Geophysical Research Abstracts
Vol. 19, EGU2017-17663, 2017
EGU General Assembly 2017

Percolating macropore networks in tilled topsoil: effects of sample size, minimum pore thickness and soil type

Nicholas Jarvis (1), Mats Larsbo (1), John Koestel (1), and Hannes Keck (2)
(1) SLU, Soil & Environment, Uppsala, Sweden (nicholas.jarvis@slu.se), (2) SLU, Dept. Ecology, Uppsala, Sweden

The long-range connectivity of macropore networks may exert a strong control on near-saturated and saturated hydraulic conductivity and the occurrence of preferential flow through soil. It has been suggested that percolation concepts may provide a suitable theoretical framework to characterize and quantify macropore connectivity, although this idea has not yet been thoroughly investigated. We tested the applicability of percolation concepts to describe macropore networks quantified by X-ray scanning at a resolution of 0.24 mm in eighteen cylinders (20 cm diameter and height) sampled from the ploughed layer of four soils of contrasting texture in east-central Sweden. The analyses were performed for sample sizes ("regions of interest", ROI) varying between 3 and 12 cm in cube side-length and for minimum pore thicknesses ranging between image resolution and 1 mm.

Finite sample size effects were clearly found for ROI's of cube side-length smaller than ca. 6 cm. For larger sample sizes, the results showed the relevance of percolation concepts to soil macropore networks, with a close relationship found between imaged porosity and the fraction of the pore space which percolated (i.e. was connected from top to bottom of the ROI). The percolating fraction increased rapidly as a function of porosity above a small percolation threshold (1-4%). This reflects the ordered nature of the pore networks. The percolation relationships were similar for all four soils. Although pores larger than 1 mm appeared to be somewhat better connected, only small effects of minimum pore thickness were noted across the range of tested pore sizes. The utility of percolation concepts to describe the connectivity of more anisotropic macropore networks (e.g. in subsoil horizons) should also be tested, although with current X-ray scanning equipment it may prove difficult in many cases to analyze sufficiently large samples that would avoid finite size effects.