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Discussions

Interactive comment on "Predicting the soil water characteristic curve from the particle size distribution based on a pore space geometry containing slit-shaped spaces" *by* Chen-chao Chang and Dong-hui Cheng

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The submitted paper introduces an improved model to estimate soil water retention curve (SWRC) from soil particle size distribution (PSD) data that based on a pore space geometry containing slit-shaped spaces. However, predictions of improved method were more accurate than those of Arya model, but this superiority may be caused by some assumptions and simplifications.

1. Since The relationship between the PSD and the pore size distribution (PoSD) is a

fundamental element when predicting the SWRC from the PSD, first adjective of this study was to compare estimated PoSD using traditional Method to measured PoSD.

a. This step includes i, estimated PoSD from PSD and ii, estimated PoSD from SWRC. The authors have to change subtitle "2) measuring the PoSD" in page 3, line 33 by "2) estimating the PoSD from SWRC".

b. To estimate PoSD from PSD, called the traditional method as Arya model, here a proportionate relationship between pore size and associated particle diameter was used to calculate the equivalent pore diameter (Eqn. 2) because it was easy to use. This simplification may be a part of the estimation error of Arya and Paris (1891) model.

c. It is noted that estimation method of PoSD from SWRC is nearly similar to the estimation method of PoSD from PSD proposed by Mohammadi and Vanclooster (2010). Although, since SWRC is influenced both soil texture and structure, if soil organic carbon or clay content would be high, differences between estimated PoSD from SWRC and PSD become more. It must be mentioned that the prediction error of estimated SWRC from PSD is at dry range of SWRC (at high suction heads) that influences by soil texture (especially clay particles). Mohammadi and Meskini-Vishkaee (2012) attribute the methods error to the roughness of soil particles, high surface energy content of clay particles and, to the simplified pore geometric concepts that does not effectively reflect the pore geometry. It is better that the authors compare estimated PoSD from measured SWRC to estimated PoSD from PSD using similar method (use Mohammadi and vanclooster method as traditional method). Therefore, I think that these calculations have to add to this part of manuscript.

2. Tuller et al. (1999) and Or and Tuller (1999) proposed including the water films coating the pore walls and water in angular spaces of pores, in calculations of soil water content. Despite great scientific interest, the proposed approach for the derivation of SMC by Or and Tuller (1999) motivated by bundle of cylindrical tubes limitations, usually fails to describe experimental data in the intermediate soil water content range

because of the low flexibility of the gamma distribution function used to characterize the PoSD (Lebeau and Konrad, 2010). In addition, the model is mathematically complex and furthermore needs specific surface area parameter which measurements and estimations are often quite variable (Carter et al., 1986).

a. The authors use pore geometry containing slit-shaped spaces proposed by and Or and Tuller (1999), But they assumed that circle-shaped central pore connected to two slit-shaped spaces. Moreover, the estimated PoSD data were fitted using a modified logistic growth model (Eqn. 5).

b. Specific surface area (SSA) is a requirement parameter to obtain the values of a and B. The authors used a power equation with two fitting parameters (Eqn. 10) to estimate SSA proposed by Sepaskhah et al. (2010). Sepaskhah et al. (2010) used twenty soil samples from a depth of 0–30 cm were collected from different locations in Fars province, in the south of Iran to calibrate the power equation. In addition, a different set of data was used to validate the calibrated model. Their results indicated that in the range of around 20 up to 200 m2 g-1 the values of measured SSA were in quite a good agreement, while for SSA greater than 200 m2 g-1, the deviations increase distinctly. Moreover, Tuller and Or (2005) stated that the psychrometric approach for SSA determination should provide reliable values for natural soils with hydratable surface areas below 200 m2/g. They recommend using SWRC values for -10 MPa and lower (drier) with an effective Hamaker constant of -6 $\times$10-20 J to predict SSA values. So, there are some ambiguities here,

i. As respects higher SSA is related to finer texture soils that usually have underestimation problem of estimated SWRC from PSD, Indeed, I think use power model to estimate SSA cannot be useful to improve estimated SWRC in fine-textured soils.

Page 9, line 4: the authors declared that "for the coarse-textured soil, the water content and prediction error of the SWRC changed relatively little for the same degree of change of the SSA". This is completely expected because not only there is not serious

problem to estimate SWRC from PSD in coarse-textured soils, but also the value of estimated SSA using power equation is below 200 m2 g-1 for coarse-textured soils.

ii. Is there any SSA measurement? Were the fitting parameters of power model controlled?

3. At the first step, the estimated PoSDs of 48 soil samples using SWRC were compared with the PoSDs calculated using PSD to identify the origins of the errors and their effects on the accuracy of the SWC and to calibrate the proposed model. Subsequently, 22 soil samples were also selected from UNSODA database to validate the model.

a. Please provide a Table involved some properties of selected samples for both calibration and validation data sets (e.g. max, min and average of clay content, organic matter, bulk density and . . . for each soil textural class).

b. About validation data set, Textural distribution of the 22 soil samples is shown in both Figure 5 and Table 3. This duplication is not necessary.

c. As regards the most prediction error of traditional models is often related to soils with good structure or high clay content. Therefore, the authors have to use more fine-textured soils to validate their proposed model. In validation data set, only 4 soil samples had clay texture and more than 60 % of soil samples are coarse-textured soils! Please add more soil samples with higher clay content and organic matter to the validation data set.

4. In page 8, line 19-21: the authors stated that "These improvements are mainly attributed to the pore model containing slit-shaped spaces, demonstrating that this pore model is better for predicting the SWC from the PSD than the concept of a bundle of cylindrical tubes". This simplification (concept of a bundle of cylindrical tubes) is introduces as major source of error in the SWRC predictor models using PSD. After that, some studies have attempted to improve the water content calculation approach by at-

tributing model errors to both a simplified pore geometry and an incomplete desorption of residual water in the soil pore within the high matric suction head range. Therefore, I think the authors have to compare proposed model to other models except Arya and Paris (1981), such as Mohammadi and Meskini-Vishkaee (2012) or Meskini-Vishkaee et al. (2014) or other models. The comparison between the performance of these models and parameter needs can be more helpful.

Please expand discussion part and state the result of proposed model for both data sets (calibration and validation) in more detail.

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