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3D Surface Reconstruction and Volume Calculation of Rills

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We use the low-cost, user-friendly photogrammetric Structure from Motion (SfM) technique, which is implemented in the Software VisualSfM, for 3D surface reconstruction and volume calculation of an 18 meter long rill in Luxembourg.
The images were taken with a Canon HD video camera 1) before a natural rainfall event, 2) after a natural rainfall event and before a rill experiment and 3) after a rill experiment. Recording with a video camera results compared to a photo camera not only a huge time advantage, the method also guarantees more than adequately overlapping sharp images.
For each model, approximately 8 minutes of video were taken. As SfM needs single images, we automatically selected the sharpest image from 15 frame intervals. The sharpness was estimated using a derivative-based metric. Then, VisualSfM detects feature points in each image, searches matching feature points in all image pairs, recovers the camera positions and finally by triangulation of camera positions and feature points the software reconstructs a point cloud of the rill surface. From the point cloud, 3D surface models (meshes) are created and via difference calculations of the pre and post models a visualization of the changes (erosion and accumulation areas) and quantification of erosion volumes are possible. The calculated volumes are presented in spatial units of the models and so real values must be converted via references.
The outputs are three models at three different points in time. The results show that especially using images taken from suboptimal videos (bad lighting conditions, low contrast of the surface, too much in-motion unsharpness), the sharpness algorithm leads to much more matching features. Hence the point densities of the 3D models are increased and thereby clarify the calculations.