Formation and Development of a Breaker Bar under Regular Waves. Part 1: Model Description and Hydrodynamics

In this work a detailed hydrodynamic model is presented, which is used for the study of cross-shore sediment transport and morphodynamics in two dimensions. The model is described in the framework of the generally unstructured, finite volume method. Considerable emphasis is put on those subtleties in the morphological formulation, which are required to achieve mass conservation for the amount of sediment in the bed and in suspension. In this first part of two, the hydrodynamic description over the cross-shore profile is presented. The model is validated against an experiment with detailed measurements of the free surface and turbulence over a fixed breaker bar profile. A test matrix covering a large interval of the surf similarity parameter is simulated, and the phase lag between the breakpoint and the initiation of the setup is described. The relation of this phase lag to a cross-shore delay in dissipation of organised energy into turbulence is described. The relation of this phase lag to the distribution of the location of maxima in bed shear stresses and magnitude of the undertow is also described. Furthermore, processes in the hydrodynamics, which will have a smoothing effect on the mean cross-shore sediment transport and morphodynamic response are considered. All simulations are presented for regular waves and for values of the deep-water surf similarity parameter, $\zeta_0$, in the range from 0.08 to 1.19, i.e. covering both spilling and plunging breakers. © 2014 Elsevier B.V. All rights reserved.

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