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Advanced characterization of macropore flow in undisturbed soil cores using time resolved three-dimensional CT images

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Macropore flow refers to rapid by-pass flow generally occurring in natural macropores (e.g. earthworm burrows, spaced left by decayed roots, desiccation cracks and some open inter-aggregates spaces) [1]. During water infiltration in unsaturated soils, macropore flow may occur, controlled by the balance between vertical and lateral flow rates at macropore surfaces and by the connectivity and geometrical properties of the macroporous network. Although soil macroporosity has been widely imaged and characterized, the dynamic of water infiltration in undisturbed macroporous soils is still poorly understood and modeled. Some fundamental questions still remain i) the location of preferential flow paths or the identification of the active part of the macroporous network (few % of the soil porosity) and ii) the determination of the flow regimes in the active macropores [2]. We propose to characterize macropore flow and preferential flow paths geometry in an undisturbed soil core initially at field capacity using time resolved localization of water infiltration during a simulated rainfall event. Our results are based on the processing and analyzing of the 3D images recently obtained thanks to a novel methodological approach developed using the serial images acquired with a multi-slice helical CT during a simulated rainfall event. Water flow in macropores will be characterized by 1) the occurrence and detection of "water voxels" in the macroporous network and 2) the localization and water filling of the active macropores as a function of time. Finally, results will be discussed taking into account for the temporal and spatial resolutions (voxel size) of the 3D images [3].

- [1] Jarvis, N. J. 2007. A review of non equilibrium flow. *Eur. J. Soil Sci.* 58:523-546.
- [2] Allaire, S.E., S. Roulier, and A. J. Cessna. 2009. Quantifying preferential flow in soils: A review of different techniques. *J. Hydrol.* 378:179 – 204.
- [3] Sammartino, S., Michel, E., and Capowiez Y. 2010. Visualization and characterization of preferential flow paths in heterogeneous natural soils using a multi-slice helical scanner. Proceedings of the 1st international conference and exploratory workshop on soil architecture and physico-chemical functions "Cesar", Aarhus University Press, Aarhus Denmark, ISBN 87-91949-59-9.

Topics : 09-Soil micromorphology

09.03 Imaging structure and probing properties of soils interfaces and aggregates