

Response to Reviewer#2

Again my thanks to the reviewer for his/her comments.

Reviewer: The author has substantially revised the manuscript based on my previous comments. Most of my comments have been addressed in a satisfactory way. I especially like inclusion of the new section on soil hydraulic conductivity function (4.2.2) to discuss the importance of having appropriate hydraulic parameters.

Author's Response: Thanks.

Reviewer: 1. There are two R_p values used in the revised manuscript: 1 mm and 4 mm. Although the author explains that it is considered to be a model parameter, it would be nice to have some discussions on what it physically means to have R_p value equal to 4 mm.

Author's Response: I have added the following sentence to the end of the last paragraph of section 2.2.3 (see Lines 412-415). "In the present context variations in R_p are purely model driven, but in reality such variations are likely to be most strongly associated with (or proportional to) changes in the soil particle dimensions and secondarily with other soil characteristics (e.g., *Leij et al.* 2002)."

This additional sentence required adding the following reference to the list of References:

[*] Leij, F. J., Schaap, M. G., and Arya, L. M.: Indirect Methods, in *Methods of Soil Analysis Part 4: Physical Methods*, co-edited by J. H. Dane and G. C. Topp, Soil Science Society of America Inc., Madison, WI, USA, 1009-1045, 2002.

Reviewer: 2. Because the number of figures significantly increased, I am wondering if the number of figures can be reduced to keep the manuscript length a little bit shorten. For example, Figures 3 and 4 in the revised manuscript can be merged into one figure.

Author's Response: I tried merging Figures 3 and 4 into one figure. I also tried the same thing for Figures 12 and 13. But in both cases the single merged figure was largely unreadable because the graph had just too many densely packed lines on it. I must decline the reviewer's suggestion.

Other Changes to the Manuscript

A. In accordance with the wishes of the Associate Editor, I rewrote or restructured several sentences in the Abstract and the Introduction. Several long sentences were broken into two sentences. I also rewrote or restructured several other individual sentences throughout the remaining text in an effort to make the manuscript more readable.

B. Changed two signs in Equation (22) to correct a typo.

C. Added finite difference terms equivalent to $\rho_w D_{\theta T} \partial T / \partial t$ to both the right-hand and left-hand sides of Equation (23) in order to make it consistent with Equation (6). Otherwise this term was mistakenly left out of Equation (23).

D. Rewrote lines 875-877 and corrected the *Smits et al.* [2012] citation.

E. Author Initiated Addition: Lines 165-180 & Lines 913-944 (Section 4.3.5) – I added a discussion about different ways of expressing the diffusive transport of vapor (Fick’s First Law of Diffusion) and the consequences this can have on simulations with my present model. This issue is very relevant and potentially quite significant to the the present manuscript, so I think the manuscript is better for having included this discussion. But, more generally, this issue can be quite important to any effort to model gas flow through porous media.

This new discussion required including four additional references to the list of References:

[*] Cowan, I. R.: Stomatal behavior and environment, in *Advances in Botanical Research*, edited by R. D. Preston and H. W. Woolhouse, Academic Press, London, UK, 117-229, 1977.

[*] Jaynes, D. B., and Rogowski, A. S.: Applicability of Ficks law to gas diffusion, *Soil Sci. Soc. Amer. J.*, 47, 425-430, 1983.

[*] Jones, H. G.: *Plant and Microclimate*, 3rd Edition, Cambridge University Press, Cambridge, UK, 2014.

[*] Solsvik, J., and Jakobsen, H. A.: A Survey of multicomponent mass diffusion flux closures for porous pellets: Mass and molar forms, *Transp. Porous Med.*, 93, 99-126, 2012, doi:10.1007/s11242-012-9946-7.