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Morphological analysis of hummocks in debris avalanche deposits using UAS-derived high-definition topographic data

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Debris avalanche caused by sector collapse of a volcanic mountain often forms depositional landforms with characteristic surface morphology comprising hummocks. Geomorphological and sedimentological analyses of debris avalanche deposits (DAD) at the northeastern face of Mt. Erciyes in central Turkey have been performed to investigate the mechanisms and processes of the debris avalanche. The morphometry of hummocks provides an opportunity to examine the volumetric and kinematic characteristics of the DAD. Although the exact age has been unknown, the sector collapse of this DAD was supposed to have occurred in the late Pleistocene (sometime during 90-20 ka), and subsequent sediment supply from the DAD could have affected ancient human activities in the downstream basin areas. In order to measure detailed surface morphology and depositional structures of the DAD, we apply structure-from-motion multi-view stereo (SfM-MVS) photogrammetry using unmanned aerial system (UAS) and a handheld camera. The UAS, including small unmanned aerial vehicle (sUAV) and a digital camera, provides low-altitude aerial photographs to capture surface morphology for an area of several square kilometers. A high-resolution topographic data, as well as an orthorectified image, of the hummocks were then obtained from the digital elevation model (DEM), and the geometric features of the hummocks were examined. A handheld camera is also used to obtain photographs of outcrop face of the DAD along a road to support the seimentological investigation. The three-dimensional topographic models of the outcrop, with a panoramic orthorectified image projected on a vertical plane, were obtained. This data enables to effectively describe sedimentological structure of the hummock in DAD. The detailed map of the DAD is also further examined with a regional geomorphological map to be compared with other geomorphological features including fluvial valleys, terraces, lakes and active faults.