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The effect of moving storm acceleration on runoff hydrographs

João de Lima (1,5), Jorge Isidoro (2,5), Vijay Singh (3), and M. Isabel de Lima (5)

(1) Department of Civil Engineering, University of Coimbra, Coimbra, Portugal (plima@dec.uc.pt), (2) Department of Civil Engineering, University of Algarve, Faro, Portugal (jisidoro@ualg.pt), (3) Department of Civil and Environmental Engineering, Louisiana State University, Baton Rouge, USA (vsingh@tamu.edu), (4) Department of Forest Resources, Polytechnic Institute of Coimbra, Coimbra, Portugal (iplima@esac.pt) , (5) IMAR – Marine and Environmental Research Centre – IMAR-CMA, Portugal

The large majority of runoff studies assumes that storms are stationary. However, runoff hydrographs are strongly influenced by the characteristics and spatial variability of rainfall, which is frequently generated by moving storms. The effect of moving storms on the characteristics of runoff hydrographs has been known for many decades. A storm movement's influence on the shape of the hydrograph and peak discharges depends on its direction, speed, length and pattern.

This study reports a preliminary assessment of this effect by physical and numerical modeling of the dominant processes involved in the response of an impervious plane surface to accelerating storms, with the purpose of relating the acceleration of moving storms to hydrograph characteristics, which has not been attempted before.

The physical laboratory model used a flume and a rainfall sprinkler-type simulator installed on a structure that was electrically driven along a rail to simulate rain cell movements and wind effect. The kinematic wave equations for planar flow, solved by the Lax-Wendroff method, were used in the numerical modelling. For both physical and numerical modeling, simulated storms were moved up and down the plane at non-uniform speed, over a range of acceleration, simulating one single dry-wet-dry cycle.

The results indicate significant differences in hydrograph shapes for equivalent moving storms with different accelerations. For example, storms that enter the drainage basin at a higher speed (decelerating) have a short response time and hydrographs react fast with high peaks.