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Detection of linear soil erosion forms with Structure from Motion (SfM) technique in a Waldrach vineyard (Ruwer Valley, Germany)

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Photo-based 3D reconstruction with SfM algorithms is a dynamically developing method in high-resolution digital surface modeling. This method has several advantages, which makes it suitable for multiple fields of science. SfM based 3D surface reconstruction is low cost and less time consuming than the similarly precise, but more complicated and technically demanding air- or ground-based lidar or radar scanning methods or the classic aerial photogrammetry. Therefore, the SfM technology has developed to be a widespread tool in mapping geomorphic characteristics and forms. Nevertheless, there are some limiting factors, which are the following: the quality of images, the type of surface and the accuracy which can be variable between the different surfaces and different post-processing methods. Most of the studies in this subject were made on vegetation-free surfaces or where the vegetation is shallow, because the vegetation can be the main influencing factor of the accurate modelling as it covers the ground. Meanwhile, numerous studies for 3D modeling of gullies have appeared, while the number of publications on the modeling of rills is still quite low. As monitoring and quantification of rills and rill development has a great importance in studying soil erosion processes it is crucial to investigate the main limitations of accurate 3D-modelling. To detect linear erosion forms and to quantify the surface changes for estimating the erosion volumes we worked with UAV (Unmanned Aerial Vehicles) based aerial images of a vineyard in Waldrach (Ruwertal, Germany) close to Trier taken at the beginning of the growing season. The used softwares were Visual SFM, Sf3M, Cloudcompare and ArcGIS 10.2. At post processing we filtered out the vegetation based on the pixel value of each of the colour bands in the RGB image. This method reduced the number of points in our point cloud and in this way decreased the dot density and made holes which resulted irregular point distribution. In the ArcGIS environment DEMs (Digital Elevation Models) were created with filtered and non filtered point clouds, to assess the volumetric changes based on the DEM from the German Topography Map (1: 10,000). The filtered surfaces have a low point density leading to strong distortions and surface changes. Thus it appears that the filtered DEMs are less suitable to quantify the surface changes. In contrast, the non-filtered point cloud is really dense, and the accuracy is in cm, but based on the image resolution our result model wasn't able to detect the smaller linear soil erosion forms. So can be seen only the main erosion and of sedimentation forms.