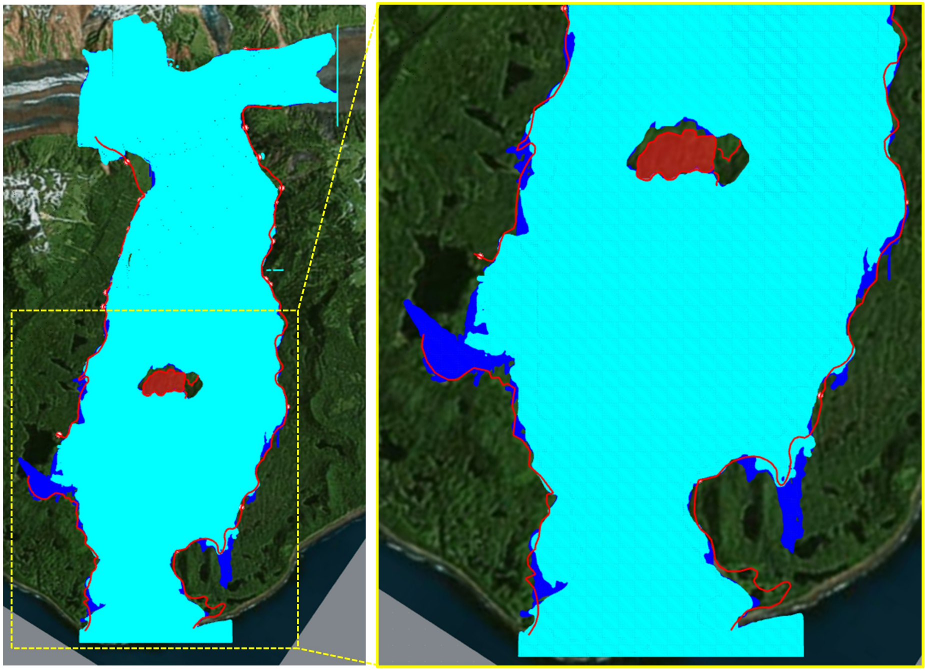

Fig. 1. Simulation of wave generation and propagation in the entire bay – comparison of simulation results in terms of inundation areas for different roughness conditions; red line: observed trimline; blue ar