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Interactive comment on "A numerical study of tsunami wave run-up and impact on coastal cliffs using a CIP-based model" *by* Xizeng Zhao et al.

Xizeng Zhao et al.

xizengzhao@zju.edu.cn

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Reviewer #1: The paper present a numerical study of the run up on cliffs located at the back of a beach. In order to do the experiments the authors propose the use of an "in-house" model based on VOF techniques and a numerical channel of 1 m long. In order to test the validity of the model, authors reproduce experiments published by Sim et al., 2015. In these experiments, solitary waves of different heights are propagated over four segments profiles (sea floor, continental slope, continental shelf, beach, and cliff) obtaining results accordingly to the previous observations. Next, Authors investigate the effect of cliff slope on the run up using the same channel configuration and varying the cliff slope. On a second channel setup, Authors investigate the effect of continental shelf gentle slope with four different solitary waves and two cliff slopes. Finally, some results are explained. Although model results are worthy and validation with laboratory

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Discussion paper

experiments are also good in my opinion the paper is not suitable for publication as it is for the next reasons:

Q: a) The paper applies an 'in-house' CIP model, probably a VOF. Although this is not completely clear, model description is very poor. For example is not clear what are the differences and advantages of using this model instead of a traditional VOF. R: a) The suggestion is valuably. We need to explain the model detail more clearly, and it has been done in section 2 according to the reviewer's suggestions. CIP is a compact high order difference scheme used in the model to solve the advection term. We also employed a VOF-type method, THINC/SW, to capture the free surface. Description and advantage of CIP and THINC/SW are added in subsections 2.3 and 2.4, respectively. Some references about CIP are also introduced in Introduction, Page 2, Lines 21-31.

Q: b) Regarding the experiments setup it is not stated the scale of the channel, moreover being numerical experiments, why experiments should be scaled? Considering the water depth of the channel (0.35 m) and a complete ocean profile (from the coast to deep ocean) a scale of the order of 1:10000 can be guessed. This lead to continental shelf length of 15 km and depth of 1 km (typical values for these are 80 km and 200 m). The use of these values must be justified. The wave heights used on simulations are one order of magnitude less than the ocean depth i.e., total depth h=0.35 and tsunamis waves H from 0.025 to 0.06 (For example a wave of 0.025 scaled to 1:10000 gives a wave of 250 m). This is completely unrealistic for tsunamis. In the case of laboratory experiments, some concessions must be done, but on numerical experiments there is no reason to do this. If there is a numerical or mathematical reason to scale the waves like this, it must be stated. R: b) The scale is important in both laboratory experiment and CFD. Limited by the computational efficiency and numerical dissipation of CFD, the quantity and slenderness ratio of computational grids should be moderate. Because of the high proportion of spatial span in horizontal and vertical in most cases, reasonable abnormal model scale in horizontal and vertical is necessary, similar to laboratorial experiment. This is added in Introduction, Page 3, Lines 21-25. And the selection of scale is same with the laboratory experiment done by Sim and Huang (2013, 2015, 2017), which is added in subsection 3.1, Page 8, Lines 11-12.

Q: c) On section 3.4 where time evolution of wave is analyzed on tank #2, Authors find, as expected, that the longer the gentle slope is, the later the wave arrives. Since we are taking about long waves this is an obvious results and there is nothing new on the description. R: c) This obvious result with nothing new is deleted in the revision.

Q: d) On section 3.5, authors evaluate the relative wave height in front of the cliff on tank #2 at different distances. Data describes a linear trend, nevertheless authors do not mention the trend values, and do not intent to find an explanation. Furthermore, was possible to find a relationship between this trend and profile slope. None of these is done by authors. R: d) Firstly, the trend values and explanation are added in subsection 4.4, Page 15, Lines 3-12. And they are also shown as follow: "In Figs. 8 (a) and (b), the maximum relative wave heights are greater than 2.5, and the gradients of trend lines are 2.22 and 2.16, respectively. In Figs. 8 (c) and (d), the maximum relative wave height is 2.4, the trend lines have gradients of 1.77 and 1.75, not as steep as those in Figs. 8 (a) and (b). In Figs. 8 (e) and (f), the trend lines are gentle, with gradients of 1.46 and 1.13. In summary, in the case of smaller wave height, the development of wave height along with the decrease of distance to the cliff is more obvious, and finally a larger relative water height appears. As for lager wave, rate of wave height increase is very small, especially when the cliff is toe-eroded. The possible cause of this interesting phenomenon can be explained as follow. According to the result of Fig. 7, the crest of wave elevation is produced by the mixing of incident and reflected wave. Under the condition of large wave, the reflected wave is very strong, which makes the mixing occupy a wide area on the beach. As a result, energy distribution of large wave is not as concentrated as small wave be. The energy concentration helps the small wave to produce a higher relative wave height near the cliff." Secondly, we speculate that the trend may effected by the beach in front of cliff, which has been discussed in section 5, Page 19, Line 11-20. The Details remains to the future work.

Q: e) On section 3.6, authors evaluate the run up on tank #2. They found that for larger continental platforms the run up is larger. This implies that (section 3.4) longer continental slopes, produce waves traveling slower and with higher run up. Authors do not discuss this idea or any other. R: e) Result is not “for larger continental platforms the run up is larger”. The result is that there is a critical length of continental platforms, which produces the largest run-up. In our studies, the critical length is 2.292 m for part of cases. And for other cases, we didn’t find the critical length, which may be caused by the different wave height and cliff inclination. This has been explained more clearly in subsection 4.5, Page 15, Lines 15-26. Besides, discussion about these has been added in section 5, Page 19, Lines 21- Page 20, Line 7.

Q: f) In conclusion, description of results is very poor, there is no discussions and conclusions are just a summary of the remarkable results. R: f) Discussion has been added in section 5, Pages 19-20.

Q: e) Finally it is rather hard going and the English needs to be improved considerably. R: e) The English expression of the whole text has been improved in the revision.

Please also note the supplement to this comment:
http://www.nat-hazards-earth-syst-sci-discuss.net/nhess-2017-37/nhess-2017-37-AC3-supplement.zip

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