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Shallow water equations for breaking surface waves

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In coastal zones, shoreward propagation of surface and internal waves generally leads to breaking. The turbulence, generated by breaking and mixing processes at the wave fronts, induces the very effective mechanism of energy dissipation and momentum exchange between waves and nearshore currents leading to sediments suspension and transport. The numerous experiments and multi-dimensional calculations reveal the complicated internal structure of breakers, which can not be described by the classic shallow water theory. Nevertheless, the long wave approximation can be very useful in the case the turbulence and mixing effects are included in the model.
A simple mathematical model for the evolution of a mixing layer with pressure gradient is developed. The problem of mixing layer interaction with a free surface in water and its transition in a turbulent surface jet is considered; in particular, breaking waves in homogeneous fluid ("spilling breakers") can be also described by this model. The internal structure of a turbulent bore in open channel flows is investigated. Dependence of the length of the transition zone from the supercritical flow to the subcritical flow is found as a function of the Froude number of the upstream flow.
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