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Fractal Behaviour and Irregularity of Wetting Fronts in Heterogeneous Porous Media

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The wetting front is the zone where water invades and advances into an initially dry porous material and it plays a crucial role in solute transport through the unsaturated zone. Water is an essential part of the physiological process of all plants. Through water, necessary minerals are moved from the roots to the parts of the plants that require them. Water moves chemicals from one part of the plant to another. It is also required for photosynthesis, for metabolism and for transpiration. The leaching of chemicals by wetting fronts is influenced by two major factors, namely: the irregularity of the fronts and heterogeneity in the distribution of chemicals, both of which have been described by using fractal techniques.

Soil structure can significantly modify infiltration rates and flow pathways in soils. Relations between features of soil structure and features of infiltration could be elucidated from the velocities and the structure of wetting fronts. When rainwater falls onto soil, it doesn't just pool on surfaces. Water –or another fluid- acts differently on porous surfaces. If the surface is permeable (porous) it seeps down through layers of soil, filling that layer to capacity. Once that layer is filled, it moves down into the next layer. In sandy soil, water moves quickly, while it moves much slower through clay soil. The movement of water through soil layers is called the the wetting front.

Our research concerns the motion of a liquid into an initially dry porous medium. Our work presents a theoretical framework for studying the physical interplay between a stationary wetting front of fractal dimension D with different porous materials. The aim was to model the mass geometry interplay by using the fractal dimension D of a stationary wetting front. The plane corresponding to the image is divided in several squares (the minimum correspond to the pixel size) of size length ε.

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