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The use of Structure-from-Motion when quantifying subtle soil erosion processes from a small-scale experiment

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The unique accessibility of Structure-from-Motion (SfM) has resulted in the rapid uptake of its application by researchers working within the geosciences. More recently, a growth in user confidence and the continued optimisation of data acquisition methods have paved the way for multi-temporal applications, which offer an exciting potential to quantify soil erosion rates. Accordingly, published research provides examples of the successful quantification of large erosion features, such as gullies and large erosion events on arable land. Soil erosion, however, also occurs through subtle, less-visible, diffuse erosion processes, such as sheet-wash. Consequently, this study aims to quantify both visible and less-visible erosion processes, through the development and utilisation of a suite of techniques, including SfM, rare-earth oxide tracers and terrestrial laser scanning (TLS).

Whilst, ultimately the techniques will be used to quantify soil erosion at the field-scale, this study will take a robust approach to the development of novel techniques, starting with small-scale, laboratory-based soil erosion experiments; allowing for rigorous testing of important variables. Using the rainfall simulator hosted within the University of Exeter Sediment Research Facility, we will quantify changes to the soil volume resulting from: compaction of the soil via rainfall, loss of soil via overland flow, and soil erosion via rilling. The findings of the SfM story, thus far, will be presented.

Using sediment capture and TLS as a benchmark, we will establish the extent to which SfM can be practically used to quantify both visible and less-visible erosion processes, to millimetre accuracy. This study also provides an opportunity to optimise data acquisition, reducing redundancies and processing times. Variables, such as the number and placement of ground control points, number and position of images, and pixel density will be interrogated to compare the highest level of accuracy with practical processing times and field application.