Dear Editor,

We thank the HESS reviewer for the detailed and valuable review of our manuscript. Please find below a reply report. We explain how the remarks were addressed in the revised manuscript. All recommended revisions were made. The added/removed parts are highlighted in "track changes" mode of "Microsoft Word" in the revised manuscript.

Kind Regards

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1-Theory:

Reply: We acknowledge the reviewer's comment about the confusion raised when using the scaling term in this manuscript. Indeed, Miller and Miller scaling theory is based on a scaling factor, linking lengths at different scales, while our scaling is based on packing density (and bulk density) at different scales. As suggested by the reviewer, we therefore removed the inappropriate citations to the Miller and Miller theory and associated literature. Please see page:6 lines:18-21 and page:7 lines:1-3. Our contribution integrates the packing density scaling factor as a substitute for soil structure in the PTF.

Most of the PTFs presented in literature poorly integrate soil structure in their model predictions. Yet, it is well known that structural properties such as aggregation and macroporosity influence strongly the soil hydraulic behavior. Structural information is especially crucial in the wet range of the moisture retention characteristic and hydraulic conductivity function (Weynantset al., 2009).

In our model, the "packing parameter ,ζ," is used as a metric of soil structure. Indeed, the ζ is derived from the bulk density, and therefore reflects the soil structure effect on hydraulic properties. It is used at 2 different levels to integrate the effect of soil structure on soil moisture retention curve. First the MV model (which is the basis of current model) includes ζ parameter to estimate the suction head of each soil moisture content. Second, the ζ parameter" is used to adjust the shape factor of SMC ("*n* parameter") expressed with the VG model. The figure 2 in our manuscript shows that this model that includes the soil structural effect performs better as compared to other PTFs.

The novelty of this approach has been better discussed. The manuscript title has been changed to insist more on this novelty.

2-MODEL VALIDATION:

Reply: 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. 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 worse prediction results than the approach based on the current scaling technique.

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

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, scaled approach showed the best performance for the SOIl PAR 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 focused, we hesitate to include the SOILPAR data-base comparison in the manuscript.

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 $P< 0.05$

MINOR COMMENTS

- Page 14307, line 28: "...does not include empirical parameter."
Recommended revision was made.

-Page 14308, line 23 to page 14309, line 6: delete
Recommended revision was made.

-Page 14309, line 26: "scaling approaches improve."

Recommended revision was made.

-Page 14312, lines 10-20: suggest to delete.
Recommended revision was made.

-Page 14313: In Eq.[13] the shape parameter *m* should be "scaled" like *n**?
Since we used the van Genuchten model with variable n and m, these parameters are independent and consequently, it is not necessary to scale the m parameter like the n parameter.

-Page 14315, lines 3-5: delete
Recommended revision was made.

- Page 14317, lines 18-21: "Moreover.(Kosugi and Hopmans, 1998)" delete
Recommended revision was made.

-Page 14318, line 20: "iv) this approach estimates the SMC more appropriately in comparison with many other models": which ones? I see only the comparison with the MV-model, but you need to add other existing models for validation purposes.
Please see general reply above.

-Page 14325, Table 2: please add information on the scaling factors for each texture class.

Information on the scaling factors for each texture class was added and the table 2 was revised (please see last column of table 2)

-Page 14327, Figure 1: improve quality, enlarge fonts
Recommended revision was made.

-Page 14328, Figure 2: improve quality, enlarge fonts
Recommended revision was made.

-Page 14329, Figure 3: improve quality, enlarge fonts, no need for the regression lines
Recommended revision was made.

We think that a "simple linear regression line" cannot show the systematic errors in the different parts of the SMC. So we suggested to draw a nonlinear regression line (for each model) to find out and compare the systematic errors in more detail. It may be used as a streamline for future studies.

References

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Arya, L. M., and Paris, J. F.: A physicoempirical model to predict the soil moisture characteristic from particle-size distribution and bulk density data, Soil Sci. Soc. Am. J., 45, 1023-1030, 1981.

Haverkamp, R., and Parlange, J. Y.: Comments on "A physicoemperical model to predict the soil moisture characteristic from particle-size distribution and bulk density data", Soil Sci. Soc. Am. J., 46, 1348-1349, 1982.

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