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Air-water two-phase flow approach to simulate nearshore wave motion

Roham Bakhtyar, Amir Mehdi Razmi, and David Andrew Barry

Laboratoire de technologie écologique, Institut d'ingénierie de l'environnement, Faculté de l'environnement naturel, architectural et construit, Station 2, Ecole polytechnique fédérale de Lausanne (EPFL), CH-1015 Lausanne, Switzerland.

Wave breaking and wave runup have a major influence on nearshore hydrodynamics. Hydrodynamic characteristics of wave motions in the nearshore zone play a key role on the beach profile changes and their evolution. In the case of wave breaking, there is significant mixing of air and water at the wave crest, along with relatively high kinetic energy, so prediction of the free surface is complicated. Most hydrodynamic numerical studies are derived from single-phase flow, in which the role of air is neglected. Therefore, single-phase flow modelling may not be a suitable tool for simulating nearshore hydrodynamics and, consequently, sediment transport. Two-phase flow modelling produces more realistic free-surface shapes. The two-dimensional two-phase Navier-Stokes equations, volume of fluid technique and a two-equation turbulence closure model were used to predict wave breaking and runup, and compared with experimental data. Comparison of the results with a corresponding single-phase flow model revealed that the inclusion of both air and water phases leads to an improvement in simulation of hydrodynamic characteristics especially in the vicinity of the breaking point. The results reveal that the two-phase model provides higher accuracy and reliability for the free surface prediction and flow field estimation than a 2D single-phase model.