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Data fusion for monitoring agricultural terraces in complex topographic and landcover conditions

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Abstract

Remote sensing can assist in the assessment and monitoring of agricultural terraced landscapes that are under threat through increased soil degradation due to climate change and land abandonment of such ecosystem services. The limitations imposed by rugged topography and the occurrence of vegetation, the application of a single High-Resolution Topography (HRT) techniques is challenging in these particular agricultural environments. Therefore, data fusion of HRT techniques (TLS and aerial-terrestrial SfM) was tested to overcome specific detection problems. SfM-TLS data fusion methodology was trialed in order to produce very high-resolution Digital Terrain Models (DTMs) of two agricultural terrace areas, both characterized by the presence of vegetation that covers parts of the sub-vertical surfaces, complex morphology, and inaccessible areas. In the unreachable areas, it was necessary to find effective solutions to carry out HRT surveys; therefore, we tested the Direct Georeferencing (DG) method, exploiting onboard multi-frequency GNSS receivers of Uncrewed Aerial Vehicle (UAV) and post-processing kinematic (PPK) data. The results showed that the fusion of data based on different methods and acquisition platforms, are required to obtain accurate DTMs without gaps in data. Moreover, in inaccessible or hazardous terrains, a combination of direct and indirect georeferencing was a useful solution to reduce the substantial inconvenience and cost of Ground Control Points placement. The high-resolution DTMs realized can provide a starting point for land degradation processes assessment of these agriculture environments.

Keyword: data fusion; coregistration; TLS; SfM; terrace; direct georeferencing