Geophysical Research Abstracts
Vol. 15, EGU2013-6339-1, 2013
EGU General Assembly 2013

Quantification of gully volume using very high resolution DSM generated through 3D reconstruction from airborne and field digital imagery

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Major advances have been made recently in automatic 3D photo-reconstruction techniques using uncalibrated and non-metric cameras (James and Robson, 2012). However, its application on soil conservation studies and landscape feature identification is currently at the outset. The aim of this work is to compare the performance of a remote sensing technique using a digital camera mounted on an airborne platform, with 3D photo-reconstruction, a method already validated for gully erosion assessment purposes (Castillo et al., 2012). A field survey was conducted in November 2012 in a 250 m-long gully located in field crops on a Vertisol in Cordoba (Spain).
The airborne campaign was conducted with a 4000x3000 digital camera installed onboard an aircraft flying at 300 m above ground level to acquire 6 cm resolution imagery. A total of 990 images were acquired over the area ensuring a large overlap in the across- and along-track direction of the aircraft. An ortho-mosaic and the digital surface model (DSM) were obtained through automatic aerial triangulation and camera calibration methods. For the field-level photo-reconstruction technique, the gully was divided in several reaches to allow appropriate reconstruction (about 150 pictures taken per reach) and, finally, the resulting point clouds were merged into a unique mesh. A centimetric-accuracy GPS provided a benchmark dataset for gully perimeter and distinguishable reference points in order to allow the assessment of measurement errors of the airborne technique and the georeferenciation of the photo-reconstruction 3D model. The uncertainty on the gully limits definition was explicitly addressed by comparison of several criteria obtained by 3D models (slope and second derivative) with the outer perimeter obtained by the GPS operator identifying visually the change in slope at the top of the gully walls.
In this study we discussed the magnitude of planimetric and altimetric errors and the differences observed between the estimates of the main dimensions of the gully (length, slope profile and total volume) for both methods. This analysis proved useful to define the field of application for each technique, considering their accuracy, cost and processing requirements.

References

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