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Hydrology and Earth System Sciences Discussions

Interactive comment on "Mass transfer effects in 2-D dual-permeability modeling of field preferential bromide leaching with drain effluent" *by* H. H. Gerke et al.

Anonymous Referee #1

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This paper deals with modelling of preferential flow effects on solute transport at the field-scale. Modelling preferential flow is still a major quest in nowadays hydrology at any scale and thus studies that address this topic are welcome and suited for HESS. This paper is well written, concise and can be accepted for HESS after revisions. Reading the paper, I found it sometimes difficult to grasp the main message of the authors and thus I would like to challenge the authors to try to clarify the manuscript. More precisely:

- Sharpen the objectives of this paper. It says: "review and analyze effects of soil

structure-related mass transfer reduction on BR- leaching with drain effluent under 2-D flow conditions", but this is rather vague: the subject is narrow for a literature review, and the focus of the analyses is not clear: 2D vs 1D, sensitivity analyses of Mass transfer parameter, or scaling.

- What is, according to the authors the main innovation of this paper? Please state innovation clearly in the objectives, discussion/conclusions and make the innovation jump out in the materials and methods section (2D versus 1D, scaling, and the mass transfer scenarios are now difficult to find).

- What do we learn from this paper? How should we treat preferential flow differenty from now on?

- As I understand, the authors used a calibrated model that has been described extensively in previous papers, to calculate the effects of the mass-transfer coefficient on bromide leaching via four mass-transfer parameter scenarios. They compare the model results with the field-experiment results, which were also previously described and on which the model was previously calibrated, and conclude that local mass-transfers between soil matrix and the preferential flow domain is important even at field-scales. Reading the paper I had to struggle to understand what is new and what has previously been published. A clearer subdivision in "new" and "old" would benefit the message of the paper.

Some general questions that I got during reading the manuscript are:

- What new information is obtained by the 2-D simulation that was not found by a 1-D simulation. What about 3-D?

- Could the effects that are now ascribed to the solute mass transfer par. ,αs, also be obtained by different values for the water mass transfer par. αw or the volume percentage of preferential flow pathways wf? Why do you only consider scenarios for αs?

- You looked at a clayey type of soil, where you state that diffusive movement of solutes between the SM and PF domain is dominant over advective movement. Would for example the water transfer parameter not be much more important in sandy drained soils? I miss such a discussion in the paper that would make the results more general.

- You switched from a 1-D model to a 2-D model to calculate solute transport to a drain. Could you now also say something about non-drained fields, with mostly groundwater flow to the nearest ditch or brook? Is preferential flow still important when drainage elements are far apart, and would you then use the same model?

- How does soil and water table heterogeneity in the entire field affect upscaling flow from a 2-D cross-section to the entire field? Can it be neglected, because of the dominance of preferential flow at the plot-scale, as you have done in this paper?

- Would wall coatings of preferential flow paths not also affect the transfer of water between SM and PF (ie αw)?

Specific comments: Title: Could be more to the point/clearer. “field preferential bromide leaching with drain effluent” is difficult to understand.

Abstract; line 6: “reductions”: reductions relative to what?

Abstract: line 20: “is analyzed as” is confusing for me. Did you conclude this from the results and do you mean to say ”was found to be”, or does it refer to the methods you have used for analyzing.

Introduction: Page 5920, line 27: are –> is

Page 5920:line 29: Furthermore. . ..Heterogeneity. I think better to rephrase sentence

Page 5921: line23: can be found in Dusek et al. (2010).

Page 5922: line 24: “This study. . .data”; This sentence seems to belong to the materials and methods section.

Page 5923: Materials methods: Maybe you can start with a small introduction (including the last sentence of the introduction) where you clearly state what is new (mass transfer scenario’s, scaling from plot to field, redistribution boundary condition?) and what has been previously published (experimental results, modelling + initial and boundary conditions), and maybe group this Materials and methods section into new and old paragraphs. I had a hard time finding what you actually did in this long chapter as it is all presented in the same way. Furthermore, maybe not all previously published material has to describe in such great detail to improve focus of the manuscript.

Page 5923, line 16: The site. . . 2004). Is this information relevant for this paper? The figure 1 seems to belong more to a previous paper than to this paper.

Page 5924: Modeling. Try to guide the reader better. Your goal is to evaluate mass transfer. Therefore the paragraphs that treat mass transfer should jump out.

Page 5927, line 5. The transfer terms..level. Strange sentence with no meaning without context.

Page 5929, line 1: You state that the parameters are adopted from previous work, but the values in Table 2 do not correspond to the values reported in the text.

Page 5930: initial and boundary conditions. I do not fully understand if the soil surface redistribution scheme is a new model feature, and if so, it is important for the paper.

Page 5932, line 8: br- leaching from tile drain back into the soil?

Page 5941 line 22: “Suggestions. . .”

Page 5942, line 23: I do not understand a reversed peak dynamic.

Page 5944, line 22: Often the term “reduced diffusive component” is used. Do you conclude this from the results that low αs values giver better simulation result? Do you mean reduced compared to the calibrated value or reduced by wall coatings etc. but with no absolute reference. Then maybe it is confusing to use the word "reduced".

Page 5945,line20:"where. . ." sentence can be read many ways. Took me a long time to make sense, please rephrase.

Figure 5: symbols for both data-timeseries are difficult to distinguish

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Interactive comment on Hydrol. Earth Syst. Sci. Discuss., 8, 5917, 2011.