

4D reconstruction of soil surface changes with time-lapse cameras

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Time-lapse photogrammetry enables fascinating visual insights into earth surface processes by compressing time. Recent advances in spatially high resolution topographic data are made possible due to Structure-from-Motion (SfM) photogrammetry. In a next step increasing the temporal resolution can allow for continuous 4D monitoring of soil surface processes.

Two case studies are presented where 4D reconstruction is performed utilising a time-lapse system with a multi-angle camera setup of three SLR cameras, which enables repeated calculation of digital elevation models (DEMs) of difference. A thunderstorm event was captured at a field with 15 seconds interval and a rainfall simulation has been observed at plot scale with a temporal resolution of 10 seconds.

A workflow is introduced for fully automatic data generation. Thereby, special care needs to be taken regarding camera calibration and subsequent image correction. Furthermore, camera movements are compensated for via template matching of stable ground control points. In addition, temporal filtering is applied to the resulting surface change models to account for random noise and to increase the reliability of the measurement of signals of change with low intensity.

Results reveal significant surface changes during the events. Ripple and pool sequences become obvious in both case studies. Additionally, roughness changes and hydrostatic effects are apparent along the temporal domain at the plot scale.