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Hydrology and Earth System Sciences
Discussions

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

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We thank the reviewer for the positive assessment of our work.

We will include his editorial comments in the revised version.

The referee raises three essential issues:

1 - How do you choose MRMT parameters in the sensitivity analysis?

The reviewer is right in that sensitivity around a point in the parameter space is insufficient to characterize the behavior of the solution. We did a lot more runs than presented in the paper, but limited the cases presented in the manuscript to facilitate

readability. To maintain it, we will not discuss additional parameter sets, but we will mention that the analysis has also been made for other combinations of parameters. Extreme values have been investigated to get the possible range of behaviors. For slopes, we adopted the range observed in nature. The porosity ratio does not have an upper bound. In fact, ideally, the mobile porosity could be zero. We adopted 150 as a large upper value. Larger upper values would not affect results and might cause numerical difficulties. The same can be said for t_N/t_1.

2 - Is it possible to fit MRMT on gamma rather than on conservative breakthrough curves?

This is a very interesting question. In fact, it is what motivated our work. If one could do it, then it would be possible to find an effective model that indeed honors spreading and mixing. What we find is that, in general, this cannot be achieved as there is already a tradeoff to fit gamma between the amplitude of the deviation and the timing of it.

3- The authors claim here (page 12990, lines 19-20?) 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?

We do not quite understand this comment as we never make such comment for dispersivity in general. The referee may refer to dispersivity in the mobile zone of MRMT models, in which case, we agree. We might as well neglect mobile zone dispersivity. We will quote earlier work on MRMT that show the dominance of exchanges on residence time distribution and thus effective dispersivity of MRMT models. However, throughout the paper, when we discuss dispersivity, we refer to either dispersivity of the HPM, which drives the generation of gradients in concentration and thus mixing, or effective dispersivity of the MRMT model, which is controlled by mobile-immobile exchanges. In either case, dispersivity is not negligible with respect to mass exchange effects. We will expand the discussion and clarify these three issues in the revised

version of the paper.

Interactive comment on Hydrol. Earth Syst. Sci. Discuss., 12, 12281, 2015.