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Hydrology and Earth System Sciences Discussions

Interactive comment on "Implementing small scale processes at the soil-plant interface – the role of root architectures for calculating root water uptake profiles" *by* C. L. Schneider et al.

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Implementing small scale processes at the soil-plant interface – the role of root architectures for calculating root water uptake profiles. CL Schneider, S Attinger, J-O Delfs, A Hildebrandt

This manuscript discusses a simulation study in which 3 approaches for modelling water uptake were compared. This is a valuable modelling study highlighting the important result that RLD profiles do not necessarily tell the whole story in terms of water uptake from the soil profile. The capacity to represent water uptake compensation across a

root system is valuable and will play an important role in understanding the interactions between root systems and their dynamic soil environment.

I suggest a few changes below. I had to read some of the sections several times to clearly understand what each of the 3 modelling approaches were and how they related to the modelling methods you detail. Consider rewording to make this clearer.

Abstract:

Consider rewording the abstract. The first time I read the abstract it was hard to work out what was going on with the scenarios, model approaches, and individuals. Reword to make the treatment design clearer.

1 Introduction:

Page 4234, line 25, reword "as well as for the water"

Page 4236, line 20, spelling, change "imply hat" to "imply that"

Page 4237, line 11, reword to "how does this variety influence the"

2 Models and methods:

Page 4237, line 18, reword to "In real plant, this leads to a distribution"

Page 4237, line 22, reword to "In this model, we only consider"

2.1 Bulk water flow in the unsaturated zone:

Page 4238 'the porosity of all soil grid cells is decreased by the corresponding fraction of volumetric root content.'

Could you please tell us a bit more about this? Have other models included this? Has the validity/effect/importance of this been demonstrated? I understand why you have included this here, but it is a complex phenomena that has a direct impact on your modelling results. The intention is that as root volume increases in a soil volume, there is less pore space for water to occupy. Hence as RLD increases available water

decreases. Hence, water uptake will reduce as RLD increases just because porosity has decreased. However, in reality roots have a complex effect on soil water content and the movement of water through a soil volume. As roots grow they move the soil around them affecting the pore space distribution. Old root channels and roots that have 'shrunk' with age can provide preferential flow paths, further impacting on the water holding and water movement characteristics of the soil.

2.2.1 Water flow within the root system:

Page 4240, line 15, reword: "drops a critical value". Should this read "drops below a critical value"?

Page 4240, line 17, reword: "flux gets variant" to "flux becomes variant"

Page 4240, line 23, reword: "leads to a systems of" to "leads to a system of"

2.2.2 The microscopic radial water flow within the soil: Could you explain a little bit more about rdisc? How big is rdisc? Is there the potential of cylinders to overlap in high root density zones? How is this accounted for?

2.5 Model input and scenarios: Consider rewording this section (particularly lines 16 to 23, page 4245). It was hard to follow what the various models and scenarios were. Consider a simple diagrammatic representation of the 3 modelling options.

Page 4245, line 19, reword: "roots own higher" to "roots have higher"

Page 4245, line 20, reword: "roots own lower" to "roots have lower"

Page 4245, line 21, reword: "reason for distinct the" to "reason for dividing the"

Page 4246, line 3, reword: "from and uniform" to "from a uniform"

Page 4246, line 19, reword: "agreement to measurements" to "agreement with measurements"

3.1 Influence of root architecture and hydraulic....:

Page 4247, line 11, reword: "approach matches perfectly" to "approach match perfectly"

Page 4247, lines 12-15, I can see some compensation going on for Scenario B, but it is not obvious to me from Fig 4 that there is compensation happening in Scenario A.

Page 4247, line 18, can you provide some explanation to the reader for what water uptake would be lowest for Scenario B? Why does lower radial resistance (easier for water to travel) lead to less water uptake?

Page 4248, line 17, and Page 4250, lines 18-22. In both the Results and Discussion you state that the Feddes model does not compensate by increasing water uptake from less densely rooted layers. Please provide a little more discussion to explain this to people who have not used the Feddes model. In your implementation of the Feddes model, water uptake is driven only by the fixed flux Tpot (or the potential at the root collar), and the RLD in a soil volume. Since there is no root growth during in simulation, there is no possible mechanism by which roots could compensate. This is the expected outcome for that model, and would have been known before the simulations were run.

4 Discussion:

The outstanding result of this paper was the finding that RLD profiles were similar amongst the 50 realisations, while the water uptake behaviour was different. It would be good to do some rewording of the discussion to make the importance of this finding a bit clearer (more explicit). Tell us a bit about why this result is important and what the implications are for modelling water uptake? Is there a need for water models to consider a spatially explicit root system rather than simulate the development of RLD with depth, and under what conditions? Will this result still hold for root systems that grow and develop over time? What would the impact be on growing root systems?

Figures:

Figure 2, Page 4260, Would be good to show 2 root systems in this figure. Would give

us a good feel for how different two individuals are.

Figure 4, Page 4261, It is a bit hard to interpret results from these graphs. It is hard to distinguish between scenarios, particularly if the paper is printed out in black and white. Consider changing the scales on Fig4b and Fig 4c from 0-0.3, to 0-0.15. I know that they will not be consistent with fig 4a, but they will be much easier to interpret which I think is more important for trying to tell your story.

Interactive comment on Hydrol. Earth Syst. Sci. Discuss., 6, 4233, 2009.