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Analysis of Floodplain Inundation Using 2D Nonlinear Diffusive Wave Equation Solved with Splitting Technique

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A b s t r a c t

In the paper a solution of two-dimensional (2D) nonlinear diffusive wave equation in a partially dry and wet domain is considered. The splitting technique which allows to reduce 2D problem into the sequence of one-dimensional (1D) problems is applied. The obtained 1D equations with regard to x and y are spatially discretized using the modified finite element method with the linear shape functions. The applied modification referring to the procedure of spatial integration leads to a more general algorithm involving a weighting parameter. Time integration is carried out using a two-level difference scheme with the weighting parameter as well. The resulting tri-diagonal systems of nonlinear algebraic equations are solved using the Picard iterative method. For particular sets of the weighting parameters, the proposed method takes the form of a standard finite element method and various schemes of the finite difference method. On the other hand, for the linear version of the governing equation, the proper values of the weighting parameters ensure an approximation of 3rd order. Since the diffusive wave equation can be solved no matter whether the area is dry or wet, the numerical computations can be carried out over entire domain of solution without distinguishing a current position of the shoreline which is obtained as a result of solution.

Key words: unsteady surface flow, nonlinear diffusive wave equation, splitting method, finite element method, finite difference method.