

## ***Interactive comment on “Sensitivity analysis of point and parametric pedotransfer functions for estimating of soil water retention” by Sami Touil et al.***

### **Anonymous Referee #2**

Received and published: 9 August 2016

#### Overall opinion

This is an interesting paper covering an important topic, namely the prediction of soil hydraulic properties, particularly the soil water retention curve for soils in Algeria. However, there are a number of issues that need to be addressed before publication could be recommended.

#### General comments

The real major issue that I have with this paper is its lack of novelty. A large number of papers on pedotransfer functions are being submitted to various peer-reviewed journals, which basically all follow the same pattern as this paper does:

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1. Data are collected locally 2. 'Foreign' PTFs are tested 3. 'Home' PTFs are often developed, but not always 4. Home PTFs are deemed better - or a foreign PTF is found better than others.

I agree that using global sensitivity analysis is very useful in decomposing the variance of the response (soil water retention) into contributions from the individual input variables. However, this analysis does not add any new information on what is already known in literature about the contribution of various predictors to the predictive quality of point and parameter-based PTFs. This issue is long known and has been shown/commented on by many papers by now.

Another weakness of the paper is its lack of clarity in many parts of the text. I expanded more on this in the specific and technical comments and the authors need to work on that. Good proofreading and editing would considerably improve the quality of the manuscript.

#### Specific comments

Title: I would suggest: 'Sensitivity analysis of point and parametric pedotransfer functions for estimating water retention of soils in Algeria'.

Page 1, line 27: What did the authors mean by: 'favourable impact'?

Page 1, lines 39-40: I would suggest: 'hydrologists face the situation where soil hydraulic data such as water retention or hydraulic conductivity are often missing. Therefore, pedotransfer functions (PTFs) are used as an alternative to estimate these properties.'

Page 1, lines 40-41: I do not agree that reports on the evaluation of PTFs outside the area of development are rare (see general comments above). This is one of the main topics in PTF studies.

Page 2, line 54: Water retention points are not part of the widespread input data for PTF

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Page 2, lines 57-58: I am missing something here; why should we call it an advantage?

Page 2, line 61: I would expect more recent references

Page 2, line 62: Could the authors provide some references?

Page 2, line 63: I would expect: 'Soil-water retention and hydraulic conductivity vary widely and non-linearly with soil water potential'

Page 2, line 68: Could the authors also provide more recent references

Page 3, lines 85-86: 'comparing the predictive performance with the Rosetta models': this looks like a third objective.

Page 3, line 88: I am missing a short description of the study area and information on soil types

Page 3, line 93: n has been used to design three different variables: (1) number of soil samples in a subset (Page 3, line 93); (2) shape factor of the water retention function (Page 3, line 111); (3) number of horizons (Page 4, line 125)

Page 3, line 96: What did the authors mean by: 'soil series was used as the calibration set'? See also Page 3, lines 97-98.

Page 3, lines 100-105: The authors should provide references for all the lab methods.

Page 3, lines 102-103: I would rephrase it as follows: 'The water retention values at -33 kPa and -1500 kPa were obtained by the Richards's apparatus. Undisturbed soil samples were collected near field capacity with 100 cm<sup>3</sup>-cylinders'

Page 3, line 122: What did the authors mean by: 'standardised module'?

Page 4, line 126: What did the authors mean by: 'The estimate is even less skewed than ME and is close to 0'?

Page 4, lines 141-142: '...may manage the functions and non-linear and non-monotonic models': this sentence is not clear to me. Please rephrase

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Page 5, line 172: The first reason mentioned by the authors for selecting the Rosetta PTFs in their study seems weak to me as these PTFs have been published 15 years ago

Page 5, line 175: The authors should give more details on Rosetta models H1, H2 and H3

Page 5, lines 175-176: The second reason for selecting the Rosetta PTFs should be better explained

Page 5, line 188: What did the authors mean by 'adapt better'?

