Numerical modelling of breaker bar morphodynamics and the role of longwave presence

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1 Introduction

Beaches and their immediate nearshore are highly dynamic under storm conditions with breaker bar formation being an important morphodynamic response. Numerical models help in understanding relationship between these complex morphodynamic processes and the governing hydrodynamics. Excessive calibration and computational time can be limiting when using these models as predictive tools. IH2VOF-SED model was developed [1] to be efficient by enabling accurate morphodynamic predictions with reduced computational time and calibration efforts. The model was previously validated for regular wave conditions, but it is necessary to extend the capabilities of the model for random sea state modelling to increase its applicability. This work focus on breaker bar formation in bi-chromatic wave condition and including the analysis of the influence of presence of long waves in the morphodynamic processes.

2 Methods

IH2VOF-SED is a 2DV RANS based depth-resolving one-phase sediment transport model. Experiments [2] using bichromatic waves, carried out in Large scale wave flume located in LIM, UPC, Barcelona were used for this study. Bichromatic waves with two primary frequencies of 0.3041 Hz and 0.2365 Hz are considered. Due to the unavailability of motion signals at the wave maker, wave data measured at a distance of 54.69m from the wave paddle is used as the input boundary condition. The experiment was run using 1st order wave generation with no active wave absorption, while the numerical model has capabilities of generating 1st and 2nd order waves together with active wave absorption. Two cases with different boundary conditions will be discussed one utilizing 1st order wave generation with original wave data and the second utilizing 2nd order wave generation after filtering out sub harmonics and super harmonics from the measured data.

3 Results

In both the cases the primary breaker bar was predicted, while in the 1st case there is an over prediction of erosion and bar development, the 2nd case produced a more accurate primary breaker bar (Figure 1). There is a considerable difference in phase lag of the long and short waves between the 1st case and measured, leading to a different breaking condition. This is due to driving the model from wave gauge data with long wave presence and length of the numerical flume being different. But the 2nd wave is driven with a longwave of phase closer to the laboratory conditions especially in the breaking zone which led to a more desirable breaking and more accurate breaker bar formation.

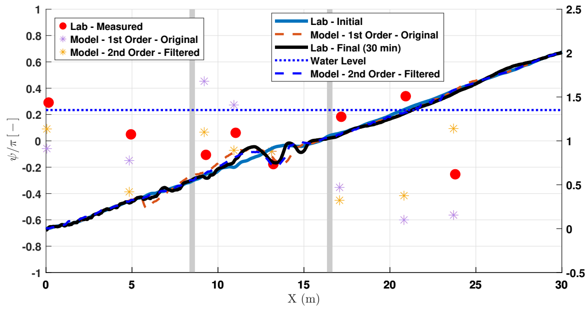

Figure 1: Right y-axis represents the elevation of beach profiles(lines), and Left y-axis represents the Phase lag between the long and short wave components(points). Grey lines are the two breaking points.

4 Conclusion

The model has predicted the morphodynamic evolution of the breaker bar very well with a reduced computational time and with no morphological calibration. Improvement in the long wave and the introduction of them closer to laboratory conditions, especially in the breaking zone, have been shown to increase the accuracy of morphodynamic prediction.

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