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Numerical modelling of surface runoff and erosion due to moving rainstorms at the drainage basin scale

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A physically-based distributed erosion model (MEFIDIS) was applied to evaluate the consequences of storm movement direction on runoff and erosion from the Alenquer basin in Portugal. The model was used to compare runoff and soil erosion caused by storms moving downstream along the basin's axis with similar storms moving upstream. Nine synthetic circular storms were used in this simulation, combining three diameters (0.5, 1 and 2 times the Alenquer basin's axial length) with three storm movement speeds (0.5, 1 and 2 m/s). All storms had a rainfall depth of 50 mm, with smaller and faster storms having larger rainfall intensities.

The model simulations on the Alenquer basin showed that the direction of storm movement, especially in the case of extreme rainfall events, significantly affected runoff and soil loss. In all tests, downstream-moving storms caused significantly higher peak runoff (56.5 %) and erosion (9.1 %) than did similar upstream-moving storms. The consequences for peak runoff were amplified for larger storm intensities. The hydrograph shapes were also different: for downstream-moving storms, runoff started later and the rising limb was steeper, whereas for upstream moving storms, runoff started early and the rising limb was less steep.