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Solute transport processes related to point source infiltrations

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Wastewater infiltrations into soils from damaged sewers lead to the pollution of the unsaturated zone, with a negative impact on the groundwater resources. Modelling the wastewater transport and transformation is dealing with a complex system of processes, interactions between a mixture of reactive solutes as well as between these and the soil matrix. In order to predict the fate of the contaminants in the subsurface, the process of simultaneous movement of water and solutes has to be well understood.

In general, the solute transport is coupled with the water flow. The unsaturated water flow is mainly determined by capillary effects, which are commonly described by well-known retention relationships (Brooks & Corey 1966, van Genuchten 1980). In order to quantify the mass fluxes from point sources (e.g. sewer leaks), a series of 3D flow and transport simulations within homogeneous soils have been performed using the WTM code (Water Transport Model, Buecker-Gittel et al. 2003).

The modelling results showed a large lateral spreading of the infiltrating water due to the gradient in the water content and the water tension resulting in a continuously decrease of the water content with increasing distance from the source, both in horizontal and vertical direction. Moreover, the same phenomenon was observed in relation with the solutes, showing a strong dilution effect due to dispersion. However, the sorptive solutes were less spread and even more diluted. The simulation results were comparable to the experimental data.

The results obtained by investigating the solute transport processes coupled to the water flow from point source infiltrations is directly influencing the evaluation of the impact of wastewater to soils and groundwater. The observed dilution gives a very different view of risk assessment in relation to soil and water resources management.