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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 #1

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Review of the manuscript entitled "On the validity of effective formulations for transport through heterogeneous porous media" (#hessd-12-12281-2015).

Following the statement that an effective formulation should honor advection, dispersion and mixing, the authors propose a comparative analysis on the ability of Multi-Rate Mass Transfer (MRMT) models to reproduce mixing observed in Heterogeneous Porous Media (HPM). They demonstrate MRMT models have a stronger memory on mixing than on dispersion at early times (initial conditions), however, it predicts smaller non-dispersive (i.e., non-diffusive, depending on the preferred terminology) mixing than HPM. Long residence times in the immobile zones may sustain the non-dispersive mix-

ing over much longer times. In general, they conclude MRMT modes can capture the spreading but not the non-dispersive mixing.

The results deserve a full attention. The paper is well-written and the analysis is thorough. I appreciate the extended bibliography review carried out in this manuscript, and I expect that the processes described will be the subject of fruitful discussions in years to come, since it is a hot-topic today, i.e., the difficulties or impossibility of models as MRMT or MIM to capture mixing in HPM, and reactivity as consequence. It is of significant interest to the HESS readership.

Hence, I can recommend this manuscript for publication, after the minor, I would say typos, are addressed:

-Chapter 2.1. Line 17. Please, for the ones that are not familiar with this topic, define m=2.5 with an example as has been done for m=1.5.

-Eq. 4. Please, define r as a distance.

-Eq. 9. Although omega (=domain) is defined later (just before Eq. 12), please, define it here.