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Building DEM for gullies in badlands from stereo photographs by drone

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Aerial photographs taken from a drone or ultra light motorized at low altitudes (<200m) using widely available cameras can be used to generate locally high-accuracy mapping products and DEMs. This presentation evaluates accuracies and limits of this technology in mapping and altimetry reconstitution (DEM) of erosion gullies in mountainous areas for an objective of hydraulic modelling. Mapping and DEM reconstitution were both based on stereo pairs and computed by aero-triangulation algorithms using ground control points. Accuracies were computed on DGPS references with topometrical complements along the main crests and talwegs. The study area is part of the Research and Experimental Draix Basins - France - dedicated to badlands erosion survey. These basins have a very rough topography, with steep slopes - steeper than 45˚- and very deep incised gullies.

Photographic images were acquired on 2 hectares with digital cameras in visible or infrared bands, at a flight altitude of approximately 200 m, the ground resolution (pixel size) appears close to 6 cm. About 500 ground control points, with a centimetre relative accuracy (X, Y, Z), were collected. Results shows an (X, Y) accuracy for DEM reconstituted by usual software of about 10–20 cm. The Z accuracy is more disappointing due to various effects 1) true resolution in interpolation processes, 2) compromise between slopes (limitation factor) and B/H stereo-photogrammetric parameter, 3) difficulty to obtain homologous points in not contrasted areas 4) Applying a specific lens correction) Z accuracy is drastically improved. The main consequences of these effects are a loose of continuity along the water paths and a big difficulty to use these DEM in hydrological modelling. A big challenge is then to merge DEM and ancillary data in order to restore this continuity.

These tests emphasize the great potential of this type of vector to produce low-cost images with a very high resolution. This study demonstrates that these products can be used in rough landscapes and areas that are hard to reach such as badlands. They are well adapted for high-scale and highly repetitive mapping on small experimental catchments such as those found at the Draix observatory. They are of great interest in the study of erosion issues because they provide a link between the local-scale survey (ground data) and the traditional remote sensing survey (aerial photograph or satellite). Such products can thus help further the understanding of hydrological measurements at the catchment's outlet.