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Quantification of skeletal fraction volume of a soil pit by means of photogrammetry

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The grain size distribution of a soil is a key parameter determining soil water behaviour, soil fertility and land use potential. It plays an important role in soil classification and allows drawing conclusions on landscape development as well as soil formation processes. However, fine soil material (i.e. particle diameter $\leq$2 mm) is usually documented more thoroughly than the skeletal fraction (i.e. particle diameter >2 mm). While fine soil material is commonly analysed in the laboratory in order to determine the soil type, the skeletal fraction is typically estimated in the field at the profile. For a more precise determination of the skeletal fraction other methods can be applied and combined. These methods can be volume-related (sampling rings, percussion coring tubes) or non-volume-related (sieve of spade excavation). In this study we present a framework for the quantification of skeletal fraction volumes of a soil pit by means of photogrammetry. As a first step 3D point clouds of both soil pit and skeletal grains were generated. Therefore all skeletal grains of the pit were spread out onto a plane, clean plastic sheet in the field and numerous digital photos were taken using a reflex camera. With the help of the open source tool VisualSFM (structure from motion) two scaled 3D point clouds were derived. As a second step the skeletal fraction point cloud was segmented by radiometric attributes in order to determine volumes of single skeletal grains. The comparison of the total skeletal fraction volume with the volume of the pit (closed by spline interpolation) yields an estimate of the volumetric proportion of skeletal grains. The presented framework therefore provides an objective reference value of skeletal fraction for the support of qualitative field records.