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Hydrology and Earth System Sciences
Discussions

Interactive comment on "Horizontal soil water potential heterogeneity: simplifying approaches for crop water dynamics models" *by* V. Couvreur et al.

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The objective of this manuscript is to provide a theoretical framework and analysis regarding the use of upscaled root water uptake models, considering or not horizontal heterogeneity within the root zone. Authors demonstrate and illustrate how to derive upscaled root water uptake parameters and state variables from small scale information. The assumption of homogeneous soil water potentials in upscaled soil elements was tested in different scenarios with respect to (i) rooting heterogeneity (maize vs wheat), (ii) soil type (silt loam vs sandy loam), and (iii) atmospheric demand for water (high, ∼4 mm/day vs low, ∼2 mm/day). A second assumption refers to the solution for

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water potential differences between bulk soil and root surface in 1-D soil layers.

The manuscript is well written and richly illustrated, and several topics are adequately discussed. Authors manage to organize a vast quantity of information into a well-organized structural text.

Some specific comments and suggestions I would encourage the authors to consider:

p. 1209, line 14-15: "and assuming that the water potential at the plant collar and leaves are identical". This assumption is equivalent to saying that longitudinal (collar to leaf) resistance is zero. Is it justified to assume this? In that case, why don't you just substitute collar potential by leaf potential in your equations? On the other hand, it would be straightforward to implement the collar to leaf resistance by an extra term in eqs. 4, 5. The manuscript would benefit by a discussion about this question.

p. 1209, line 27-28: "Even though it does not appear in their units". This affirmation sounds a bit odd and is, I think, unnecessary. You might also refer to two plants, a dozen of plants, or a square meter. In fact, if you presume all related computations are realized "per plant", then in eq. 5, Krs is "the equivalent conductance of the root system, PER PLANT". If you want to maintain the affirmation "per plant" on line 28, you should include it also in some other units (values of K). On the other hand, you might omit all of these, or make a more general statement at the beginning of the section explaining the considered system is "one plant". Observe that you already use the plant-1 unit at some places in the manuscript (e.g. p. 1218, line 19).

p. 1219, eq. 20 and shortly after that: Here there is some inconsistency in values and units. (1) Consider substituting "t (T) is the time of the day" by "t (T) is the time after midnight". "Time of the day" can also be interpreted as number of seconds per day. (2) You cannot say that the unit of 2pi, a number, equals d-1. To make this less ambiguous, you should replace 2 pi in equation 20 by a symbol, representing it with units rad T-1 and value 2pi/Td, Td (T-1) being the time of one day. (3) You also cannot state that the unit of tau is T d-1, as d-1 is a unit of time, hence T-1. Instead, consider defining tau as

HESSD

11, C195–C197, 2014

time per time of one day (t/Td), dimensionless or with units T/T-1.

p. 1221, line 14-15 and p. 1242, table 2, and other places: Consider replacing “time consumption” by “computing time”.

p. 1221, line 22-25 and p. 1223, lines 23 and further: This is a plausible and interesting finding. If it is correct, wouldn’t this imply in the fact that the scale of modelling is too detailed to be of practical use? In other words: if simulated differences in root water uptake are masked by compensatory water flows that level out the pressure head differences, wouldn’t that be an indication that a simulation at a less detailed scale would be an improvement in terms of modelling efficiency?

p. 1228, line 3-7: In their conclusions, Faria et al. (2010) state that “a correction factor had to be included accounting for heterogeneity of root length density and root activity as well as imperfect soil-root contact. This correction factor also compensates for the assumption of a unique root radius”. You therefore did not “provide another reason” (line 6), but investigated one of the mentioned reasons with more detail.

p. 1248, fig 5: Replace “logarithmic scale” by “X-axes on logarithmic scale”.

p. 1249, fig 6: This figure caption is quite confusing, consider adding the words Maize and Wheat on the left side of the graphs and Soil and Root in the top line Instead of only hidden in the axis titles).

p. 1210, line 4 Replace “Understanding what are the implications of using it on” by “Understanding the implications of its application to”

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