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Using UAV data for soil surface change detection at a loess field plot

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Application of unmanned aerial vehicles (UAV) denotes an increasing interest in geosciences due to major developments within the last years. Today, UAV are economical, reliable and flexible in usage. They provide a non-invasive method to measure the soil surface and its changes – e.g. due to erosion – with high resolution. Advances in digital photogrammetry and computer vision allow for fast and dense digital surface reconstruction from overlapping images.
The study site is located in the Saxonian loess (Germany). The area is fragile due to erodible soils and intense agricultural utilisation. Hence, detectable soil surface changes are expected. The size of the field plot is 20 x 30 meters and the period of investigation lasts from October 2012 till July 2013 at which four surveys were performed.
The UAV deployed in this study is equipped with a compact camera which is attached to an active stabilising camera mount. In addition, the micro drone integrates GPS and IMU that enables autonomous surveys with programmed flight patterns. About 100 photos are needed to cover the study site at a minimal flying height of eight metres and 65%/80% image overlap. For multi-temporal comparison a stable local reference system is established. Total station control of the signalised ground control points confirms two mm accuracy for the study period. To estimate the accuracy of the digital surface models (DSM) derived from the UAV images a comparison to DSM from terrestrial laser scanning (TLS) is conducted. The standard deviation of differences amounts five millimetres. To analyse surface changes methods from image processing are applied to the DSM. Erosion rills could be extracted for quantitative and qualitative consideration. Furthermore, volumetric changes are measured. First results indicate levelling processes during the winter season and reveal rill and inter-rill erosion during spring and summer season.