Low Cost 3D Mapping Using a Commercial Drone/UAV: Application in Structural Geology

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Abstract

This presentation describes an experience of mapping a geological structure with a commercial drone/UAV (Unmanned Aerial Vehicle). Being based in Venezuela, an appropriate area for the acquisition was identified in the Andes Cordillera where a major strike slip fault (Boconó Fault) intersects geomorphic features modeled by the latest glaciation. This fault is a major tectonic lineament oriented SW-NE, extending more than 300 km along the Venezuelan Andes and accommodating a dextral slip in the order of 1 cm/year. This motion has displaced various landscape features that cross the fault, in particularly the "Los Zerpa" moraine system, located a few kilometers NE of the locality "Apartaderos". The moraine formed during the last glaciation that ended 10000 years ago; its northern tip crosses the Boconó Fault and is displaced 100 m towards the NE; this corresponds to a rate of 1 cm/year, which is consistent with GPS measurements. To perform the test, an area of 400 by 600 m was covered over the moraine system, acquiring images at an initial altitude of 60 meters and with a 70% overlap. A total of about 300 images were acquired in two flights 20 minutes long. They were later elaborated with Pix4D, a dedicated software for UAV mapping, generating a single georeferenced map and a 3D digital model. The analysis of the 3D digital model has permitted to clearly identify various geomorphic features related to the interaction between the Boconó Fault and the moraine deposits: tectonic scarps identifying the fault trace; 90° sharp bend of the stream running down the glacial valley, where it gets captured and deviated along the fault strike; 100 m dextral displacement of the lateral moraines and glacial valley as they cross the fault; two terraces witnessing past periods of fluvial infill within the glacial valley, later eroded when the fault activity opened a fluvial escape through the right lateral moraine; the abandoned fluvial valley that used to drain the moraine system before it was breached by the fault. In conclusion this experience has proven that UAV technology can be a useful tool in geological field work: acquisition can be made in remote impervious areas with difficult access; maps can be acquired at low cost and high resolution (typically a few cm per pixel); 3D models are generated at true scale and can be used to measure distances, thicknesses, and volumes; geological features can be observed from the most favorable point of view.