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How does pit-mound microrelief affect preferential flow and runoff formation in forest soils? A case study using rain simulator and dye tracer

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The distribution of rainwater and subsurface runoff formation in forest soil can be strongly affected by soil disturbance and microrelief. This study analyses preferential pathways of dyed water after artificial rainfall on a forested slope with pits and mounds formed by historical tree uprooting.

Two heavy rain experiments were carried out using a special tailored rainfall simulator. The first plot was situated above the pit-mound transition. The second (control) plot was situated at a nearby undisturbed surface. The soil profiles were excavated after the rainfall simulation and the dyed stained patches indicating preferential flow were photographed. Subsequently, advanced image analysis was performed to assess differences in water flow patterns in both soil profiles.

The results show contrasting dyed patterns in soil, indicating significant differences in the preferential flow and runoff formation at each plot. The dye-stained patches revealed in image analysis indicated much higher water entry into subsoil of pit profile (31 % of area) than in control plot (8 %). These findings support our previous hypothesis about the significant impacts of terrain depressions formed by tree uprooting on preferential flow and subsurface runoff formation. These terrain disturbances may redirect shallow subsurface flow and force the redistribution of water into deep subsoil layers. The effects of pit-mound microrelief on the hydrology of forested slopes should be considered in future hydrological modelling and land management.