

Analysis of Soil Pore Images: Thresholding and Configuration Entropy

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With the recent rapid advancement in digital cameras, computer processing, physical memory, and software, complete image analysis systems can be readily built for the quantitative image analysis of soil morphology^[1]. Thus image analysis has become an useful tool to describe soil structure and to relate it with soil conservation. Black and white pictures of thin soil sections and preferential flow have been analyzed to get a detailed description of the geometry based on fractal dimensions^[2,3]. A very important step in image analysis of soil sections is to decide on the threshold value that converts an image to a binary combination of solid and pores. Our work is focused to study the influence of the threshold value selected and the gray distribution in images of soil sections.

Seven images of soil samples were selected to represent different soil void patterns (named G16-9, G15-1, G4-1, GD-21, GM38, GDSC23, GC31) that are obtained after several soil treatments. Images had a 520×480 pixel lattice with a 256-level gray scale. A multifractal analysis was performed on the distribution of gray levels applying a direct determination of the $f(\alpha)$ ^[4]. The configuration of gray levels was related to the configuration of the pore distribution. A higher complexity in the distribution is reflected in a wider spectrum (Figure 1).

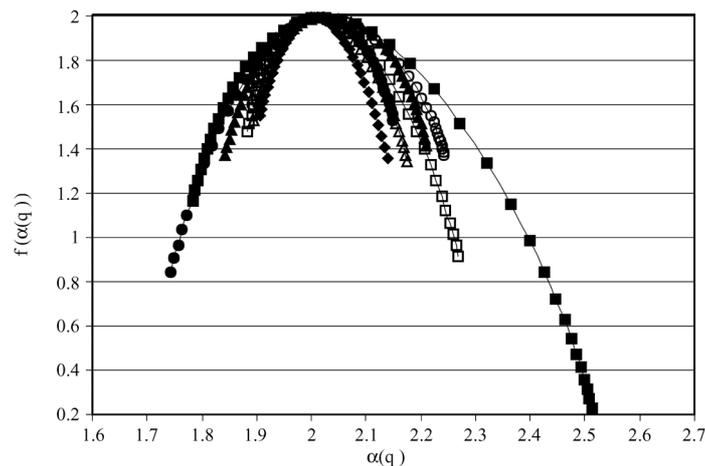


Fig. 1 Multifractal spectrum for each gray image: G16-9 (■), G15-1 (▲), G4-1 (●), GD-21 (◆), GM38 (□), GDSC23 (△), GC31 (○).

The images were bi-partitioned with several threshold values. Then there were inverted, so pores appear in black.. With these sets of images the configuration entropy ($E(L)$) and the characteristic length

(L) were calculated^[5]. A relation between the variation of entropy and characteristic length with the selected threshold values and the complexity observed in Figure 1 is discussed.

References

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