New nonlinear equations in the shallow water wave problem

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The classical problem of irrotational long waves on the shallow water is reconsidered. The model of ideal fluid moving under the influence of gravity is used with an appropriate perturbation approach allowing consistent treatment of small parameters. Additionaly to two standard parameters which control aplitude of waves and shallowness of the system, respectively, the third one, governing the amplitude of the bottom topography is introduced. Under the assumption that the bottom does not vary rapidly with the horizontal coordinates the new nonlinear equations describing shallow water waves are derived. Several different forms of equations have been obtained for different orders in three small parameters. For the flat bottom KdV equations of different orders, depending of the order of perturbation, are recovered. Some particular examples of numerical solutions to those equations are presented, as well.