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Soil water percolation at different bulk densities

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Soil structure, and specifically bulk density, porosity and connectivity have strong influence on water transport in the soil. In this work we describe the percolation of a fluid particle through a soil simulating its movement through voxel-thick images of the soil, imposing a downwards movement as a fluid particle randomly delivered from the top of a soil image. From the simulation, porosity, frequency distribution of random walk time (expressed as number of simulation steps), and depth reached by random walks was obtained.

This work extended the analysis presented in Ruiz-Ramos et al. (2009). An arable sandy loam soil was packed into polypropylene cylinders of 6 cm diameter and 5 cm high at five different bulk densities: 1.2, 1.3, 1.4, 1.5 and 1.6 Mgm−3. The image stacks of 260x260x260 with voxel-thick slices were generated from the 3D volumes by using VGStudioMax v.1.2.1. Simulation of the percolation was done applying a set of 5 to 7 threshold values based on the analysis of the histogram region corresponding to 5 voxels. From each image, corresponding to a bulk density, percolation speed distribution in depth was estimated from the simulation outputs. Consequences and relationships among density, grey threshold, porosity and connectivity were discussed. Obtained distributions did not fit to a normal equation, preventing from applying the Darcy's Laws for describing water movement on these soils.

References

Ruiz-Ramos M, del Valle D, Grinev D and Tarquis AM, 2009. Soil hydraulic behaviour at different bulk densities. Geophysical Research Abstracts, Vol. 11, EGU2009-6234.