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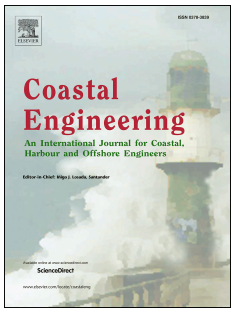

Numerical modelling of the flow and bed evolution of a single bore-driven swash event on a coarse sand beach

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Numerical modelling of the flow and bed evolution of a single bore-driven swash event on a coarse sand beach.

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Abstract

This paper examines the numerical prediction of the sediment transport and bed evolution for a single swash event on a coarse sediment beach. In these conditions bed load is the dominant mode of sediment transport. Laboratory experiments of a single bore-driven swash event are simulated numerically using a fully-coupled model that solves the system of Non Linear Shallow Water Equations and the Exner sediment conservation formula. The analysis focuses on two aspects: the optimal choice of parameters for the Meyer-Peter and Müller sediment transport formula and the model used for computing the shear stress. The methods tested for the bed shear stress are the momentum integral method and the Chezy formulation in which the friction factor is computed using two different formulae. Infiltration into the beach and its effects on the shear stress and sediment transport are also modelled. Results show that the basic Meyer-Peter and Müller sediment transport formula provides good results in the run-up. On the other hand, the sediment transport in the early stage of the backwash is overestimated. A reduction of the sediment mobility constant in the formula in the backwash marginally improves the results. However, the causes of the overestimation of the sediment transport at the early stage of the backwash is the overestimation of the shear stress, while at later stages there are several contributions that are identified, i.e. modelling of the sediment transport and infiltration. It is also suggested that the Meyer-Peter and Müller sediment transport formula might not capture the complexity of the processes involved during the backwash. The comparison of the methods for the estimate of the bed shear stress show that comparable results can be obtained using the momentum integral method and the Chezy formulation with time and space varying friction factor. The resulting bed evolution is also described. In the predicted final profile, deposition is found in the upper part of the beach and erosion in the lower part. A bed step is formed just below the position of the initial shoreline. This feature is determined by the onset of an hydraulic jump during the backwash.

Keywords: Swash zone, morphodynamics, bed load, coarse sediment beach.