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Hydrology and Earth System Sciences Discussions

Interactive comment on "Simple physics-based models of compensatory plant water uptake: concepts and eco-hydrological consequences" *by* N. J. Jarvis

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I would like to thank the referee for these comments, which made me realize that I should have explained the model better. In a revised version of the paper, I have completely re-written the model description in a way that I believe is much easier to follow. In particular, I placed more emphasis on the use of dimensionless variables, as the nature of uptake compensation then becomes much clearer. My responses to the individual points raised follow:

1. Yes, thank you. The model description has been completely re-written, but this

subscript is now included in all relevant equations.

2. The referee is mistaken and the definition in the paper is correct (omega is only equal to Ea/Ep if there is no compensation). As suggested, I have added the exact expression for omega as an equation in the revised version.

3. There was no reasoning needed. These equations were just combined to derive an expression for $\alpha 2$. But this section has been completely re-written and this part of the model is no longer introduced in this way.

4. Yes, thank you, the layer notations have now been added. The mix-up with the root parameter was a typo. It should be defined by the Greek symbol throughout.

5. I introduced the root parameter in connection with equation 6, by stating that it depends on both root diameter and root length density. I also cited de Jong van Lier et al. (2008) for the reader wishing to see a detailed derivation of this equation. However, I agree that for extra clarity, it would be good to include the relevant equations defining in the paper, and I have done so in the revised version.

Yes, M represents an average value in the bulk soil between roots. I have clarified this in the revised paper. I have also added a sentence explaining that at the microscopic scale, M increases from Mo at the root surface outwards into the bulk soil (see point 7).

6. No, Mo is constant (spatially, though not temporally) in the original formulation derived by de Jong van Lier et al (2008) (see equation 11). In the Jarvis version of the model it does, however, vary with depth in the soil as a function of M (equation 15).

7. The maximum supply rate to the roots will equal the maximum transpiration rate if storage changes in the plant are assumed to be negligible. I have added this point to the revised text. I think the graph mentioned by the referee is not necessary, as I have added some more explanations on M under point 5 above.

8. Yes, I definitely agree that omega-c is plant-species dependent, but it is not true that it's expression does not allow for plant physiological components to influence com-

pensation. The analysis in the paper shows that omega-c depends on soil hydraulic properties, root length and potential transpiration (equation 13). In turn, potential transpiration depends on plant factors such as unstressed stomatal conductance, leaf area and plant morphology (e.g. plant height). However, I realize that I did not make this point clearly enough. These dependencies on plant factors are more strongly emphasized in the revised paper.

Comment on section 2:

I am confident that the revised model description will help the referee (and readers) to better understand the point of the first case study, the nature of uptake compensation and the conceptual basis of the model.

Comments for section 3 and 4:

Yes, thank you, I will add a citation to this paper in this section.

Interactive comment on Hydrol. Earth Syst. Sci. Discuss., 8, 6789, 2011.