Sveriges lantbruksuniversitet
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How do properties of the structural pore network affect preferential water flow in agricultural soil?

Credits: 30
Level: Master
Subject: Soil Science/Environmental Science
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Background

Large structural pores in soil (macropores) exert a dominant influence on the efficiency of soil drainage and thus aeration for plant growth, as well as the risks of nutrient and contaminant leaching to groundwater and surface water (via subsurface drainage systems) by rapid preferential flows. The kinematic wave equation (KWE) is widely used to model water flow in soil macropore networks because it has some physical basis and is also relatively simple, with only three parameters to estimate: the saturated hydraulic conductivity of the macropores, the conducting macroporosity and the so-called kinematic exponent. To date, the kinematic exponent has always been derived by model calibration against water flow measurements, for two main reasons: i.) methods of direct measurement are lacking, and ii.) no statistical algorithms (so-called pedotransfer functions) are available to estimate the exponent from more easily measured soil properties. In principle, the kinematic exponent should depend on geometrical and topological properties of soil macropore networks. These properties can be quantified by X-ray tomography.

Objectives

To explore the relationships between properties of macropore networks (e.g. size distribution, connectivity) and the kinematic exponent in the KWE for contrasting agricultural soils (e.g. sand/loam/clay soils, topsoil/subsoil).

Methods

The work involves:

- X-ray tomography and image analysis
- Laboratory irrigation experiments on undisturbed soil columns
- Statistical analysis (regression, correlation)

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