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Intra-rainfall soil surface change detection using close-range photogrammetry

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During precipitation events, the physical properties of soil surfaces change significantly. Such changes influence a large range of processes, e.g. surface runoff, soil erosion, water infiltration, soil-atmosphere interactions and plant growth. It has been proven that successive precipitation events change soil surfaces, but detailed studies on soil surface change within a single rainfall event do, to the best of our knowledge, not exist, due to a lack of suitable methods.

However, recent developments in the use of photogrammetry are becoming a common tool in geoscience and can be utilized in soil surface detection. New concepts, developments in hardware and software allow a quick and user friendly calculation of surface models with close-range imagery and processing based on structure from motion (SfM) approaches.
In this study we tested the potential of close range photogrammetry for detecting changes in soil surface topography within an artificial rainfall event. We used a photogrammetric approach to capture multiple images of the soil surface on two different soil types (loamy and sandy soil) under laboratory conditions while they were exposed to a 60 minute duration 47(60) mm hr-1 intensity rainfall event from a gravity driven rainfall simulator. The photographs were processed using Photoscan to produce point clouds which were then interpolated to produce DEM surfaces.

Of the 126 surfaces produced during the rainfall event 125 were usable and able to demonstrate changes with a resolution of <1 mm in the z dimension and with a xy resolution of <0.5 mm.
We demonstrate the potential of photogrammetry for surface detection within a precipitation event. The use of close-range photogrammetry opens new possibilities to monitor soil surfaces and could be developed for a range of other applications. Our results have the potential to lead to better understanding of infiltration, runoff, nutrient transport and soil erosion processes within precipitation event.