An Investigation of the Influences of Bedrock Lithology and Vegetation on Low-Order Streams in the Luquillo Mountains, Puerto Rico

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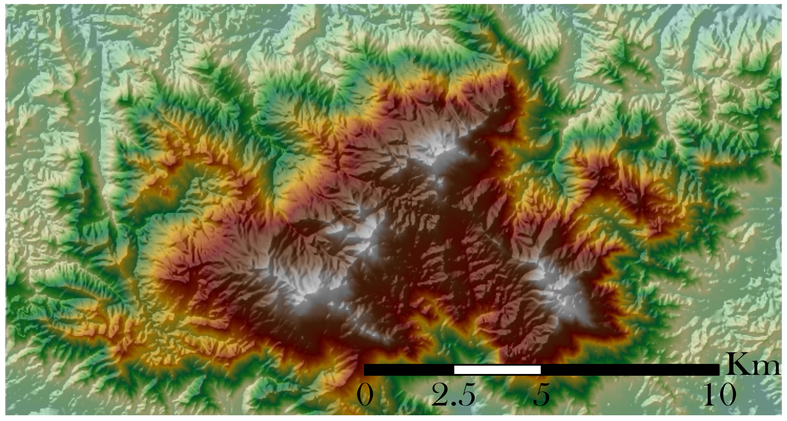
I. Introduction

Drainage networks of streams in tropical ecosystems are the result of an advanced inter-connected system of relationships, including both abiotic and biotic influences. It was the goal of this study to analyze the extent to which bedrock lithology and vegetation control stream bifurcation and networking in a tropical montane ecosystem. More specifically, a GIS was created to model drainage densities of low-order streams within the study area to extract precise differences among different rock and forest types. The following table outlines the subclasses of each environmental parameter that were included within the developed GIS model.

CLASS	ID	AREA (HA)
Bedrock	Volcanoclastic (V)	6015
Bedrock	Quartz Diorite (Q)	2218
Bedrock	Hornfels (H)	2780
Vegetation	Tabonuco (T)	5711
Vegetation	Colorado (C)	3463
Vegetation	Palm (P)	1819
Vegetation	Elfin (E)	371

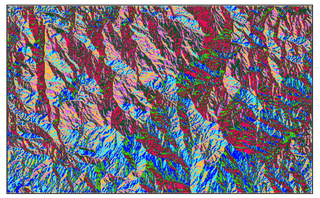
II. Study Area

The study area is located within the Luquillo Mountains in northeast Puerto Rico (approx. 18°20' N, 65°52'W). The mean annual rainfall was calculated to be 3920 mm/yr. The climate of the area is dominated by seasonal tropical storms and hurricanes. Prevailing winds and orographic lifting create perpetual cloud forests along elevation bands beginning at approximately 600 masl. The total relief of the study area is 1049 meters. Below is a DEM with low elevations represented in green and peaks in white.

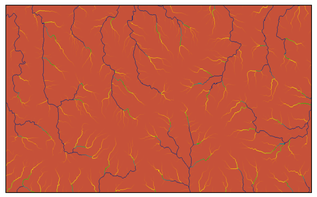


III. Methods

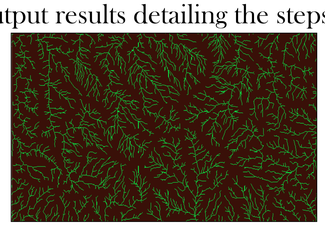
A cartographic model was constructed which simulated the flow hydrology of the landscape to derive an accurate stream network from the DEM. This stream network was then used in a spatial analysis to detect differences in drainage densities based on each environmental parameter within the model. The work flow shown below shows individual output results detailing the steps taken by the computer model.



