Dear Editor,

We thank the HESS referee ≠2 for the review of our manuscript. Please find below a reply report.

Best regards

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Major comments:

Reply 1: Using of pressure plate apparatus is a standard method in measuring the SMC (Dane et al., 2002). However, it has been reported that this method is susceptible to some errors at high soil suction heads (Campbell, 1988; Gee et al., 2002 and Cresswell et al., 2008). We suggest that a part of the underestimation in the dry range of SMC of our method is partially related to this limitation of pressure plate apparatus for measuring the SMC (Solone et al., 2012). Since the relative systematic error of pressure plate apparatus is still not known, we can not correct the data for this systematic error. The modelling error in the dry range will therefore encompass the systematic measurement error. The underestimation of the pressure plate measurements with our model is in any case consistent with the overestimation of pressure plate measurements as compared to dew point measurements. The SMC of majority of databases has been measured using pressure plates apparatus (Gee et al., 2002) and therefore most of the current PTF models have been obtained or calibrated with data obtained from pressure plates (e.g., Clapp and Hornberger, 1978; Leij et al., 1996; Rawls et al., 1982; Saxton et al., 1986; Schaap et al., 2001; Vereecken et al., 1989,). For instance, UNSODA (a wordwide database of basic soil and hydraulic properties from 790 samples from around the world, Nemes et al., 2001) has been used to calibratemany physical based models such as represented in Arya et al. (1999), Chan and Govindaraju (2003), Minasny and McBratney (2003), Dexter (2004) and Hawng and Choi (2006) and etc.

A cautionary note on this problem has been added in the discussion section of the paper.

Reply 2: Since MV model has already been evaluated and compared with Arya et al., (1981) and Haverkamp and Parlange (1986) models (please see Mohammadi and Vanclooster 2011 figure6 and Table 3), we did not consider the comparison of the current models that are based on the MV with these models again.

Since the Arya et al. (1999) approach in which alpha is estimated using the Logistic growth curve, requires different parameters, we think that the comparison of our approach with this model could not be so useful. However, we acknowledge the reviewer's suggestion about comparing our model with the result of ROSETTA software (Schaap et al., 2001). We run ROSETTA software by the similar predictor information (sand, silt, clay and bulk density) for our data and compared the results of the neural network predictions with the result of proposed approach. The results are shown in Table1 (and also Table 2 of the main manuscript). Table 1 shows that there is a significant difference between performance of scaling approach (RMSE=0.060) and that of the ROSETTA approach (RMSE=0.745) (p=5%). Despite the pure statistical and empirical nature of the ROSETTA approach, it provided worser prediction results than the approach based on our scaling technique.

Moreover, we used the "SOIL PAR 2"data-base (Acutis and Donatelli, 2003) for an additional evaluation of our scaling model(data of three profiles were selected :AVT 83, FRO270 and MN5). The comparison with another data set allows assessing somehow the uncertainty of our approach. The results are shown in Table 2. The RMSEs of the predicted and measured moisture contents were 0.0843, 0.0626and 0.0796for the original MV-VG model, the scaled approach and ROSETTA, respectively. In terms of RMSEs, our scaled approach showed the best performance for the SOILPAR 2 data-base, similar as compared to the UNSODA data base (statistically significant in p=5%). The improvement of scaled approach is also reflected by the RI value. Table 2 also indicates that the scaling approach improves the prediction of the MV-VG model on average by 28%.However, to keep the manuscript focussed, we hesitated to include the SOILPAR data-base comparison in the manuscript.

Table 1.Comparison of RMSE values for the MV-VG Model (2012), neural network approach provided by Rosetta software (Schaap et al., 2001) and scaling approach (present study) in predicting experimental moisture contents.

Soil texture	Number of soil	RMSE*		
		MV-VG model	Scaling approach	Neural network approach (Rosetta)
Clay	8	0.088	0.041	0.1150
Clay loam	1	0.027	0.017	0.1468
Loam	8	0.078	0.045	0.0546
Silt loam	19	0.082	0.059	0.0512
Silty clay	2	0.076	0.061	0.0868
Silty clay loam	1	0.129	0.093	0.1080
Loamy sand	11	0.093	0.060	0.0862
Sand	27	0.093	0.073	0.0254
Sandy clay loam	1	0.084	0.065	0.0653
Sandy loam	4	0.073	0.035	0.0776
Average	**82**	**0.086 a**	**0.060 b**	**0.0745 a**

[a]Different lowercase letters indicate significant differences at $P < 0.05$

Table 2.Average Root Mean Square Error (RMSE) and hydraulic parameters for each soil profile of SOIL PAR 2 database, with standard deviations in parentheses.

