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Sprinkling experiments to simulate high and intense rainfall for process based investigations – a comparison of two methods

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Land use and land management changes affect runoff and erosion dynamics. So, measures within this scope are often directed towards the mitigation of natural hazards such as floods and landslides. However, the effects of these changes (e.g. in soil physics after reforestation or a less extensive agriculture) are i) detectable first many years later or ii) hardly observable with conventional methods.

Therefore, sprinkling experiments are frequently used for process based investigations of near-surface hydrological response as well as rill and interrill erosion. In this study, two different sprinkling systems have been applied under different land use and at different scales to elucidate and quantify dominant processes of runoff generation, as well as to relate them to the detachment and transport of solids.

The studies take place at the micro-scale basin Zemmer and Frankelbach in Germany. At the Zemmer basin the sprinkling experiments were performed on agricultural land while the experiments in Frankelbach were performed at reforested sites. The experiments were carried out i) with a small mobile rainfall simulator of high rainfall intensities (40 mm h-1) and ii) with a larger one covering a slope segment and simulating high rainfall amounts (120 mm in 3 days).

Both methods show basically comparable results. On the agricultural sites clear differences could be observed between different soil management types: contrasting to the conventionally tilled soils, deep loosened soils (in combination with conservative tillage) do not produce overland flow, but tend to transfer more water by interflow processes, retaining large amounts in the subsoil. For the forested sites runoff shows a high variability as determined the larger and the smaller rainfall simulations. This variability is rather due to the different forest and soil types than to methodologically different settings of the sprinkling systems.

Both rainfall simulation systems characterized the runoff behavior in a very similar way. Nevertheless, the slope scale sprinkling system showed to be suitable to quantify different runoff generating processes, such as surface overland flow and sub-surface flow. In contrast, the small scale rainfall simulator was able to show the spatial variability of surface runoff processes and to deepen into erosion processes.