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Topology of a percolating soil pore network

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A connectivity function defined by the 3D-Euler number, is a topological indicator and can be related to hydraulic properties (Vogel and Roth, 2001). This study aims to develop connectivity Euler indexes as indicators of the ability of soils for fluid percolation. The starting point was a 3D grey image acquired by X-ray computed tomography of a soil at bulk density of 1.2 mg cm-3. This image was used in the simulation of 40000 particles following a directed random walk algorithms with 7 binarization thresholds. These data consisted of 7 files containing the simulated end points of the 40000 random walks, obtained in Ruiz-Ramos et al. (2010). MATLAB software was used for computing the frequency matrix of the number of particles arriving at every end point of the random walks and their 3D representation.

In a former work (Capa et al., 2011) a criteria for choosing the optimal threshold of grey value was identified: Final positions were divided in two subgroups, cg1 (positions with frequency of the number of particles received greater than the median) and cg2 (frequency lower or equal to median). Images with maximum difference between the Z coordinate of the center of gravity of both subgroups were selected as those with optimal threshold that reflects the major internal differences in soil structure that are relevant to percolation. According to this criterion, the optimal threshold for the soil with density 1.2 mg cm-3 was 24.Thresholds above and below the optimal (23 and 25) were also considered to confirm this selection; therefore the analysis were conducted for three files (1 image with 3 grey threshold values, which have different porosity). Additionally, three random matrix simulations with the same porosity than the selected binaries images were used to test the existence of pore connectivity as a consequence of a non-random soil structure. Therefore, 6 matrix were considered (three structured and three random) for this study. Random matrix presented a normal distribution of percolation speed contrary to the simulated percolation speed for structured soil images. For all of them, Minkowski functionals were calculated applying Ohser and Mucklich (2001) methodology. Interpretation of results in terms of soil percolation behavior of these soils will be derived.

References

Capa-Morocho M, Ruiz-Ramos M and Tarquis AM, 2011. The influence of binarization threshold in soil percolation: relationships between soil physical properties. The American Geophysical Union Fall Meeting 2011, poster number EP41C-0624, December 2011, San Francisco, California, USA

Ohser, J., Mücklich, F. 2001. Statistical Analysis of Microstructures in Materials Science, Wiley-VCH, Weinheim, Berlin,

Ruiz-Ramos M, del Valle R, Grinev D and Tarquis AM, 2010. Soil water percolation at different bulk densities. Geophisical Research Abstracts, Vol. 12, EGU2010-8041.

Vogel H and Roth K. 2001. Quantitative morphology and network representation of soil pore structure. Advances in Water Resources. 24, 233-242.

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