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Statistical analysis of site factors controlling preferential flow and transport in soils

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Knowledge of the solute transport characteristics of soils at field and catchment scales is important for sustainable management of environmental and agricultural resources. It is known that preferential flow and solute transport through macropores often contribute substantially to the transport of diffuse pollutants to groundwater or surface water via drains. As direct measurement of preferential flow parameters is expensive and time consuming, more easily obtainable soil properties must instead be used as surrogates to predict preferential flow, using so-called pedotransfer functions (PTFs). However, there is evidence that the soil properties used in classical PTFs (soil texture, bulk density, fraction of organic matter) are not sufficient to infer the flow and transport characteristics of near-saturated and saturated soils (e.g. Weynants, M. et al., 2009. Revisiting Vereecken Pedotransfer Functions: Introducing a Closed-Form Hydraulic Model. Vadose Zone Journal 8: 86-95). Rather, the incorporation of additional data such as land use, soil-biota, and soil-type information appears to be necessary (e.g. Jarvis, N. J. et al., 2009. A conceptual model of soil susceptibility to macropore flow. Vadose Zone Journal 8: 902-910). In this study, we make use of a database comprising results of breakthrough curve experiments and corresponding site (parent material, climate, land use, etc.) and soil properties (texture, bulk density, etc.) published in the peer-reviewed literature to identify through statistical analyses (e.g. factorial and cluster analysis) the key soil properties and site attributes that control susceptibility to preferential flow.