Page 5, line 193: 'Other evaluation criteria noted that the index of agreement also shows that the point PTF is...': this sentence is not clear and should be rephrased

Page 6, lines 199-200: Did the authors perform a significance test to confirm this?

Page 6, lines 216-217: '...with Si in order to (OM: 0.821; 0.630) and (C %: 0.782; 0.585) at -33 kPa and -1500 kPa, respectively (Fig. 2)': this sentence should be rephrased

Page 6, line 227: m is directly linked to n by a simple relation (see Page 3, line 113). Therefore, we should only consider 4 parameters:  $\theta_s$ ,  $\theta_r$ ,  $\alpha$  and n

Page 7, line 241: What did the authors mean by 'The stability in estimation of PTF before and after classification'?

Page 7, lines 265-266: What did the authors mean by: 'when the variation sensitivity index calculated for sand is the leading'? Please rephrase

Page 7, line 276: What did the authors mean by 'the majority presence'? Please rephrase

Page 8, lines 290-294: These 2 sentences are not clear to me. Please rephrase

Page 8, lines 300-301: Which variable do the authors refer to?

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Page 8, line 306: What did the authors mean by: 'favourable sensitivity'? Please rephrase

Page 8, line 315: What did the authors mean by: 'advanced water retention'? Please rephrase

Page 8, line 320 to Page 9, line 321: This sentence is not clear to me. How the global sensitivity class and the silt can be estimates of water content? Please rephrase

Page 9, line 322: What did the authors mean by: 'the main values of VSi'? Please rephrase

Page 9, line 323: 'or the texture is pure clay': I do not understand this part of the sentence. Please rephrase

Page 9, line 325: Do the authors refer to the estimate of water retention or of the van Genuchten parameters?

Page 9, lines 325-327: These 2 sentences are not clear to me. What did the authors mean by 'favourable impact', 'a better pedological interpretation'? Please rephrase

Page 9, lines 335-336: '...as the latter is always considered as the best predictor of soil water retention particularly in clayey soils'. Could the authors support this affirmation by references to recent literature?

Page 9, line 336: What did the authors mean by 'positive sensitivity impact'? Please rephrase

Page 9, lines 345-347: This sentence is very weak and does not add on what is already well known from previous studies

Page 9, line 348: '...predicts more accuracy than...': Please rephrase.

Page 9, lines 357-358: As a conclusive sentence, this is not clear to me. Please rephrase

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Tables and figures - Tables and figures should be self-explanatory in their titles and contents. The authors should provide all the necessary information such as explanation for abbreviations, measurement units, etc. Please see also specific comments

- The order of captions of tables and figures should generally correspond with the order of appearance in the text

- What do the authors mean by cubic model in Table 2?

Technical comments

Title: I would suggest: Sensitivity analysis of point and parametric pedotransfer functions for estimating water retention of soils in Algeria.

Page 1, lines 20-21: the way values of RMSE are reported in the abstract is confusing.

Page 1, line 21: RMSE values are in cm<sup>3</sup> cm<sup>-3</sup> as units for water retention. Page 1,

line 28: medium textural class Page 2, lines 44-45: 'estimated' instead of 'constructed'

Page 2, line 47: the parameters of the van Genuchten model ( $\theta_s$ ,  $\theta_r$ ,  $\alpha$  and  $n$ ) have been introduced before the van Genuchten model itself (line 51). It would be more logical to remove them in line 47 and insert them in line 53. Page 2, line 53: I would suggest: '...to predict the van Genuchten parameters ( $\theta_s$ ,  $\theta_r$ ,  $\alpha$  and  $n$ ) with soil texture classes only...'

Page 2, line 54: 'bulk density' instead of 'density' Page 2, line 55:

'Pedotransfer functions' instead of 'PTFs' Page 2, line 60: 'water retention' instead of

'the water retention' Page 2, line 72: 'pedotransfer' should be deleted Page 2, line 76:

'complementary' instead of 'complimentary' Page 3, lines 82-83: I would suggest: 'Deriving and validating two approaches of PTFs using regression methods.'

