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Complex network representation of soil porous architecture

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The structure of soil is 3-D dynamic, heterogeneous framework in and through which all soil biological, chemical and physical process occur [1]. Whilst it is recognised the pore morphology of soil has a profound effect on soil function, most existing theories for these functions do not adequately account for pore geometry and, as such, cannot be used for the development of fully mechanistic models. As a direct result, there is a need to develop an understanding of how porous structure affects the specific function of soils.

A novel approach using complex networks to model soil structure towards elucidating the coupling between soil porous architecture and function was recently proposed [2]. Using images of soil structure obtained by X-ray computed tomography, complex networks were constructed and derived from a simple measure of soil pore connectivity showing scale-free topology induced by the pore size distribution.

Here we further advance the representation of soil porous architecture by complex networks based on fitness network model [3] using simplest unbiased fitness function [4] enchanced with the spatially dependent part. Computing degree dependent clustering coefficient and network correlations we seek to detect the intrinsic hiearchy of soil structure. Finally, we show how to dynamically build topologically equivalent (from the network perpsective) soil porous structures using heterogeneous preferential attachement model [5] for growing networks, and how to, based on built networks, generate binary soil images.

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