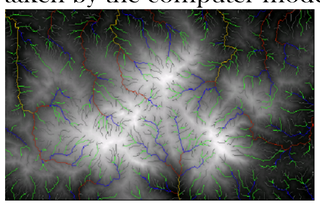
Flow Direction



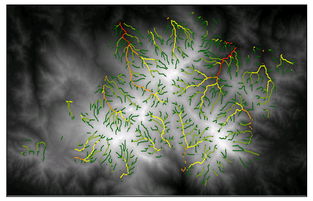
Flow Accumulation



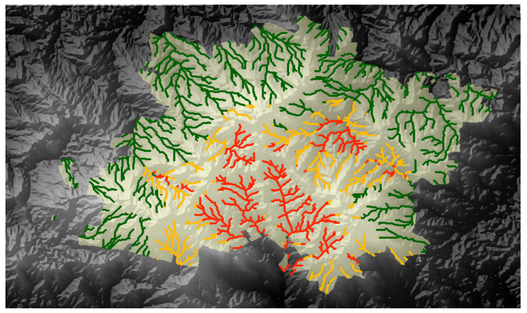
Critical Area Threshold



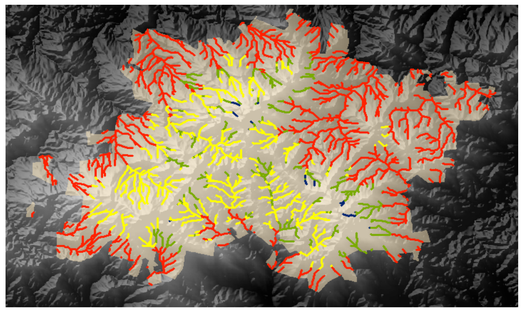
Stream Order



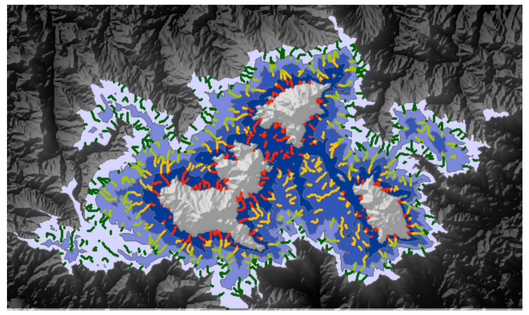
Vector Stream Network



Streams by Geology

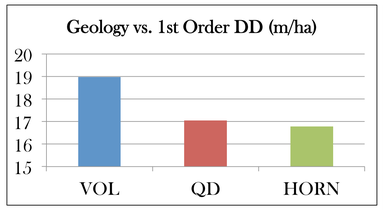


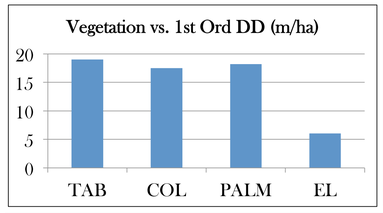
Streams by Vegetation

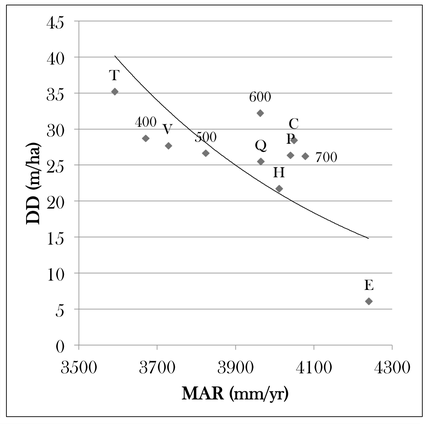


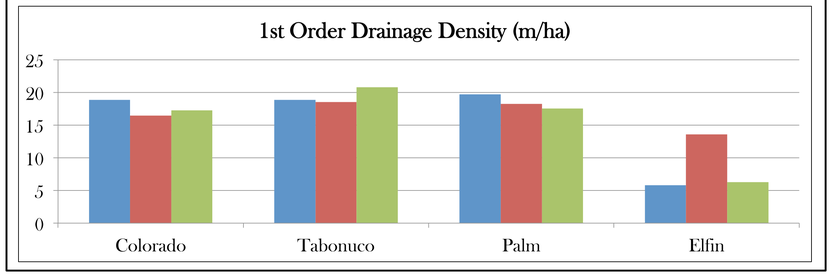
Streams by Elevation

IV. Results









V. Conclusions

- Volcanoclastic bedrock weathers into a clay-rich soil, thereby impeding water infiltration rates promoting overland flow. Such flow characteristics favor greater stream densities than quartz diorite which weathers into sandy soil and the weather resistant contact metamorphic hornfels. This is supported by the data.
- Elfin forests have low DD due to low overall distribution. Tabonuco and Colorado forests favor spatial areas similar to volcanoclastics and have high DD. Palm forests are found nestled in stream valleys and have high total stream length values creating high DD values.
- Elevation can be used as a proxy for mean annual rainfall and micro-climates. As can be seen in the data, no strong significant relationship between MAR and DD exists.

Acknowledgements

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