Computational Extensions to Implicit Routing Models+

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ABSTRACT: Dynamic flood routing models based on an implicit nonlinear finite difference solution of the Saint-Venant equations have been extended computationally to allow a larger range of practical applications and greater reliability and ease of use. This paper presents a brief description of the following computational developments: (a) a computationally efficient algorithm for treating transient flows in channel networks, (b) convenient selection of various internal boundary conditions to simulate rapidly varied flows at dams, bridges, etc., (c) an algorithm for simulating the effects of levee overtopping, (d) an algorithm for stable computation of mixed (subcritical-supercritical) unsteady flow, (e) an automatic computational stability enhancement via a temporary reduction in time step size or increase in the θ weighting factor of the finite difference approximating equations, and (f) an algorithm to create additional cross sections via linear interpolation between two adjacent sections.

Introduction

During the last few years, operational dynamic flood routing models based on a weighted, four-point, implicit, nonlinear finite difference solution of the one-dimensional unsteady flow (Saint-Venant) equations have been increasingly used to analyze dam-break flooding and other transient flows in mild-sloping river systems affected by tides, backwater and man-made structures (dams, bridges-embankments, levees, flow bypasses, etc.). This paper presents a brief description of several practical concepts and algorithms which have been developed to significantly extend the range, reliability, and ease of application of two operational implicit flood routing models, DWOPER and DAMBRK previously described by the author (2,3). Although the computational extensions presented were developed for particular models, most are generally applicable to dynamic routing models of the implicit (linear or nonlinear) or explicit type.

Computational Extensions

Networks.--A network of channels presents complications in achieving computational efficiency when using the implicit formulation. Equations representing the conservation of mass and momentum at the confluence of two channels produce a Jacobian matrix in the Newton-Raphson method with elements which are not contained within the narrow band along the main-

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