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# A computational method for modeling spatiotemporal variability of sandy soil hydrodynamic properties under drainage and recharge

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This paper proposes an analytical strategy that combines X-ray Computed Tomography (CT) and Continuous Wavelet Transform (CWT) analysis as an alternative solution to long-term experiments that seek to investigate spatiotemporal variations in soil hydraulic properties induced by drainage and recharge cycles. We conducted CT scanning on 100-cm-high column filled with two types of sandy soil in a laboratory environment to simulate, over a month, the equivalent of nearly 40 years of drainage/recharge cycles akin to agricultural fields adopting subirrigation as water management practices. We also monitored soil matric potential, water inflow and outflow, and the movement of tracers. This later consists in zirconium oxide ($ZrO_2$) that we added to the top 20 cm of each soil column. The results revealed that drainage and recharge cycles greatly affect the evolution of soil hydraulic properties at different locations along the soil profile by reducing drainage and capillary capacities. The approach also allowed us to identify each periodic component of drainage and recharge cycles, thereby calculating the systematic drift over time. The proposed method can be applied to predict soil evolution according to soil texture, drainage system design and water management, thereby offering a potential basis for proposing mitigation measures related to soil hydrodynamics. It may find its application in agricultural farms adopting subirrigation and surface (e.g., drip) irrigation approaches and mining and civil engineering.