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Hydrology and Earth System Sciences Discussions

Interactive comment on "SWRC fit – a nonlinear fitting program with a water retention curve for soils having unimodal and bimodal pore structure" *by* K. Seki

Anonymous Referee #3

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General comments

The paper presents a tool, which is also executable on the internet, to analyze measured water retention curves using various uni-modal and bi-modal models. The nonlinear fitting routine is based on the Levenberg-Marquardt algorithm. The performance of the tool is checked against measured data sets that are available in the UNSODA database. The nonlinear fitting procedure is a standard routine, which is implemented in various software packages. The tool itself does not warrant an acceptation of the paper. It is also questionable, whether such a detailed description of the software should be part a paper or belongs in a separate manual.

Novel about the paper is the introduction of a bi-modal water retention function of Kosugi's log-normal pore-size distribution model by superposition, following Durners approach. Unfortunately, the bi-modal model formulation is only restricted to the water retention curve and not to the hydraulic conductivity function, which both are a necessity to model water flow in the vadose zone. Another novel aspect is that the user does not need to provide initial parameters estimates. These values are internally supplied by the tool itself. However, as the author state himself, it is the users' responsibility to give a good set of initial estimate and not of direct scientific interest.

There are a few points that limit the scientific use of the presented tool: (i) There is no possibility to give a weight to the individual data points; (ii) Except for the residual water content, there no possibility to fix parameters, which might be an interesting option for the saturated water content; (iii) The program allows that the fitting parameter residual water content can have negative values, which is physically unrealistic; (iv) Except for R2, no measures are given to judge the the goodness of fit, like confidence intervals or a correlation matrix; (v) Having no control on the initial parameter estimates, the user loses flexibility to fit a model to the measured data, in case the automatized method does not perform well; (vi) By focusing only on the water retention curve, there is no possibility to include other measurements of hydraulic parameters, e.g., hydraulich conductivity, and perform a simultaneous fit.

Although I agree that the tool would benefit, when it is able to fit a model to hydraulic conductivity data - or when it would plot the hydraulic conductivity function-, the author restricts its applicability to the water retention curve. I therefore suggest to omit those parts from the paper that deal with the hydraulic conductivity function (especially, Table 1 (P425) which includes the analytical solutions of uni-modal hydraulic conductivity models; P410 L17 - P411 L5; P419 L26 - P420 L21), because its of no relevance for the new tool presented in this paper.

Specific comments:

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P407 L4-5: The models are fitted to the data, not vice versa

P408 L24: Define the variables z and t.

P411 L4: Priesack and Durner (2006) gave an analytical expression for Durners bi-modal model

P411 L5: There is not only one closed-form expression possible. For the VG model, an analytical expression for the hydraulic conductivity function is obtained for m - 1 + 1/n = i, where i is an integer. The simplest case arises for i=0, which leads to m = 1-1/n.

P411 L19-20: Define r, r_m and sigmaˆ2

P413 L16-17: modality k is not consistent with the subscripts i of the parameters

P417 L13-14: It is not clear, how the initial estimates of the residual (if variable) and saturated water content were determined.

P417 L20: "... by fitting many VG curves to LN curves." How many curves were considered to determine the given relationship. The author should also provide a measure of goodness of fit.

P417 L 17: "... by fitting certain numbers of the data points ...". The author must be more precise how the tool selects the data points for the analysis, otherwise the user can not deduce the fitting procedure.

P419 L14: Mention the base of the log-transformation

P421 L6-7: it is not clear to me what the author means by "... a comparison of the parameters to other soils and a discussion of the parameters with soil scientist..."

P421: L23-28: For cases that the uni- and bi-modal models give almost identical values of RMSE, it might be worthwhile to look at criteria other than the weighing factor w (like confidence intervals or parameter correlations) to judge which model is more appropriate.

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P425: Tables should be self-explanatory. Therefore, define all parameters used in the equations. The definitions of the parameters are not given in the text, where the first reference to the Table was given.

P432, 433, and 434: The model names in the captions are different from the model names in the legend of the axes in Figure 6 and 7. It seems that Figure 6 and 8 are identical.

Technical corrections:

P409 L13: "...analyzes the soil water retention curve and unsaturated hydraulic conductivity, amongst others, ...". Measurements of diffusivity can also be input.

P409 L18: "the program was ..."

P410 L13: air is entrapped in the pore space

P411 L8: "The constraint ... was imposed ..."

P422 L14: Change into "There are no measurements between these two data points, ..."

References:

Priesack, E. and W. Durner, 2006. Closed form expression for the multi-modal unsaturated conductivity function. Vadose Zone Journal 5: 121-124.

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