

Simulation of flow in river networks and comparison with Mike 11 software

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Abstract

In this paper Time Splitting Projection Method (TSPM) is applied to solve the governing equations of unsteady flow in open channel using explicit and implicit techniques. For modelling flow in river network Double Sweep Method (DSM) is implemented. The proposed model is validated by comparing the numerical results with some benchmark analytical examples and with the results of Mike 11 commercial software. Comparisons reveal that proper results can be achieved implementing TSPM and without using high order accurate techniques. Besides, the proposed method possesses acceptable execution time in comparison with other methods.

Keywords: numerical modelling, one dimensional model, river network, Hydrodynamics.

Introduction

Although hydrodynamic phenomena in rivers and reservoirs are physically three-dimensional, by making some assumptions it is possible to consider that the flow is one dimensional. With respect to high efficiency of one-dimensional models in riverine studies, in this research a one dimensional model is proposed to solve the equations of open channel flow. The governing equations of unsteady flow in open channel in one dimensional form are Saint Venant equations. For solving these equations various methods including analytical, numerical graphical and approximate models have been presented. Some of the approximate models are kinematic wave method, diffusion analogy method and Muskingum method which was presented by Cunge (1969). Numerical methods include finite difference method, method of characteristics (Stoker 1957 and Abbott 1966, 1979) and finite element method. Each method has its own advantages depending on the stability criterion, convergence and accuracy. Preissmann's four point implicit scheme is one of the most well-known numerical methods among one dimensional models in river modelling (Preissmann, 1960). This method has been examined by several researchers and utilized in commercial software such as ISIS, HECRAS, HEMAT1D as a basic method. In addition to implicit methods which require a large amount of memory space for solving set of equations, explicit methods such as Lax- Wendroff have been used by researchers (Liggett & Cunge 1975) to solve one dimensional equations of