

Interactive comment on “On the validity of effective formulations for transport through heterogeneous porous media” by J.-R. de Dreuzy and J. Carrera

Anonymous Referee #2

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The paper focuses on the modeling of solute transport processes in heterogeneous porous media. In particular, the authors provide an assessment of the capabilities of the widely used multi-rate mass transfer model (MRMT) to represent the various mechanisms that contribute to mixing and spreading of the solute in the considered heterogeneous systems.

I find the paper is well structured and written and provides an interesting analysis, which can be useful also in considering the ability of effective models (such as MRMT) to model reactive transport settings. However, I think some of the modeling choices made by the authors should be better motivated and some additional analyses may

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be necessary to assess the generality of the presented results. Given this general assessment I detail in the following a number of revisions which should be performed before publication.

The authors characterize mixing and spreading as rendered by the MRMT and compare the results to those obtained by direct simulation in heterogeneous media. By doing so they select specific values of the model parameters. For example at line 5-6 pag. 12296 they introduce the parameters used to obtain the results in Figure 3. However it is not clear to me how the values of β and t_N/t_1 have been selected by the authors. There is no discussion of this choice in the paper. A similar remark holds for the sensitivity analysis reported in Table 1 and discussed at page 12297: the authors explore the sensitivity of the result by changing one parameter at a time, but all results are conditional to the values of the other two parameters which are fixed. Again, the values selected for the parameters appear to be arbitrary: there is no explanation in the paper as to why these specific values are selected.

At page 12295 line 17-20 the authors mention that calibration on breakthrough curves does not guarantee an accurate reproduction of mixing. However, MRMT could be calibrated to interpret mixing measures, e.g. to reproduce the time evolution of γ . In my opinion this analysis would be necessary to complete the presented results (and would, at least partially, resolve the issues raised above on the parameters choice).

Minor corrections:

Pag 12290 line 19-20: The authors claim here that dispersivity is always negligible with respect to mass exchange effects. Can the authors provide a reference to support this statement? Is this general? And if so, why not completely disregarding dispersivity?

Pag 12290 line 17: please provide a definition of the advection time.

Pag 12291 line 20: please quantify “intermediary”.

Figure 4: symbols in the legends should be corrected.

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C6436