Hydrol. Earth Syst. Sci. Discuss.,
https://doi.org/10.5194/hess-2019-132-SC1, 2019
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Hydrology and Earth System Sciences
Discussions

Interactive comment on "Simulating preferential soil water flow and tracer transport using the Lagrangian Soil Water and Solute Transport Model" *by* Alexander Sternagel et al.

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Received and published: 15 May 2019

A note upfront from the submitting person: This review was prepared by Sandra Werthmüller and Jasmin Kesselring, both master students in Earth System Science at the University of Zurich. The review was part of an exercise during a second semester master level seminar on "the biogeochemistry of plant-soil systems in a changing world", which I organize. We would like to highlight that the depth of scientific knowledge and technical understand- ing of these reviewers represents that of master students. We enjoyed discussing the manuscript in the seminar, and hope that our comments will be helpful for the authors.

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Discussion paper

—- Sternagel et al. (2019) developed a model to simulate preferential water flow and tracer transport in macroporous soil. As a starting model, they have used the Lagrangian model of Zehe and Jackisch (2016) and added two extensions to the model. Firstly, they added a solute concentration (C) to each particle so that solute transport can be simulated. Secondly, the inclusion of a preferential flow domain allows to simulate the influence of macropores on water and solute dynamics. To evaluate the model Sternagel et al. (2019) used data of an experiment that was done in the Weiherbach catchment by Zehe and Flühler (2001). They concluded that their simulation of solute transport under well-mixed conditions corresponds generally well with the observed data from Zehe and Flühler (2001). The same is true for the preferential flow domain. The additional sensitivity analysis that they conducted shows that the conductivity (ks) of the soil has a major impact on the infiltration of the water.

General comments: In general, we think that the manuscript has a good structure and one can follow the development of the model the way it is described in the paper. However, we think that the introduction is slightly too long compared to the rest of the manuscript.

For us as beginners in the field, it is hard to understand why your model is innovative. Could you explain at the beginning of the paper what makes your model innovative compared to others in the field? And how your work is embedded in the broader work of soil water modelling? We understand that the paper is about discussing the development of a new model and is thus theoretical. However, we think a more practical description of the use of the model would be nice. For instance: For which studies is this model a must have addition? We also think that the model would have to be compared to more than one practical study to fully be called a valid model. There are some additional points we find unclear:

Page 3 Line 36 ff: How is the number of bins i and the subdivision into N bins defined? What exactly is the difference between those two and how do you choose the ‘perfect’ number of bins?

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Page 4 Line 30-33: Here, you list four subchapters that will follow in the next paragraph. Why not name the actual subchapters according to this list?

Page 9 Line 31ff: You already start the interpretation of results, why not in the dedicated section (discussion and conclusion)?

The layout of your references makes it hard to differentiate references. We also noticed that a lot of citations and references you used are from the same authors. We were wondering, if there are other scientists that are working on the same problem to which you could compare your results with.

—- Detailed comments: The abbreviation for confer is cf. not c.f. It is used inconsistently in the manuscript.

Page 1 Line 34: become a major issue (change an to a)

Page 4 Line 24ff: This sentence is a bit difficult to understand. Maybe make two sentences e.g. ...corresponding to the molecular diffusion coefficient. Additionally, this needs to be smaller than. . .

Page 6 Line 4: k_m1 or k_m1 with a subscript 1 as in the formula above?

Page 8: Has unnecessary empty space

Page 9 Line 21ff: In this sentence you suggest that the parameter hydraulic conductivity of the matrix ks, diameter of macropores dmac and the amount of macropores nmac are the most sensitive for the model behaviour and simulation results. Please elaborate why and give a reference for it.

Page 9 Line 24ff: In this paragraph you mentioned different configurations for depth distribution and distribution factors. They have the same numbers, which is confusing and makes the text hard to understand. If possible, clarify the difference between depth distribution and distribution factors.

Page 13 Line 37 ff: You mention that your model is highly computational efficient and

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with a short simulations time (about five minutes). How does this short simulation time compare to other similar models? Could you give a reference time? And could you explain how this new model increased computational efficiency?

Figure 1: Why are pore size and soil water content equal to each other? (x-axis) Maybe mention in the figure caption how the bin width is calculated.

Figure 2: In line 3 of the caption: describe DM, LM, dz separately like the other parameters and not as a group. We do not understand what figure b) means. What do the different colours stand for? Describe it better in the text where you reference it as well as in the figure caption.

Figure 3/4: Is the coloured in area the uncertainty range? Are these different parameters in figures 3 and 4 or why do they have different colours? For us the graphics are also a bit small which makes it difficult to read them. It would be better if the graphics were a bit bigger.

Figure 9: In all four plots use the same colour for the same configuration number. This makes it easier to see the influence of the different factors on the configurations.

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