Exact solution of the linear KWE for 1D overland flow under moving rainstorms.

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An exact solution of the linear Kinematic Wave Equation (KWE) for one-dimensional (1D) overland flow under moving rainstorms is presented and discussed. The linear KWE is based on Zarmi's hypothesis. The rainstorm movement assumes uniform motion of a rain cell, represented by a single block with constant rainfall intensity, over a plane surface. The linear KWE is solved, both for upstream and downstream moving storms, using Laplace transformation. A single continuous function for the total space-time-domain of the overland hydrograph is obtained, allowing the evaluation of depth and discharge over time at any point of the surface.

The results match the ones obtained using both numerical schemes and another analytical solution. The results obtained with the proposed analytical solution were compared with experimental runs using a laboratory flume and a rainfall simulator and showed a good fit. The proposed solution was thus validated.