profile	Number of layer	RMSE			Hydraulic properties					
		MV-VG model	Scaling approach	ROSETTA model	RI value (%)	α (L^{-1})	m (-)	n (-)	n* (-)	λ (-)
AVT 83	6	0.0728	0.0462	0.0585	31.06	0.0075	1.3718	0.7167	0.4765	0.6652
		(0.0331)	(0.0181)	(0.0168)	(34.53)	(0.0134)	(0.7493)	(0.1634)	(0.1076)	(0.0200)
FRO270	5	0.0632	0.0334	0.0463	46.71	0.0085	0.7171	0.7470	0.4659	0.6221
		(0.0185)	(0.0157)	(0.0103)	(23.07)	(0.0072)	(0.2671)	(0.1079)	(0.0792)	(0.0275)
MN 5	5	0.1191	0.1117	0.1383	6.02	0.0222	0.8712	1.0445	0.7511	0.7082
		(0.0175)	(0.0261)	(0.0169)	(18.02)	(0.0289)	(0.5703)	(0.5281)	(0.4095)	(0.0397)
Average	**16**	**0.0843 a**	**0.0626 b**	**0.0796 a**	**28.12**	**0.0124**	**1.0107**	**0.8286**	**0.5590**	**0.6652**
		(0.0338)	**(0.0394)**	**(0.0435)**	**(30.12)**	**(0.0185)**	**(0.6167)**	**(0.3304)**	**(0.2611)**	**(0.0446)**

[a]Different lowercase letters indicate significant differences at $P < 0.05$

Reply 3:For the underestimations at the dry end, we refer to the first reply and the data uncertainty associated with the pressure plate apparatus. The innovation in the present approach resides in the fact the current approach includes conceptually the effect of soil structure. The statistical evaluation confirms that the present approach improves significantly the predictions as compared to those made with the previous model (see table2 and figures 1, 2 and 3). However, it is obvious modelling error remain and part of this modelling error is due to experimental error, while another part is due to model structure error and the use of "bundle of cylindrical capillaries" concept to represent the pore space geometry and the lack of consideration of surface forces (Or and Tuller, 1999; Tuller et al., 1999; Mohammadi and Meskini-Vishkaee, 2012). We think that our approach that conceptually includes structure is a considerable step forward in SMC modeling and we don't expect that this approach augment all previous SMC variations.

Reply 4: Whencomparing Eq (9) of our manuscript with Eq(2) of comments, one can see: 1) that our model estimates the α and ζ coefficient separately, while Eq (2) integrates α and ζ in a single R0 estimate., 2) we do not constrain m and n to fit our model (in contrast to Eq (2) where the $M=1-2/N$ constrain is imposed). Since the value of N,n will strongly depend on the constraining strategy and the correlation between M and N, we think that figure 1 obtained by reviewer#2 cannot be valid to test our approach.

We disagree with reviewer#2 in which "the MV model is only valid for close-packed cubic arrangement with void ratio less than 0.9099". The validity of MV model for a wide range of soil void ratio is demonstrated by Mohammad and Vanclooster 2011 (please see figure 4 and table 1). They stated that

"**Examination of the values of β and ζ for different packing types shows a strong correlation (*r* = 0.95). This means that the ratio β/ζ may reasonably be considered constant in different packing states" a**nd also" **linear relationship between ζ and β is justified to be used in a generic conceptual model, not only for dense, compacted soils, but also for well-structured soils".**

Reply 5: For the underestimation issue at the dy end, we refer to the discussion in reply 1 and 2. In short, underestimation is due to experimental problems with pressure plates (that generally overestimate moisture as compared to dew points measurements) and model structural error. This model structural error may be from different origin. We agree with reviewer#2 that part of this modelling error may be related to an overestimation of "n" Eq [9]. But also other structural modelling errors can contribute (e.g., the use of the capillary bundle concept). Hence we could use an additional correction by modifying n. Yet, this would not be an appropriate approach, given the uncertainty on n in the estimation process. Also, this would weaken the generic nature of our approach. To keep the generic formulation, we propose not to adjust the n parameter, and keep a modelling error which is much smaller than the modelling error obtained in previous studies.

Reply 6: Lassabatère et al. (2006) developed the Beerkan (BEST) method to estimate the SMC by combining particle size distribution with infiltration experiments. Since the UNSODA database does not include infiltration data, we cannot compare our approach with BEST method. Minasny and McBratney (2007) developed a neural network model to estimate theSMCfrom thesand and clay content.This method is conceptually similar as the one used by ROSETTA. The comparison of this method with our approach does not really add value compared to the comparison with the ROSETTA approach

Minor comments:

P14307L20:
Reply: Recommended revision was made.

P14309L26:

Reply: Recommended revision was made.

P14310L20:

Reply: Recommended revision was made

P14311L5:

Reply: Recommended revision was made.

References:

Reply: Recommended revision was made.

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