Modelling nearshore waves with an efficient shallow water flow model including non-hydrostatic pressure

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Abstract

A numerical method for non-hydrostatic, free-surface, rotational flow governed by the nonlinear shallow water equations including the effects of vertical acceleration and turbulence is presented at the aim of studying surf zone phenomena.

A vertical boundary-fitted grid is used with the water depth divided into a number of layers. A compact finite difference scheme is employed for accurate computation of frequency dispersion requiring a limited vertical resolution. The influence of wavebreaker-generated turbulence is modelled through a simple eddy viscosity concept. Mass and momentum are strictly conserved at discrete level while the method only dissipates energy in case of wave breaking.

The numerical results are verified with various cases of laboratory data and show that the proposed model using two layers enables to resolve propagating nonlinear shoaling, (non-)breaking waves within the surf zone in an effective and accurate manner.