

## A program for fitting soil water retention models with 5 models including a new bimodal lognormal pore-size distribution model

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The soil hydraulic parameters for analyzing water movement in variably saturated soil can be determined by fitting a soil water retention curve to a certain soil hydraulic function. Several models have been proposed to express the soil water retention curve with a function having several parameters. After soil water retention data is measured, soil hydraulic parameters is calculated by performing nonlinear fitting to a certain soil hydraulic model. For this purpose, a program called SWRC Fit which performs nonlinear fitting of soil water retention curves to 5 models by Levenberg-Marquardt method was developed. The five models include 3 unimodal pore-size distribution models (BC; Brooks and Corey model, VG; van Genuchten model, LN; Kosugi's lognormal pore-size distribution model), and 2 bimodal pore-size distribution models (DB; Durner's bimodal pore-size distribution model, and BL; bimodal lognormal pore-size distribution model developed in this study). Main features of SWRC Fit are:

(1) It can be directly executed via web site (<http://purl.org/net/swrc/>). By just inputting soil water retention data in a textbox and press Calculate button, the models, the fitted parameters and  $R^2$  values are shown in tabular form, and the fitted curves are also drawn. The fitting performance of each model can easily be compared by  $R^2$  values and the fitted curves. For those people who would like to make intensive calculation or make their own programs utilizing this software, client version of the program, written in numerical calculation language GNU Octave, is also available.

(2) It automatically determines all the necessary conditions for the nonlinear fitting, such as initial estimate of the parameters, and therefore users only need to input the soil water retention data to get the result. This feature is the main advantage of SWRC Fit over the software of similar purpose, RETC (van Genuchten et al., 1991), or other general nonlinear fitting software.

(3) It was validated that SWRC Fit can make proper fitting with over 700 soil water retention curves registered in UNSODA database.

(4) It does not only have the generally used unimodal functions, but also have bimodal pore-size distribution functions. Bimodal function is useful for analyzing soil water retention curve of aggregated loams, when the measured suction range is relatively wide. Moreover, it implements a new model, BL model. As there are LN (lognormal pore-size distribution) model and DB (bimodal pore-size structure) model, which is a linear superposition of VG model, it is straightforward to think of a bimodal or multimodal lognormal pore-size distribution (BL) model, a linear superposition of LN model, which is proposed in this study. After validating with over 90 data in UNSODA database, it was shown that the BL model has the same fitting performance with the DB model.