



Implicit and explicit representations of structures and processes

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Flow and transport in the subsurface is governed by the spatial structure of material properties. This is true across many different scales from pores to catchments. In this contribution we discuss for a hierarchy of scales the different strategies of implicit versus explicit representation of structures and processes in modeling flow and transport. This is done by identifying characteristic spatial scales where the material can be considered to be macroscopically homogeneous. In a second step we address the question how structural properties are transformed into 'effective' descriptions and related parameterizations. This includes non-equilibrium conditions which gain importance when increasing the scale to larger domains and herewith to larger averaging volumes and includes the phenomena of preferential flow. Finally we present some new findings for the general problem which structural measures are decisive for flow and transport properties. This is explored by generating multiple realizations for various sets of structural measures using global optimization and then comparing their transport properties based on numerical simulations.