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Multifractal analysis of soil micro and macroporosity using digital images obtained with fluorescent dye

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Characterizing the complex geometry of soil pore structure is a major challenge that would allow to better understand physical processes that take place in soil systems as heat flux, soil aeration and respiration, leaching, groundwater solute and microbial movement, among others. In last decades, fractal geometry has been successfully applied to asses this complex structure. In this work we explore two techniques to imaging sections of soil samples to apply multifractal tools to the study of the pore size distribution of soils from the mountain range of Madrid (Spain). A confocal microscope and a conventional photo camera, using UV light, were used to obtain digital images from sections of soil samples filled with a hardening resin mixed with a fluorescent dye. Both methods allow to study different ranges of porosity, depending on the resolution of the device. Photography yields macroporosity data while the microscope images show the water storage pores. In both cases a protocol for obtaining digital images and their latter segmentation was developed. Segmentation is a prior step to analyzing soil images. This process yields digital binary images from grey-scale images as source. In the binary images only two values are possible: pore and no-pore. The usual procedure for segmentation is visual comparison of the grey scale image and the binary one. We use a method that minimizes the error made with the visual comparison. After obtaining the porosity related data and building the pore-size distribution, their singularity and Rényi spectra were obtained. These spectra were similar to multifractal spectra of multiplicative multifractal distributions.