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An evaluation of the predictive capabilities of CTRW and MRMT

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The prediction capability of two approximate models of non-Fickian transport in highly heterogeneous aquifers is checked by comparison with accurate numerical simulations, for mean uniform flow of velocity U. The two models considered are the MRMT (Multi Rate Mass Transfer) and CTRW (Continuous Time Random Walk) models. Both circumvent the need to solve the flow and transport equations by using proxy models, which provide the BTC $\mu(x,t)$ depending on a vector $\mathbf{a}$ of unknown 5 parameters. Although underlain by different conceptualisations, the two models have a similar mathematical structure. The proponents of the models suggest using field transport experiments at a small scale to calibrate a, toward predicting transport at larger scale. The strategy was tested with the aid of accurate numerical simulations in two and three dimensions from the literature. First, the 5 parameter values were calibrated by using the simulated μ at a control plane close to the injection one and subsequently using these same parameters for predicting μ at further 10 control planes. It is found that the two methods perform equally well, though the parameters identification is nonunique, with a large set of parameters providing similar fitting. Also, errors in the determination of the mean eulerian velocity may lead to significant shifts of the predicted BTC. It is found that the simulated BTCs satisfy Markovianity: they can be found as n-fold convolutions of a "kernel", in line with the models' main assumption.