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A field rainfall simulator system for the analysis of runoff and infiltration interactions related to soil surface structures.

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For sediments in the initial stage of development, we hypothesize that the interaction between infiltration and runoff is dynamically changing depending on the structure of the surface. Previous experimental approaches, however, have either been focussing on surface runoff and erosion or on infiltration and percolation in the soil, mostly neglecting effects of surface changes and interactions.
The objective is to develop an experiment design for a rainfall simulator system for field observations as well as a measurement and monitoring concept. Experiments were carried out in the Lusatian post-mining landscape of the open-cast lignite mining area of Welzow-South located south of Cottbus, Germany.
Our rainfall simulator consists of a single central Fulljet nozzle (6.2 mm in diameter) mounted in 5 m height. The 3 m x 3 m experimental plots were irrigated with rain intensities between 160 mm/h and 250 mm/h, comparable with natural storm characteristics. The spatial distribution of the rain intensities was observed at the sides of plot and a laser distrometer (Parsivel) was used to determine rain drop velocities and size distributions. For the central 2 m x 2 m plot area, the soil surface structures were recorded with a digital camera during the irrigation event. Surface runoff and sediment transport was recorded quantitatively. Soil moisture was recorded with tensiometers. Furthermore the surface was surveyed using close-range photogrammetry before and after the experiment as well as soil samples were taken.
For surface surveying different methods were evaluated, but close-range photogrammetry was the fastest and provides best results. For the quaternary sandy sediments we found significant changes in the surface runoff characteristic between an initially surface as compared to the situation for the same plot one year later.
The rainfall simulator system has been successfully tested so far and could provide complete water balance data for testing coupled numerical runoff-infiltration simulation models. Still difficulties remain in dealing with the discrepancy between optimising the experimental boundary conditions and monitoring structural changes under natural conditions.