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Mixing and dispersion effects in shallow water dynamics

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The second order approximation of the shallow water theory is widely used for the simulation of nonlinear wave interactions. There are numerous variants of Boussinesq type equations. The main disadvantage of these equations is that they do not describe the transition from smooth waves to breaking waves when the amplitude of a wave reaches the limiting value. Another problem with the Boussinesq type equations is that they are not hyperbolic. The infinite velocity of the perturbation spreading results in some problems with the boundary conditions, especially near the coast line, as well as in the effectiveness of the numerical algorithm for multidimensional problems.

Recently alternative approaches to the problem of surface wave simulation are being developed to include dispersive and mixing effects which represent the evolution of nonlinear waves within a genuinely hyperbolic framework (Liapidevskii&Teshukov, 2001; Liapidevskii&Xu, 2006). In the presentation the dispersive hyperbolic model is applied to the problems of nearshore hydrodynamics. The steady and unsteady nonlinear wave structure is described by the second order models of the shallow water theory and by the corresponding hyperbolic analogs. The comparison of exact and numerical solutions for free surface flows over a local obstacle and in the run up problem shows the effectiveness of dispersive hyperbolic models in the problem under consideration.

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