Geophysical Research Abstracts,
Vol. 10, EGU2008-A-10687, 2008
SRef-ID: 1607-7962/gra/EGU2008-A-10687
EGU General Assembly 2008

Spatial-scale analysis of soil variables from 3D images using wavelet correlation.

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Knowledge on soil pore geometry is important for understanding soil processes as it controls the movement and storage of fluids on various scales. With the advent of modern non-destructive tomography techniques there have been many attempts made to analyse pore space features mainly concentrating on the visualization of soil structure.

Multifractal formalism or the wavelet transform have revealed as useful tools in these cases where highly complex, non-stationary and heterogeneous medium are studied as shown in previous work done by some of the authors [1].

In this paper a scale-dependent variance of wavelet coefficients (sometimes called the wavelet spectrum [2]) is defined and a scale-based ANOVA (analysis of variance) is used to visualize how the variability of the data at different scales changes in space. The corresponding covariance and scale-dependent correlation seems to be useful for periodicity detection and description while the ability of wavelet transform to focus on local behaviour also allows to detect local features such as transient variations.

The methodology is illustrated using well-known fractal structures and results are illustrated with 3D images of soil samples with 45 m resolution (256x256x256 voxels) with closer porosities (ranging from 12% to 14%) and different spatial arrangements.

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