**Hydrology and
Earth System
Sciences
Discussions**

Interactive
Comment

Interactive comment on "A novel explicit approach to model bromide and pesticide transport in soils containing macropores" *by* J. Klaus and E. Zehe

M. Larsbo (Referee)

Mats.Larsbo@slu.se

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General comment:

The manuscript deals with modelling transport of the non reactive tracer bromide and the herbicide isoproturon in a tile drained hillslope. The same model has previously been applied to the same field experiments but the inclusion of solute transport adds new challenges and novelty to the manuscript. This topic is well suited for HESS and the manuscript is generally well written and well structured. Before being considered for final publication a number of scientific matters need to be resolved and further discussed and the presentation needs to be improved.

Specific comments:

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As I understand it, one of the objectives of the new modelling approach is to explicitly account for earth worm burrows that act as preferential flow paths connecting the soil surface to the tile drain. You are clearly dealing with a 3-D problem. There is 1) flow in the vertical direction, 2) flow along the slope parallel to the tile drains and 3) the flow and transport to the drains through burrows, mainly in the direction perpendicular to the tile drains. In order to analyse point 3, which I find strongly related to your objectives, it would have been, perhaps even more interesting to use the dimension perpendicular to the tile drain instead of the along the slope. Please comment on your choice of dimensions.

On P1004L4-5 you state that 'We are aware that, in the case of behavioural adsorption, n should be smaller or equal to one'. This is certainly true. Reported literature values for IPU are in the range 0.8-0.95. A better fit to measured data is a poor justification for using Freundlich n-values larger than one. When you use n-values as large as 5 you are no longer modelling adsorption. This exercise does not and cannot give any information on the transport of IPU. Figures 7-9 and the corresponding discussion should be removed.

There are possible explanations for the small retardation of IPU observed in the field experiment. You should discuss e.g. non-equilibrium sorption in bio-pores and possible reasons why the sorption in bio-pores may be very different from the sorption in the surrounding soil matrix.

P993L24-P995L22. Please clarify why you chose to include these references in your study. What do you conclude from these references? Is there a need for a more explicit model?

On P998L7-8 you write that the site was instrumented with 25 TDR-probes. You do not mention how these TDR measurements were used. Why did you not use the data to determine the initial conditions and for model evaluation? Please explain.

Minor comments:

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Title: I suggest you change 'macropores' to 'earth worm burrows' to give a better representation of the content of the paper.

P992L5. I suggest you remove 'spatially highly resolved' since it is a subjective statement.

P993L2. On what scale do you consider preferential flow to be a primary cause of spatial variability in soil water contents?

P993L4. Change to '. . .flow and transport in soils containing non-capillary structures. . .'

P993L11-14. This text requires further explanation or could be removed.

P996L13-15. This point does not add anything to the previous two points and can therefore be removed.

P999L8-9. Define p_lat. What does this mean? A 0.05 probability of 'digging' laterally and a 0.1 probability of 'digging' vertically leaves a 0.85 probability of not digging at all?

P999L10-11. It is not clear what you are referring to here. Where did you outline the grid?

P1000L15. Refer to figure 2 and use e.g. the terms 'upslope' and 'downslope' instead of 'left' and 'right'. What does free flow mean? Please clarify.

P1001L4. A grid size of 30 cm means that an individual grid element is much larger than a real worm burrow. An unrealistically large part of the solutes are applied directly in the 'burrows'. What consequences does that have for the solute transport?

P1001L24-25. What does 'maximum filter velocities in the tile drain' mean? Please clarify.

P1002L14-15. The transport of bromide and IPU is probably very sensitive to the values of the effective diffusion coefficient. Explain briefly how the value of this parameter was determined and why you chose to keep it fixed.

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P1003L6-9. Please justify this approach. It seems arbitrary.

P1005L13-15. I don't agree that 'lines from the soil surface down' can be seen in figure 6.

P1005L23-24. It is not possible to see that the 'simulations are rather insensitive for the k_f'. This point would be clearer if you used a log scale.

P1008L18-20. This sentence is not justified. What you show is that the model approach works well for both tile drain flow and bromide transport. This does not mean that parameter values are 'true' values. It is clear from table 2 that different section widths work equally well.

P1008L22-25. This conclusion is not supported by the presented data since you have only tested one approach. It is possible that simpler models that handle macropore flow can reproduce the data equally well. Is the term topology suitable in this context?

Figure 2. The location of the tile drain would be informative.

Figures 3-5. The curves for simulated results are neither visible on screen nor in print. The font size should be increased

Some typological errors:

P995L14. 'approached' P999L16. 'assumptions are' P1001L12. 'model' P1008L6. 'a homogeneous' P1010L16 'selected'

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