

This study presents an evaluation of pedotransfer functions that are used to derive parameters of a model that considers preferential flow and transport. Simulations of the parameterized model were compared with data from lysimeter experiments. In order to evaluate the effect of preferential flow, also simulations were run in which the preferential flow process was ‘turned off’. The results indicate that the fraction of the leached tracer shortly after tracer application was considerably better predicted when preferential flow was taken into account and parameterized using the pedotransfer functions. Besides a direct comparison between simulated and measured leachate rates and leached solute fractions, also the measured and simulated ranking of the soils in terms of their vulnerability to leaching and preferential transport was compared.

The outcome of this study is of great relevance for risk assessment and risk management or mitigation that is related to diffuse pollution of groundwater by surface applied agro-chemicals, which require regional scale evaluations of solute transport. So far, preferential flow processes have rarely been considered in regional scale assessments. It would be good though if some references are made to other studies in which regional scale modelling of e.g. pesticide leaching was carried out.

Although the paper is in general clear and sufficiently detailed, there are a few things that need clarification.

Firstly, leached mass fractions are evaluated after certain amounts of pore volumes were drained. It is however not clear how the pore volumes were defined. Since the water content varies over time, the definition of a pore volume is not straightforward. Secondly, I assume that the lysimeters were not weighted neither that water contents in the lysimeters were measured. Therefore, it is not clear how pore volumes could have been derived directly from measurements.

Secondly, it would be good if some more basic parameters of the water balance in the lysimeters were given. For instance, what was the amount of rainfall, potential crop ET, and leachate during the measurement period in the different lysimeters? This could give an impression about the importance of the root water uptake parameters such as the rooting depth and the root water uptake compensation factor. I guess that for situations where crop ET is close to the potential crop ET, root uptake parameters will not have a big impact on the water balance simulations. In the supplementary material, it would be good to show also the cumulative amount of leachate. Given the length of the experimental period (one to two years) it is rather strange that less than 0.3 pore volumes leached out of some lysimeters. For a lysimeter of 1 m length, a volumetric water content of 0.25, 0.3 pore volumes corresponds to 75 mm of leachate which is rather low for a period of 1 to 2 years.

Detailed comments:

p2247 ln 20 and following: ‘errors or uncertainties in the estimations of agro-environmental GIS’

I would skip: ‘the estimation of’

‘errors in the parameter estimation algorithms used to estimate model parameters’

I would skip ‘used to estimate model parameters’

p 2251 ln 8 and 9: The organic carbon contents and bulk densities give here, are these parameters of the individual soil horizons? Are the median values calculated from the values of all soil horizons?

p 2251: ‘Daily weather data were available...’ The generation of macropore flow is highly dependent on the rainfall intensity. Since the time scale of a rainfall event is considerably

smaller than a day, daily rainfall data are not representative of the actual rainfall intensities. For simulating Hortonian surface runoff, aggregation of rainfall data on a daily time scale leads to a considerable underestimation of the runoff (Mertens, J., D. Raes, and J. Feyen. 2002. Incorporating rainfall intensity into daily rainfall records for simulating runoff and infiltration into soil profiles. *Hydrol. Process.* 16:731-739). Could this be discussed?

p 2252: In 22 and following. The length of the warm up period seems to depend on the time period between the installation of the lysimeter (or weather station) and the tracer application. The duration of a spin up period should be at least cover the time period that is necessary so that the system state at the start of the tracer application does not depend anymore on the initial conditions but on the weather conditions before the application and the soil properties. For most studies, the spin up period seems to be sufficiently long to fulfil this criterion. However, I am wondering whether this is also the case for the Brimstone study, for which only 14 days of spinup were considered.

p 2253 In 21: ‘... the saturated water content in the soil matrix’ Is this the water content of the soil when the water potential head is -10cm? Maybe add this definition here.

p 2254 In 5: Could some information be given about the method that is used to measure $K_{S(m)}$? I think differences in methods that were used to measure $K_{S(m)}$ are more relevant than the different researchers that carried out the measurements.

p 2254: In table 3, estimated macroporosities for different soil layers are given. The macroporosity decreases with depth.

p 2257 In 12: How was the pore volume of water drained calculated? The pore volume drained is the amount of water drained divided by the amount of water in the lysimeter. The water content in the lysimeters was not measured and it changes over time. Therefore, the pore volumes must have been estimated making some assumptions about the water content.

p 2258: Eq. 5. I think the CCC is not correctly defined in Eq. 5. The squared deviation between the means should be added to (not subtracted from) the variances of the two variables.

p 2259: In 19 and following. I think it is necessary to indicate briefly the effect of the compensation factor β on the water balance. I guess that a compensation factor β of 1 leads to more root water uptake than a compensation factor β of 0.

On the other hand, I guess that increasing R_{max} leads to more root water uptake and decreasing it to less root water uptake. Therefore, the same amount of root water uptake (and consequently leachate) may be obtained when R_{max} is decreased and β is increased. Is it possible to disentangle R_{max} and β can not be disentangled from measured leachate without measured depth profiles of water content?

p 2260 In 21. I propose defining the anion exclusion factor here since it may be defined in different ways. I am familiar with a definition using a retardation factor that is smaller than 1.

p 2261 In 1: Solute transport parameters were optimized based on the accumulated solute leaching. I propose including here that the parameters were optimized based on the accumulated solute leaching versus the cumulative leaching. Later in the text, it is mentioned that the entire breakthrough was used to calibrate the solute transport parameters.

p 2263: In the discussion on the calibrated R_{max} and b parameters, I think it should be mentioned that when these parameters are calibrated based on leachate measurements only, their estimates will be (negatively) correlated. Therefore, I am wondering whether the calibrated parameters have a physical meaning.

p 2263: ln 16. The excluded water content is expressed as a percentage. But it is not clear of what this percentage is taken? Is it a percentage of the total bulk soil volume (i.e. in line with the definition of a volumetric water content)? Or, is it a percentage of the saturated water content (i.e. in line with the definition of a degree of water saturation)?

p2264 ln 4-7. It is not clear to me what the authors mean exactly with this sentence. Is the result remarkable because preferential flow also plays a role in soils and weather series for which no preferential flow is expected? Or is the result remarkable because despite the fact that in a number of soils and weather series no important preferential flow was simulated, the effect of preferential flow was nevertheless large when all soils were considered?

p 2270 table 1: I propose including the dates when the tracers were applied. Breakthrough of tracers that are applied in autumn will not be influenced by the parameterisation of the root water uptake whereas breakthrough of tracers that are applied in spring will be more sensitive to root water uptake parameterisation.

p 2271 table 2: I propose to use besides the original classification of the soil types also a common classification for all different soils that are used.

Supplementary material: I guess that the simulation results are those from the uncalibrated model? I would be good if this was mentioned. Why aren't also the simulation results of the calibrated models shown?

I think it would also be useful to show the cumulated amounts of drainage that are divided by the lysimeter lengths. This gives an overall impression of the amount of water leached during the experimental period relative to the length of the lysimeters.

Supplementary material: ln 14-15 water flow and solute transport are switched.

Supplementary material ln 16: 'modelled water and solute flow have been downscaled ...' I would say that a temporal downscaling results in a higher temporal resolution.