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Reproducibility of UAV-based photogrammetric surface models

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Soil erosion, rapid geomorphological change and vegetation degradation are major threats to the human and natural environment in many regions. Unmanned Aerial Vehicles (UAVs) and Structure-from-Motion (SfM) photogrammetry are invaluable tools for the collection of highly detailed aerial imagery and subsequent low cost production of 3D landscapes for an assessment of landscape change. Despite the widespread use of UAVs for image acquisition in monitoring applications, the reproducibility of UAV data products has not been explored in detail. This paper investigates this reproducibility by comparing the surface models and orthophotos derived from different UAV flights that vary in flight direction and altitude.

The study area is located near Lorca, Murcia, SE Spain, which is a semi-arid medium-relief locale. The area is comprised of terraced agricultural fields that have been abandoned for about 40 years and have suffered subsequent damage through piping and gully erosion. In this work we focused upon variation in cell size, vertical and horizontal accuracy, and horizontal positioning of recognizable landscape features. The results suggest that flight altitude has a significant impact on reconstructed point density and related cell size, whilst flight direction affects the spatial distribution of vertical accuracy. The horizontal positioning of landscape features is relatively consistent between the different flights. We conclude that UAV data products are suitable for monitoring campaigns for land cover purposes or geomorphological mapping, but special care is required when used for monitoring changes in elevation.