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A rainfall simulator for characterising dominant runoff processes on the scale of hillside segments

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At present time it is common to use different kinds of hydrologic models or GIS applications to simulate runoff generation. Otherwise, especially the spatial variability of soil conditions and a lack of essential soil data makes it difficult to identify the specific mechanism of discharge generation at the plot scale or even at catchment scale. For this reason, sprinkling experiments combined with multi-attribute soil analysis are still a basic prerequisite for a realistic and knowledge-based assessment, which offers also the possibility of validating models in a second step.
In several studies we performed sprinkling experiments for different land use types and a number of different substrates using the portable rainfall simulator according to Karl & Toldrian. The configuration consists of a U-shaped pipe system: Two parallel, 10 m long iron pipes are oriented along the slope line, and at their rear end, connected by an additional, 5 m long pipe (50 sqm). Six standpipes (70 cm height) with low-pressure-nozzles irrigate the area homogeneously. The open side of the U was located in downhill direction with a soil pit at the bottom. To measure the discharge of several runoff processes (overland flow, subsurface flow), a large soil pit of 3 m width was prepared with angled sheet metals in different depths. The effective experimental area is about 30 sqm as a consequence of two adjacent one meter wide also irrigated border lines which act similar to a double ring of an infiltrometer setup. The used irrigation schedule is adapted to the flood events in winter time of 1993 and 1995 with a sum of 120 mm precipitation in three days. Four 15-minute intervals of 10 mm precipitation were applied each day. Nevertheless, only sprinkling experiments are not suitable for identifying the key-parameters dominating the respective runoff processes. For this purpose, auxiliary field experiments and soil analysis are necessary. The conventional setup include tracer irrigation, infiltration experiments and soil physical analysis (texture, pore size distribution, hydraulic connectivity, bulk density) as well as the survey of earthworm burrows in different layers amongst others.
The large-sized rainfall simulator ensure the adequate scale to take impacts from land use into account as well as to measure and assess significant runoff processes accurately. Some examples of sprinkling experiments will be presented and discussed critically with respect to technical aspects and scientific significance.