Using 3D Drone-based Digital Models to Investigate the Fluvial Geomorphology of an Eroding Arroyo

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In the arid West, conversion of intermittent streams to arroyos makes the already limited water even less available to the ecosystem. This study used two drones (one we designed and built in 2016, and a DJI Phantom we piloted in 2018) to study a rapidly down-cutting stream--the average movement of the major nickpoint from 1999-2017 was 5.6m/year (Google Earth data). The stream had three active nickpoints and was divided into 4 sections: Surface Stream, Incised Section (downstream of the first nickpoint), Active Section (defined based on movement seen in Google Earth), and Arroyo. Two hypotheses were tested: (1) Basic hydrologic characteristics of the stream should differ between the sections and reflect the increasingly incised stream. (2) The sections should differ in erosion and deposition rate. Statistical analyses of two digital surface models from 2017 and 2018 and the multispectral orthomosaic from 2017 showed that the intermittent stream transitioned from an upstream section with deep pools and shallow, grassy riffles to a deeply incised state (low entrenchment ratio) with no or few shallow pools to hold water. As the stream transitioned, it became disconnected from its floodplain until the floodplain re-formed in the Arroyo. The Active section had the steepest slope and the highest erosion and deposition rates. However, the presence of multiple sharp "nickpoints" and bank collapses suggested that erosion was generally occurring "catastrophically" (i.e., quickly, in large quantities) in a few places rather than gradual erosion in all areas.

Awards Won:
Fourth Award of $500
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