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A new method to determine filtration of pollutants in urban soils

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Stormwater management zones must enable water to infiltrate easily, primarily due to macropores, but little is known about the transport of pollutants through these macropores. Some coupled methods using, for example, dyes, disc, or ring infiltrometers were developed to give insight on the respective contributions of the macropores versus the matrix to the bulk infiltration. However, these methods do not visualize where and how water infiltrates. Besides, no information is given on the solute transfer in soils, whereas this issue is crucial regarding the quality of soils and groundwater. One of the goals of the national program INFILTRON (https://infiltron.org) project granted by the French national research agency is to develop superparamagnetic iron oxide nanoparticles (SPIONs) which mimic both pollutant and bacteria flow behavior in soils (Raimbault et al., 2021) and are detectable by ground-penetrating radar (GPR). Within its framework (Lassabatere et al., 2020), we aim to show how nano-tracers can help detect preferential treatment flows (lithological heterogeneity, root system) and quantify or qualify the pollutant transfer in heterogeneous soils. A specific device was designed and presented for the concomitant monitoring of water infiltration and nano-tracer injection. This specific infiltrometer involves two water supply reservoirs and a ring diameter of 50 centimeters. This device maintains a constant depth of water (10 cm) above the soil and delivers the water infiltration into the soil. Two rules posed on the reservoirs allow monitoring the water drop and computation of the cumulative infiltration. Fifty volumes of SPIONs solutions (5 mL of 3.35g/l SPIONs solution) were injected into the ring to maintain a constant concentration in the ring. GPR monitors the bulb of infiltrated water and SPIONs. GPR data is treated with ReflexW (©Sandmeier geophysical research) and RockWorks (RockWare®) software. Combining this specific prototype with the use of GPR for the detection of water and the SPIONs gives insight into the processes of infiltration and SPIONs transfer and localization in the soil. These data allow us to understand and model pollutant transfer into the vadose zone.

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