

Interactive comment on “A Comprehensive Quasi-3D Model for Regional-Scale Unsaturated-Saturated Water Flow” by Wei Mao et al.

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Review of ‘A Comprehensive Quasi-3D Model for Regional-Scale Unsaturated-Saturated Water Flow’ by Mao et al. HESS-2019-87

The paper presents a combination of a simplified one-dimensional unsaturated flow model and a full-3D Modflow aquifer model to achieve regional-scale modelling of a system consisting of a soil and an underlying phreatic aquifer over an impermeable layer.

The paper presents a logical step in the model development of the unsaturated zone

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model (UBMOD). I was unfamiliar with that model but I like it. Unfortunately, we have a conflict with Elsevier at the moment so I have no access to the paper that describes the model. Perhaps for that reason I would like to have the equation used for the drainage function included in the paper. Also I would like to know how the hydraulic conductivity is related to the water content, and how the water content is related to the matric potential.

I agree with the way the authors established the coupling between UBMOD and Mod-Flow. This coupling is the main contribution of the paper, as both models have already been published. The coupling is not trivial and appears to be well-conceived, so I have no reservations about the suitability for publication in HESS.

The structure of the paper is logical and clear. The writing is mostly clear, but the English will need editing. The only sections that I really could not follow were Equation (1) and the description of the iterative procedure.

In Eq. (1), I expected the layer thickness M to have an index running between 1 and j indicating the layer number. From the description it is not clear to me if the equation applies to M_1 (the top layer) or involves a summation over all layers ($M_1 \dots M_j$). I believe this can be easily clarified. I also would like a more thorough explanation of the way infiltration is handled. I do not understand the difference between I and I_d . I also could not find anything about the partitioning of rainfall between infiltration and runoff, and about the way infiltration is added to the soil water. The paper mentions 'allocation of infiltration' but I do not understand what that means. Evapotranspiration was not discussed either. As I explained I am unable to consult the paper in which UBMOD was discussed, but I believe it is acceptable to repeat the key points of UBMOD here, with proper referencing to the earlier paper.

Regarding the iterative solution, Figure 2 is not always helpful in supporting the text to explain the iterative process. I indicated where I got lost in the pdf file. I also make suggestions for improvements there. I was also puzzled by the three time increments

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(the stress time and the time steps for UMBOD and ModFlow). I cannot really see how they interact in the iterative process, where you only use one type of time step without indicating which of the three it is.

You set the values of the three time steps a priori for all tests without indicating how you arrived at the chosen values, or helping the reader find the optimal values for a given problem. Also, if I am not mistaken, the time steps for UMBOD and ModFlow are constant and equal for all test cases. Is this a necessity in this model?

The test cases are limited in scope and very much non-regional. I suggest to reduce the overselling of the test case based on data from the Hupselse Beek, since it is really only a single profile that is being considered. The second test case is a 2D problem of a system of only a few meters. I do not consider the limited scale to the test cases a serious drawback because they do the job of providing a test of various model components. And the demonstration case that follows the test cases truly aims at the scale for which the model is intended.

Some minor points:

- In a few locations the grammar was such that I could not discern the meaning of a sentence (see detailed comments in the manuscript).
- I printed out the figures so I could consult them while working on the pdf file to do the review, but the fonts were so small that I had a hard time reading the texts.
- I suggest redesigning Figure 2. It cannot be read stand-alone, and I found that it not always helped me understand the iterative process.
- In Eq. (2) I believe the minus sign should only be there if the vertical coordinate is defined positive downward, but the text indicates otherwise.

All in all I consider this a good paper that deserves publication in HESS after moderate revisions. To help with the revisions I made some remarks directly on the manuscript.

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Please also note the supplement to this comment:

<https://www.hydrol-earth-syst-sci-discuss.net/hess-2019-87/hess-2019-87-RC1-supplement.pdf>

Interactive comment on Hydrol. Earth Syst. Sci. Discuss., <https://doi.org/10.5194/hess-2019-87>, 2019.

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