

EGU21-3248, updated on 23 Jun 2021

<https://doi.org/10.5194/egusphere-egu21-3248>

EGU General Assembly 2021

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Meso- to macro-scale landscape modelling with SfM-MVS photogrammetry: a case study from the Urft Lake water reservoir (Eifel Mountains, western Germany)

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3D landscape reconstruction derived from imagery acquired by unmanned aerial systems (UAS) is an increasingly applied method within the field of geosciences. Low-cost UAS and subsequent Structure from Motion (SfM) and multi-view stereo (MVS) processing provides the opportunity to study landforms and processes in high detail; for instance mapping of river terraces (Li et al. 2019) or landslide monitoring (Devoto et al. 2020).

Due to an almost complete drainage of the Urft Lake reservoir in the northern Eifel mountains (W-Germany) in the autumn of 2020, the lake's entire ground could be surveyed using a low-cost UAS.

The lake stretches for 12 km and has a maximum impoundment volume of approximately 45 million m³. Its shape is characterized by multiple fluvial bends and steep slopes, which required an elaborated flight layout. A DJI Phantom 4 Pro V2.0 was used. Each flight was carried out in two parallel heights (90 and 120 m), 80° camera inclination, and in double-grid pattern. Five full days of surveying yielded over 6,000 aerial images. Despite the difficulty to access the drained reservoir, 154 evenly distributed ground control points were taken using a Leica RTK dGPS instrument (accuracy <5 cm). SfM-MVS photogrammetric processing was conducted with Agisoft Metashape Professional 1.6, using an optimized workflow based on USGS (2017) and James et al. (2020).

The resulting 3D model features high accuracy and precision making it suitable for further detailed stationary as well as multi-temporal geomorphologic analyses. The derived DEM features a spatial resolution of <6 cm and will be used to calculate geometric changes of the reservoir body since its construction in 1905; in particular, due to sedimentation and mass movements along the hillslopes. Moreover, the products can be used to study the anthropogenic influences of the water reservoir on the fluvial morphology of the Urft.

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