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The development of protection and remediation plans for contaminated soil and groundwater require a detailed understanding of the transport of pollutants in the subsurface. However, such understanding is affected by the lack of spatial and temporal coverage provided by the current in situ characterization technologies.

A new system has been developed in order to overcome such limitations. The vadose zone experimental setup is a new development combining cross-hole geophysics and the Vadose Zone Monitoring System (VMS).

In cross-hole geophysics, an injection of an electrical current using electrodes installed in vertical boreholes is triggered. From measured potential differences, spatial patterns related with subsurface heterogeneities, water content and solute concentrations are inferred. The VMS allows continuous measurements of water content at different depths of the vadose zone, as well as water sampling. The system is formed by a flexible sleeve containing monitoring units along its depth which is installed in a slanted borehole.

The system was installed at a former industrial site in Belgium, where soil and groundwater are contaminated with BTEX, PAH, and heavy metals. Two VMS were installed in two slanted boreholes on site, together with four vertical boreholes containing electrodes for geophysical measurements.

The site was initially monitored under natural recharge conditions. Water content sensors located along the VMS registered fast wetting and draining reactions to rainfall events followed by the activation of water transport through fractures. Results from soil water samples show continuous evolution of water chemistry with depth, due to disequilibrium between infiltrated water and the hydrochemical conditions in the unsaturated zone.

Subsequently, a saline tracer was injected in the surface. The transport of the tracer in the subsurface was monitored via cross-hole and surface geophysics. Results from imaging reflect the evolution of a plume through vertical and lateral transport and dilution.