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It's a macroporous world; we just model in it

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Many soil physical models assume a homogeneous domain and equilibrium conditions, even as decades of evidence have suggested that such states are rarely present in the real world. Instead, natural soils tend to be characterized by physical heterogeneity (e.g., macropores) and non-equilibrium movement of water, solutes and gases (e.g., preferential flow and transport), making it critical to develop physically realistic yet parsimonious descriptors of these processes. In this presentation we discuss recent advances using multi-domain descriptions of soils to model preferential flow and subsurface contaminant movement under field conditions. Here we emphasize the use of simplifying assumptions and straightforward parameterizations, and consider whether those factors constrain the ability of such models to realistically represent underlying physical mechanisms. We also discuss results of an innovative field experiment aimed at constraining macropore porosity, which is a key yet highly uncertain factor in such multi-domain models. Finally, we consider the relevant scales of these multi-domain models, and whether such approaches merit consideration in larger (e.g., hillslope- or catchment-scale) simulations.