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Development of efficient overland flow routing based on recursive algorithms - a case study

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Two primary concerns in performing watershed overland flow routing are the numerical instability and computational efficiency. The stability of an explicit scheme is usually restrained by selecting an adequate routing time increment to follow the Courant–Friedrich–Lewy condition and the Hunter condition. The Courant–Friedrich–Lewy condition is adopted to confirm that the numerical marching speed is larger than the wave celerity, and the Hunter condition is used to avoid back-and-forth refluxing between adjacent grids on flat regions, whereas selection of a small time increment following these two conditions has decreased the computational efficiency in performing overland flow routing. This study aims to create a robust algorithm to relax both restrictions simultaneously. The proposed algorithm was first implemented on a 1D overland plane to evaluate the accuracy of the numerical result by comparing it with an analytical solution. Then, the algorithm was further applied to a mountain watershed for 2D runoff simulations. The results show that the proposed integrated algorithm can provide an accurate runoff simulation and achieve satisfactory performance in terms of computational efficiency.