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Saturated hydraulic conductivity and biofilms: A theoretical approach linking pore and pedon scale

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The fate of active substances in the soil environment is shaped by soil physical properties as well as microbial life. Microorganisms degrading those substances occur in soil pores either in suspension or as biofilms on grain surfaces. At the same scale, i.e. pore scale, the soil physical properties texture, density, porosity, and water content have an impact on transport behaviour of active substances. Macroscopic parameters describe these processes at pedon scale; e.g. hydraulic conductivity summarizes the effect of named pore scale parameters. Narsilio et al. [2009] derived a relationship between the saturated hydraulic conductivity and pore scale water velocity fields based on Navier-Stokes equation for incompressible fluids. However, they did not analyse the influence of heterogeneity and microbial activity, whereas microorganisms, especially biofilms, do have an impact on hydraulic conductivity [Vandevivere and Baveye, 1992]. Biofilms alter the pore geometry while growing. This alteration directly influences the soil water flow field and hence the convective transport of active substances.
Here, we present a way to couple the saturated hydraulic conductivity at macro scale to biomass population dynamics and pore space. The hydraulic conductivity will be analysed with regard to heterogeneous soils. The model combining fluid flow, reactive transport, and biofilm dynamics is applied to investigate the degradation and transport behaviour of pesticides in heterogeneous soils.

References

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