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Solutions to Overland Flow Incorporating Infiltration

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Overland flow is represented by flood wave propagation and plays an important role in hydrology and hydraulics. Flood wave propagation concerns many disciplines and thus, scientists such as hydrologists, city planners, irrigation practitioners and hydraulic and environmental engineers are studying on developing accurate solutions for flood wave equations. The dynamic wave equations consist of continuity and momentum equations and describe unsteady and non-uniform flow conditions. Diffusion wave equations can be derived from the dynamic wave equations by neglecting the local and convective acceleration terms in the momentum equation. The kinematic wave model obtained by ignoring both inertial and pressure terms is the simplest routing method which substitutes a steady uniform flow relationship in the momentum equation. In order to calculate the overland flow, these three types of flood wave equations are solved with many different numerical techniques. Nevertheless, the dynamic interaction between surface flow and infiltration is not sufficiently investigated. In this study, the effect of infiltration on overland flow is explored by incorporating the integrated Horton equation into the flood wave equations. Integrated Horton method calculates infiltration under variable rainfall intensity. MacCormack explicit finite difference method is employed in solving the coupled infiltration-overland flow problem. Hydrographs for overland flow with and without infiltration effects are obtained under different rainfall intensities and soil conditions and compared. It is found that infiltration affects both the peak and the shape of hydrographs considerably. Furthermore, the effect of rainfall intensity and soil conditions on overland flow is also observed.

Keywords: Overland flow; MacCormack; infiltration; Integrated Horton Method; Kinematic waves, Diffusion waves, Dynamic waves.