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Using random walks to characterize local geometry and connectivity in 3D soil pore networks

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Analyzing the spatial features of soil pore networks is very important to obtain different parameters that will be useful in obtaining simulation models for a range of physical, chemical, and biological soil processes. Over the last decade, technological advances in X-ray computed tomography (CT) have improved the reconstruction of natural porous soils at very fine scales. Delimiting the pore network (pore space) by different binarization methods can result in different spatial distributions of pores influencing the connectivity and geometry parameters used in the simulation models [1].

The 3D Combining Singularity-CV method is applied in this work. It combines the Singularity – CV (Concentration Volume) method [2] and a global one (the Maximum Entropy method) to improve 3D pore space detection [3].

Random walks have been applied in global soil pore networks to obtain parameters such as spectral dimensions or tortuosity to explain the diffusion processes better [4,5]. In this work, random walks are locally applied to obtain information about the local geometry and connectivity in 3D pore networks for the first time. The results show what is gained in this local analysis that at the global scale is missing.

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