Exact Transport Upscaling under Spatial Random Adsorption

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We study transport upscaling under linear instantaneous equilibrium adsorption characterized by a spatially random retardation factor. In a stochastic framework, we present a methodology to quantify explicitly the impact of spatial disorder on effective transport dynamics. We derive an exact effective transport equation, which is equivalent to transport under linear kinetic adsorption characterized by a spectrum of adsorption times. The distribution of adsorption times is given explicitly in terms of the spatial disorder distribution.