Introduction

Numerical technique.

Laboratory data which give a good agreement for confirming the skills of the applied numerical technique. In this work, we investigate numerical modeling of near-shore undular bore dynamics using a Boussinesq model accompanied with surface and bottom frictions using a Galerkin technique [4]. Numerical results are used for constructing kinematic and dynamic breaking criteria. Furthermore, results are compared with some published laboratory data which give a good agreement for confirming the skills of the applied numerical technique.

Boussinesq Model

Following [1], the Boussinesq model is given using depth integrated momentum and continuity equations as follows:

\[ \frac{\partial H}{\partial t} + \frac{\partial (Hu_y)}{\partial x} = \frac{\partial}{\partial x} \left[ H \left( \frac{1}{6} \sigma - h^3 + h^2 \frac{\partial}{\partial x} \right) \frac{\partial^2 S}{\partial x^2} + \frac{1}{2} \left( \frac{\partial S}{\partial x} \right)^2 \right] = 0 \]

where \( S \), \( H \), and \( t \) are time, horizontal axis, surface elevation, reference level, velocity at reference level, gravity, and water total depth. Furthermore:

\[ H = h + T, \quad S = \partial u_y / \partial x, \]

\[ T = \partial (H u_y) / \partial x + \partial h / \partial t \]

Breaking Wave

Modelling of breaking waves can be described by the surface roller concepts, the vorticity transport models, and by including of eddy viscosity [3]. In this study, breaking and non-breaking waves are separated based on: (i) a hybrid model and (ii) a kinematic model. In the hybrid method, we utilize the Boussinesq-type (BT) system prior to the breaking event and broken waves are solved using fully non-linear shallow water equations (Fig. 1). The breaking criterion is based on the local wave slope. At each step wave steepness is check using a down-crossing method over calculated surface elevation data. The kinematic criterion assigns the onset for the breaking when the particle velocity at the crest proceed the wave phase speed. For simplicity, we use this criterion to investigate the onset of undular bore breaking (Fig. 4).

References