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Laboratory experiments on the influence of hillslope shape on the hydrologic response of moving rainstorms

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The soil material transported by overland flow is an important factor in water quality management, environmental decision making, urban management and ecosystems sustainability. This study aims at contributing to increased understanding of water erosion factors and processes. The main objective is to quantify experimentally the influence of hillslope shape on soil loss caused by both non-moving and moving rainstorms.

Laboratory experiments were carried out using an articulated soil flume and a movable sprinkling-type rainfall simulator. The soil flume was composed of 3 parts (2 m long each) allowing different combinations of surface slopes in order to represent various hillslope shapes (e.g., for an average of 7%: 2-6-13%, 6-2-13%, 13-2-6%, etc.). The width of the flume was 1 m. To simulate moving rainstorms, the rainfall simulator was moved upstream and downstream over the soil surface at different speeds. The simulator could also produce non-moving precipitation at any part of the flume.

During runoff events overland flow and sediment transport were measured in order to determine hydrographs and sediment production over time. The results show how hillslope shape affects the water erosion process for a large range of hydrologic conditions varying spatially and temporally. Distinct hydrologic responses for storms moving upstream and downstream were identified. Soil loss by sheet erosion caused by downstream moving rainstorms was higher than that caused by identical upstream moving rainfall storms or non-moving storms.