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Prefractal scaling of apparent soil moisture estimated from vertical planes of Vertisol pit images

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Image analysis could be a useful tool for investigating the spatial patterns of apparent soil moisture at multiple resolutions. The objectives of the present work were (i) to define apparent soil moisture patterns from vertical planes of Vertisol pit images and (ii) to describe the scaling of apparent soil moisture distribution using fractal parameters.

Twelve soil pits (0.70 m long x 0.60 m width x 0.30 m depth) were excavated on a bare Mazic Pellic Vertisol. Six of them were excavated in April/2011 and six pits were established in May/2011 after three days of a moderate rainfall event. Digital photographs were taken from each Vertisol pit using a Kodak^{TM} digital camera. The mean image size was 1600 x 945 pixels with one physical pixel $\approx$ 373 μm of the photographed soil pit. Each soil image was analyzed using two prefractal scaling exponents, box counting (capacity) dimension (D_{BC}) and interface fractal dimension (Di), and three prefractal scaling coefficients, the total number of boxes intercepting the foreground pattern at a unit scale (A), fractal lacunarity at the unit scale (Λ_1) and Shannon entropy at the unit scale (S_1).

All prefractal scaling parameters identified significant differences between both sets of spatial patterns. Fractal lacunarity was the best discriminator between apparent soil moisture patterns. Soil image interpretation with prefractal parameters can be incorporated within site-specific agriculture toolbox. While fractal exponents condense information on space filling characteristics of the pattern, prefractal coefficients represent the investigated soil property as seen through a higher resolution microscope. In spite of some computational and practical limitations, image analysis of apparent soil moisture patterns could be used in connection with traditional soil moisture sampling, which always renders punctual estimates.

Key words: Image analysis, fractal scaling, apparent soil moisture, Vertisols

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