INVESTIGATION OF DIRECTIONAL SPREADING EFFECT ON WAVE RUN-UP USING SWASH

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INTRODUCTION

In order to keep optimal safety of coastal lines, it is necessary to maintain an appropriate crest level of coastal dikes. This is designed based on wave run-up height and/or wave overtopping discharge. Therefore, it is important to estimate wave run-up and overtopping as accurate as possible. However, the influence of directional spreading on wave run-up and overtopping has not been fully understood yet. For example, Guza and Feddersen (2012) indicated that the wave run-up is influenced by directional and frequency spread, based on their numerical study. Altomare et al. (2020) conducted a physical wave basin model and concluded that directional spreading influences the overtopping discharge in shallow foreshores. On the other hand, Feidler et al. (2018) reported that the SWASH 1D model, without directional spreading, agrees with field data. Therefore, in this study, we investigate the influence of directional spreading on wave run-up.

METHOD

In this study, non-hydrostatic model SWASH (Zijlema et al., 2011) is used. First, we implemented a wave run-up model in SWASH in 2DV (flume like) and 3D (basin like). Then wave run-up are simulated for some different cases and compared to the existing empirical wave run-up formulas in literature (e.g. Holman, 1986 and Mase, 1989). Holman (1986), on the one hand, derived wave run-up formula based on 149 data sets measured in the field experiment conducted in October 1982 at the Coastal Engineering Research Center (CERC) Field Research Facility at Duck, North Carolina (i.e. measurement was conducted in a 3D environment). On the other hand, Mase (1989) conducted physical model tests with a wave flume of 50 cm wide, 27 m long and 75 cm deep (i.e. 2DV flume).

RESULTS

Figure 1 shows the non-dimensional wave run-up height in the function of the surf-similarity parameter. The red line indicates wave run-up formula derived by Mase (1989), and the black line is the wave run-up formula by Holman (1986). It is noted that the dotted lines shows the scatter range. Here, we see apparent differences between Mase (1989) and Holman (1986), namely differences between a flume test and a field measurement. However, it is not clear which process most contributes to the difference. We hypothesise that the difference is due to the directional spreading since it is one of the missing physics in a flume test. To explore, we applied SWASH to investigate the directional spreading effects, and the results are shown in Figure 1. As can be seen, SWASH results with and without directional spreading follow the estimated lines, respectively.

CONCLUSIONS

The results prove the accuracy and feasibility of SWASH for directional spreading to reproduce its effects on wave run-up. Further discussion will follow in the presentation.
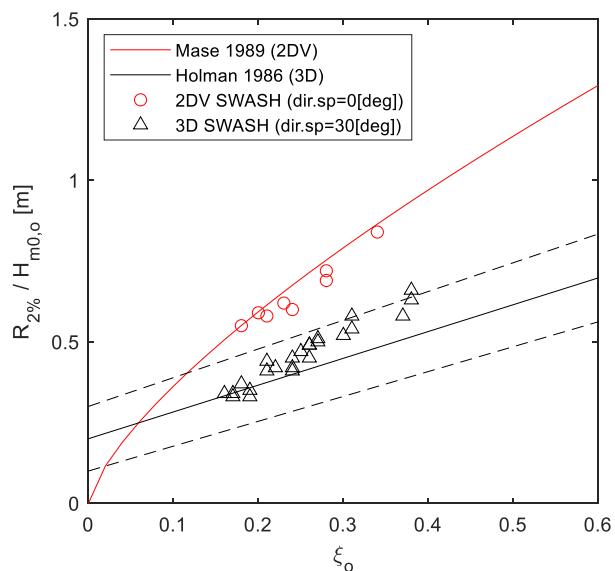

Figure 1 - Comparison of the wave run-up for the different directional spreading

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