

Interactive comment on “Reduction of maximum tsunami run-up due to the interaction with beachfront development – application of single sinusoidal waves” by N. Goseberg

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The referee generally highlighted the usefulness of the presented experimental data though he/she suggested a number of corrections before final publication. The author read the reviewer's comments thoroughly and is willing to adjusted the manuscript accordingly for final publication. On the basis of the suggested additional discussion items which the author highly appreciates the following corrections and comments to the specifics are listed below:

1. Referee #2 commented on the spatial extent of the surface elevation of the wave

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shown in Fig. 1, which indeed is much longer in experiments (around 107 m) than shown in the figure. The intention of Fig. 1 is twofold; a) it should be depicted that a sloping beach is attached to a horizontal bottom where the shallow water wave propagates and eventually runs up; b) the used variables should be presented in a graphical way. These requirements together with the available space on the page led to a 'short' wave in the sketch. In order to keep up with the useful referee comment it is decided to modify the sketch shown in Fig. 1 according to the supplement file, which gives the changed figure. In addition, a comment is added in the figure stating, that the figure is a "Schematic sketch - Wave length not to scale" in order to make fully clear that a much longer wave is used. Further, a reference to Table 1 is added to the caption of Fig. 1.

2. Referee #2 suggests detailing the choice of appropriate boundary conditions with the aim to investigate the research questions raised in the introduction. The horizontal particle velocity that may be calculated from linear theory assuming small wave amplitudes reads $u_{\max} = H/2 \cdot \sqrt{g/h_0}$. For the given correlation, theoretical particle velocities should amount to approx. 0.30 m/s. Particle velocities were measured for a sinusoidal wave used for this investigation ($T = 60$ s, $H = 0.12$ m) in the lab ranging between $u_{\text{trough}} = 0.25$ m/s and $u_{\text{crest}} = 0.4$ m/s. The variations between wave trough and crest are probably contributed to the non-linear characteristics of the shallow water wave. A recent paper of the author published in Coastal Engineering supports the suitability of the applied wave maker for the investigation of tsunami-like long waves and the same waves were used for this paper (cp. Goseberg et al. (2013). Laboratory-scale generation of tsunami and long waves, Coastal Engineering, 79, pp 57-74). In order to clarify the raised question in the manuscript it is hence suggested to incorporate a discussion about particle velocities of the applied waves in relation to a time series plot of the measured velocities in Sec. 3.2 as well as a citation of the recently published paper.

3. Referee #2 asks why a dimensional analysis is elaborated on the various param-

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eters that may or may not influence the given problem of an approaching long wave interacting with beachfront development and why some of the parameters were not used in the subsequent study. The dimensional analysis was added in order to firstly show that the investigated parameters long- and cross-shore obstruction ratio as well as the specific arrangement of MR elements is of important influence to the question. Secondly, it has been included in order to detail which parameters may also be of influence for future research that had yet to be excluded from the current work due to time constraints. Yet, Sec. 3.1 may be deleted in a revised manuscript if explicitly wished.

4. Sec. 3.2 describes some formula used for analytically describing the wave run-up for either breaking or non-breaking cases. The intention is to apply one of the listed formulas for comparison with the achieved experimental data. Especially, the run-up formula proposed by Madsen and Schäffer (2010) is presented since it proves to be suitable for comparison and the overall agreement (cp. Fig. 9) between theoretical and experimental data is excellent. Irrespective of the Madsen and Schäffer formula which is applied the Hunt formula for breaking waves may be removed in a revised manuscript according to the referee's comment since it is not used in the remainder.

5. Referee #2 raises the question whether the angle of MR element rotation, which was set to 45° in the presented work, has strong or weak influence on the wave run-up reduction and he assumes from the manuscript, that the influence is rather weak. The influence of the block angle is discussed on p1144, line 15 to p1145, line 7 while it is descriptively commented on some aspects on p1137, line 23ff comparing arrangements Gamma 1 and 4. Table 3 summarizes the differences between the investigated variations (arrangements Gamma 1-4 with different angles and so on). As listed in Table 3, cases Gamma 2 (aligned, $\phi=45^\circ$) and 4 (staggered, $\phi=45^\circ$) always depict higher run-up reductions compared with the reference case Gamma 1. In our opinion, this substantiates the conclusion that the influence of block angle is stronger than the influence of aligned or staggered arrangement. This result holds true for either 5 or 10 rows of MR elements. In order to state this finding it is hence written on p1145, line 4-7:

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“Hence, from the results obtained by an comparison of effects due to angle of rotation and due to MR element configuration it is apparent that the angle of rotation stronger influences the overall run-up reduction than the distinction of aligned or staggered configuration.” This statement could yet of course be detailed or sharpened in a revised manuscript in order to prevent any further misunderstanding if explicitly wished.

6. Referee #2 suggests discussing in greater detail how one can use the obtained data in practical applications. The suggested discussion is highly important although it must be emphasized that it is not advisable to start investigating such a multi-dependent problem without restricting oneself to parameterized cases in the first place. To the author's knowledge, this type of experiments on the research questions given in the introduction is unique to date and no comparable attempts of others were found from literature. This is the reason why the random distribution of MR elements was circumvented for this work. Nevertheless, additional discussion is going to be included in the Chap. 5 which already discusses the parameterizations made on p1145, line 10-19. In addition, the use of nomograms is going to be explained in more detail on p1145, line 20-22 in order to explain how nomograms that are regularly applied for example in hydraulic engineering could be used as a tool to estimate the run-up reduction effect of beachfront development. Some more discussion is going to be added in a revised manuscript.

7. Referee #2 comments in analogy to referee #1 on the dynamics of the receding wave shown in Fig. 16. It is referred to the reply given in regard with RC of referee #1. The remarkable result is contributed to temporary effects in the dynamics of wave run-up and draw-down since the snapshots of the surface elevation are taken at the same time. Hence, this shows the retarding effect that the beachfront development has to the draw-down phase of wave evolution. The effect to the overall run-up is not affected by this feature and it is not measured at the area which is depicted in Fig. 16 but at the maximum run-up extent up the beach slope. Further information is given in the reply to referee #1.

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Please also note the supplement to this comment:
<http://www.nat-hazards-earth-syst-sci-discuss.net/1/C538/2013/nhessd-1-C538-2013-supplement.pdf>

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