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A Fractal Approach to Evaluate Biological Soil Crust in Arid and Semiarid Ecosystems

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Biological soil crusts (BSC) are an integral part of dryland ecosystems and They are intimate association between soil particles and diverse microorganism, including cyanobacteria, algae, lichen and bryophites, which live on the uppermost millimeters of soil. The successional stage of BSCs cause changes in soil surface conditions such as soil stability, soil aggregate stability and roughness, and affects some ecosystem processes including nutrient cycling, erosion, runoff, water retention and increase carbon secuestration.
Fractal dimension can be associated with the roughness of a surface represented by a digital image. Because surface roughness is so related to scale and to BSCs successional stage, a fractal analysis is worth pursuing and it would give realistic results. In order to differentiate the successional stages of BSCs in quantity, we determined several fractal parameters in a series of different developmental BSCs in a tropical semiarid region of Venezuela. A progressive classification of soil crust type from incipient crust through various BSCs successional stages were selected in two semiarid ecosystems (Quibor and Ojo de agua) in the Quibor Depression, Venezuela. This study focus on characterize the development stage of the BSC based on Fractal image analysis.
To this end, grayscale images of different biological soil crust at different successional stages were taken, each image corresponding to an area of 12.96 cm^2 with a resolution of 1024x1024 pixels. For each image lacunarity and fractal dimension through the differential box counting method were calculated, using the software ImageJ/Fraclac. Fractal dimension and lacunarity could be good descriptors of BSCs successional stages, and could be very useful in a further exploration of the link between the BSCs successional stages and other soil properties.