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Modeling of infiltration fronts in highly heterogeneous fields

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Soil is usually a highly heterogeneous porous medium. Infiltration into soil leads therefore often to flow along preferential paths, with a fast front and a slow part travelling behind. The preferential flow can be characterized by clear channels, for example due to flow in earthworm burrows or root channels. But also more moderate heterogeneous structure of soil material can lead to preferential flow. Infiltration in such structures is often modelled using double-continua concepts for the porous media. The medium is then considered as consisting of a mobile and an immobile (or less mobile) part with exchange flux between the two continua.

We present a model to describe the spatially averaged water content of an infiltration front, which is based on such a double-continuum approach. By linearizing the capillary flow in the immobile soil part, the water content in the mobile part can be described with a Richards equation, which has a source term that is non-local in time. This source term accounts for the fluid exchange with the immobile part. We discuss the approximations made for this model with laboratory experiments and show some numerical test cases.