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Hydrology and Earth System Sciences
Discussions

Interactive comment on "Parametric soil water retention models: a critical evaluation of expressions for the full moisture range" *by* R. Madi et al.

Anonymous Referee #2

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The manuscript tries to address several issues, e.g., the deficiency of soil water retention (SWR) models near saturation, SWR models near the dry end, development of a general criterion for plausible hydraulic conductivity (K) curves, comparison of different SWR and K models, different methods for parameter optimization, numerical simulation to evaluate model selection on drainage and evapotranspiration, and model calibration/inverse model. Even the abstract contains multiple paragraphs, each of which addresses a different issue. As a result, neither of the issues is convincingly addressed.

In my opinion, the development of a general criterion (Eq. 4) for plausible K curves is interesting and can be the main issue of the manuscript. If so, the manuscript needs to

provide convincingly theory and experiment results and the conditions a model can or cannot be used. However, to validate the correctness of the criterion, experiment errors need to be considered as well. For example, the SWRs were measured with several methods and the results differ more or less for a given soil. If the difference among different SWR models is less than the measurement error, the SWR model should be fine. The manuscript needs to provide the implications to the readers how they can use the models correctly or appropriately. Section 2.2 is very long and can go to an appendix.

I don't think the numerical simulations using different SWR and K models can be used to validate or invalidate the models. First, modeling evaporation and drainage is challenging and different simulators can produce very different results because they may use different algorithms to solve the problem. Second, some models perform better for certain flow process (e.g., infiltration, redistribution) or soil types while other models perform better for different processes (e.g., evaporation, drainage) or soil types. Third, the assignment of initial and boundary conditions can lead to very different results. For example, for a soil that is never saturated for a simulation, the inaccuracy at the near saturation condition probably does not matter much.

The dry-end issue may be left out because it was mentioned but not addressed. The parameter optimization should just be the methods to obtain parameters. It's better if the uncertainty in the optimized parameters be given.

For the reasons above, the manuscript is not publishable in the current form.

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