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A simplified close range photogrammetric technique for soil erosion assessment

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Surface reconstruction using digital photogrammetry offers a great advantage for soil erosion research. The technology can be cumbersome for field application as it relies on the accurate measurement of control points often using a survey grade instrument. Also, even though digital photogrammetry has been used in many soil erosion researches, its sensitivity in detecting soil elevation changes has rarely been assessed. This paper aims at simplifying the digital photogrammetric procedure for soil erosion research and assessing the sensitivity of this technology to detect soil surface elevation changes. To simplify the technology, we proposed a two-step photogrammetric technique for soil erosion assessment. The method combines a photogrammetric procedure for control points generation in a first step followed by a conventional photogrammetric Digital Elevation Model (DEM) extraction procedure. The performance of the method was assessed in the laboratory and tested in the field to digitize ephemeral gullies. In the accuracy test of the first step of our methodology, we found that the maximum Length Measurement Error (LME) was 3.4 mm while the maximum angular deviation from the vertical or horizontal axes was 0.93°. The maximum error between control points coordinates generated by photogrammetry and those generated by a survey grade total station was 26 mm on the horizontal axes and 10 mm on the vertical axis. We also found that the sensitivity of digital photogrammetry in detecting soil surface elevation changes was similar to that of a laser scanner when the detection was performed on smooth soil surfaces and when the standard deviation of the elevation changes was approximately three times the precision of the photogrammetric DEM. This new development reduces the need to have a regular survey instrument in order to obtain the coordinates of control points in conventional photogrammetry procedure.