

Variation of Downstream Channel Morphology in the Tropical Montane Streams of the Luquillo Mountains, Puerto Rico

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Abstract. Steep gradient mountain stream channels can be subject to structural constraints by lithologic resistance, tectonic faults, and variable grain sizes that hinder their ability to form well developed downstream hydraulic geometry and graded longitudinal profiles commonly seen in alluvial channels. Similarly, variable land uses and disturbances such as landslides may deliver sediment unevenly within a watershed, thus altering reach-scale channel morphology. This study uses several indices to test whether stream channels draining a steep, humid, subtropical landscape in Northeast Puerto Rico self-organize into a geometry that reflects changes in discharge and gradient.

Watersheds draining the humid subtropical Luquillo Experimental Forest are characterized by a steep, unglaciated rainforest landscape of varying volcanic-derived lithologies and multiple land uses. A total of 105 stream cross-sections in four adjacent watersheds (Rio Blanco, Rio Espiritu Santo, Rio Mameyes, and Rio Sabana) were surveyed to calculate bankfull channel geometry, grain size, and channel gradient. Analysis of a 10m Digital Elevation Model (DEM) was used to derive landscape scale-factors for each cross-section, including reach slope, drainage area, annual runoff, and channel energetics.

Hydraulic geometry analyses showed systematic changes in channel geometry and channel energetics in response to increasing discharge among all watersheds. However, longitudinal profiles were not smoothly graded, and lithology (most notably granodiorite) was found to strongly affect the profile shape. The results suggest the streams are able to form an approximate reach-scale channel geometry equilibrium with the supply-limited flow regime despite apparent bedrock constrictions. In contrast, profile-scale morphology reflects lithologic controls rather than the flow-regime.

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