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Reproducibility of UAV-based earth surface topography based on structure-from-motion algorithms.

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A representation of the earth surface at very high spatial resolution is crucial to accurately map small geomorphic landforms with high precision. Very high resolution digital surface models (DSM) can then be used to quantify changes in earth surface topography over time, based on differencing of DSMs taken at various moments in time. However, it is compulsory to have both high accuracy for each topographic representation and consistency between measurements over time, as DSM differencing automatically leads to error propagation. This study investigates the reproducibility of reconstructions of earth surface topography based on structure-from-motion (SFM) algorithms.

To this end, we equipped an eight-propeller drone with a standard reflex camera. This equipment can easily be deployed in the field, as it is a lightweight, low-cost system in comparison with classic aerial photo surveys and terrestrial or airborne LiDAR scanning. Four sets of aerial photographs were created for one test field. The sets of airphotos differ in focal length, and viewing angles, i.e. nadir view and ground-level view. In addition, the importance of the accuracy of ground control points for the construction of a georeferenced point cloud was assessed using two different GPS devices with horizontal accuracy at resp. the sub-meter and sub-decimeter level. Airphoto datasets were processed with SFM algorithm and the resulting point clouds were georeferenced. Then, the surface representations were compared with each other to assess the reproducibility of the earth surface topography. Finally, consistency between independent datasets is discussed.