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Natural Hazards and Earth System Sciences
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Discussions

Interactive comment on "High-resolution modeling of tsunami run-up flooding: A case study of flooding in Kamaishi City, Japan, induced by the 2011 Tohoku Tsunami" *by* Ryosuke Akoh et al.

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Reply to Reviewer-1:

We already replied to the questions and comments made by Reviewer-1 before, but considering the comments that Reviewer-2 sent us after then, we changed the paper construction and modified the content, which affects the parts we wrote in the reply to Reviewer-1. Therefore, we sent it again.

[Comment-1]

P2 L21-22. I do not understand the meaning of "... with 2 grid sizes...".

[Reply-1]

Liu et al. (2001) showed results of two calculations with grid size of 50 m and 5.5 m, respectively, to discuss the effect of building layout resolution on tsunami run-up flow calculation for inundation caused by the 1896 Sanriku Earthquake Tsunami.

However, Reviewer 2 suggested that the detailed description of existing studies distracted from the objective of this paper and suggested us to reduce the introduction (Comment-1). Therefore, we eliminated the parts regarding to "two grid sizes".

[Comment-2]

P2 L37. Why was Z=HU used as the indicator of flow intensity? This is flowrate. Wouldn't momentum flux HUĖĘ2 be a better indicator, as this is what forces on structures usually depend on? Either way, the authors should justify their choice of the parameter they choose to use.

[Reply-2]

We adopted Z=HU as flow intensity indicator which means the momentum contained in a unit area water column in old manuscript. As the reviewer commented, however, the momentum flux (Z=HU2) seems better for the indicator. Therefore, we will adapt the spatial distribution of latter in the new manuscript (Fig.20, 21). Because the new indicator showed the same tendency as the former one, the discussion in Section 5.2 will be kept in the new manuscript, except the change of notation for indicator from Z to IF to avoid confusion with elevation (z).

[Comment-3]

P3 L11. Is Kamaishi really reliant on marine products? Isn't the city's main industry its factory for production of steel products?

[Reply-3]

The city of Kamaishi developed by the steel industry after a large iron mine was found in 1857, and had the peak of population 92,123 in 1963. In addition, the working population of the marine product industry at that time was about 2.5 times larger than that of the current. After closing the mine in 1993 and the refinery in 1998, population decreased to 35,000 at present, and its major industry became marine industry after improvement of port. We will change the sentence in the new manuscript as follows:

[Revise]:

The Kamaishi City population of approximately 35,000 is mainly reliant on marine product industries and steel industry.

[Comment-4]

P6 L6 you should cite the joint research group in a proper reference such as Mori N, Takahashi T, Yasuda T, Yanagisawa H. Survey of 2011 Tohoku earthquake tsunami inundation and runâĔŸARĔĞ up. Geophysical research letters. 2011 Apr 1;38(7).

[Reply-4]

We will cite their work in the new manuscript and add the website to the reference list.

[Comment-5]

Table 1. The Manning's n roughness values shown look too small, especially for Forest, Factory, Residential areas. Bricker et al shows up to 0.15 for high-density urban, and greater than 0.1 for forests (up to 0.2 for dense forests with branches submerged).

[Reply-5]

Because the flow resistance by buildings is taken account as the drag force in BH model, the ground surface roughness coefficient should be smaller than BR model in which the building drag resistance is conveniently included in the surface roughness. Therefore, we adopted the smaller value for Manning's n for the "city center area where BH model was used". However, we agree to reviewer's comment that larger roughness coefficient should be taken for "surrounding areas where we adopted BR model".

Therefore, we applied the values of Manning's n proposed by Bunya (2010), referring Bricker's paper for the "surrounding area" in the new manuscript. The new results did not show much difference in the "city center area" from those in the old manuscript. We will replace the new calculation results (Fig.14-19), and add Bunya's work in the text and reference list.

[Comment-6]

P6 L13 if the local resident's video is available (i.e., YouTube), you should cite that reference here.

[Reply-6]

We will add the URL of the website to the reference list.

[Comment-7]

P6 L28 The fact that the Kamaishi bay-mouth breakwater was ignored should be justified more, as the breakwater had an effect on delaying tsunami arrival time onshore, and also mitigated flood elevation and speed onshore. See for example, Tomita et al. 2012. Effect of breakwaters on reducing flow depth during the Great East Japan Tsunami. Journal of JSCE, series B2 (Coastal Engineering).68(2):I_156-60.

[Reply-7]

We agree reviewer's comment that calculation condition at the bay mouth was different from the actual situation. But, we hope the reviewer understand that the point of our paper is to consider the effect of dense building arrangement on the tsunami run-up flow. We know Tomita et al. (2012) investigated the effect of breakwater on the tsunami propagation into the bay by comparing "distinctive three calculations"; with the breakwater before tsunami arrival; with damaged breakwater configuration measured after the tsunami; and without breakwater, while they did not show the tsunami wave deformation in the process of breakwater destruction. It is still remained for future study. Because of the uncertainness, we did the elaborate photo image analysis for tsunami wave height just near the coast line in order to examine the calculated time series near the coast line could be used for the run-up calculation in the city center area. We hope again the reviewer understand the point of this study and our efforts. We will add the following sentence at the end of “3.2.1 Ground surface elevation” in the new manuscript in order to make clear that the tsunami propagation during the collapse of breakwater is still remained for future study.

[Revised]

Tomita et al. (2012) investigated the effect of breakwater on the tsunami propagation into the bay by comparing three calculations; with the breakwater before tsunami arrival; with damaged breakwater configuration measured after the tsunami; and without breakwater, while the actual process of breakwater destruction is still remained for future study. Therefore in this study, the damaged configuration measured after the tsunami (****, 20**) was assumed for calculation.

We will add the purpose of the photo image analysis at the beginning of section “4.1.1 Field data analysis” in the new manuscript in order to make sure our consideration.

[Revised]

As mentioned earlier, in this calculation, the breakwater at the bay mouth was considered with damaged configuration measured after the tsunami due to the uncertainty of its destruction process. In this study, therefore, time series of tsunami wave height near the coast line were obtained by image analysis was carried out using digital photographs taken by residents in order to examine the calculated time series near the coast line could be used for the run-up calculation in the city center area.

[Comment-8]

Section 5.3. The protection given to inland buildings due to shielding by concrete buildings near the coast reminds me of a paper I saw by Takagi et al (2015) Assessment of the effectiveness of general breakwaters in reducing tsunami inundation in Ishinomaki.

Coastal Engineering Journal. 2014 Dec;56(04):1450018. They may have discussed similar effect.

[Reply-8]

We guess the year of publication by Takagi et al. was “2014” though the reviewer-1 wrote “2015”. In our understanding, the main topic of their numerical study using BR model was the tsunami attenuation by breakwater surrounding the port of Ishinomaki. In the same paper, they suggested that the damage of houses was smaller behind a large concrete building “from aerial photograph observation”, but it was “not from numerical simulation”; their calculation was based on BR model, which could not estimate the effect of each building footprint. We will insert the following sentence in 5.3.

Some reports suggested that large buildings protected the houses behind from tsunami impact (e. g., Matsutomi et al, 2012; Takagi et al., 2014)

PS. We will make native check before submitting final revised manuscript.

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