Page 3, line 87: 'input perturbation' is not appropriate. Please rephrase. Page 3, line 92: I would suggest: 'The PTFs are developed using a database of soil samples collected from some regions in Algeria' Page 3, line 93: 'contains' instead of 'containing' Page 3, line 99: 'more than 30 cm' instead of 'upper than 30 cm' Page 3, line 100: 'was conducted using...'

Page 3, line 100: I would suggest: 'Undisturbed soil samples taken...'

Page 3, line 101: '(According to the case)' should be deleted Page 3, line 104: I would sug-

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gest: 'Water content measurements were conducted by the gravimetric method' Page 3, line 106: The word 'defended' is inappropriate. Please rephrase Page 3, lines 111-112: 'were calculated' instead of 'will be calculated' Page 3, line 117: 'by comparing the values that they predicted' Page 3, lines 118-119: I would suggest: 'To discuss the validity of the PTF developed, we used the following criteria.' Page 3, lines 119-120: 'the root mean square error (RMSE)' instead of 'the mean square error (RMSE)' Page 3, line 120: 'of the quality of the prediction' instead of 'of quality prediction' Page 4, line 129: 'the root mean square error (RMSE)' instead of 'the mean square error (RMSE)' Page 4, lines 143-144: Is it  $X_1$  or  $X_1$ ? This needs to be uniform. Page 4, line 144: I would suggest: ' $X=(X_1, \dots, X_p)$  is the input variable set' Page 4, lines 147-149: The elements of equations 6 and 7 are not explained Page 4, line 157: 'between 0 and 1' instead of 'between [0.1]' Page 5, line 161: What is  $X_i^*$  in equation 9? Page 5, line 168: I am missing sentences that introduce Table 1 and Table 2. Moreover, Table 2 is not mentioned in the whole text. Page 5, line 170: I would suggest as title: 'Development of PTFs' Page 5, lines 172-173: With respect to the title in line 170, this sentence should be placed at the end of the paragraph Page 5, line 177: 'soil water retention' instead of 'the soil water retentions' Page 5, line 184: I would suggest: 'the point MLR PTFs' instead of 'the PTF points (MLR)' Page 5, line 185: '0.041 and 0.044' instead of '0,041 and 0,044' Page 5, line 188: 'parametric PTFs' instead of 'parametric PTF' Page 5, line 189: 'neural' instead of 'neuron' Page 5, line 189: 0.0613 and 0.0605 cm<sup>3</sup> cm<sup>-3</sup> Page 6, line 199: 'while' should be deleted Page 6, line 207: 'PTFs' instead of 'pedotransfer functions' Page 6, line 209: 'fundamental to understand the...' instead of 'fundamental to understanding the...' Page 6, line 211: 'as bulk density' instead of 'as the bulk density' Page 6, lines 214-217: This sentence is too long and should be divided into 2 sentences. Page 6, lines 215-216: 'at two pressure points' instead of 'in two pressure points' Page 6, line 219: 'in third place' instead of 'in third order' Page 6, line 222: 'MLR' instead of 'linear multiple regression' Page 6, line 224: I would suggest: 'point PTF using MLR is mainly based on...' Page 6, line 225: I would suggest: 'parametric PTF using MNLR' Page 6, line 226: I would suggest: 'which has other inputs than tex-

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ture and bulk density' Page 6, line 229: I would suggest: 'textural grouping' instead of 'textural classification' (see Page 6, line 234) Page 6, lines 231-232: I would suggest: '...used to develop PTFs from basic soil characteristics to estimate water retention for different textural classes' Page 6, line 235: 'FAO' instead of 'FOA' Page 6, line 238: I would suggest: 'textural grouping' instead of 'textural stratification' Page 6, line 239: I would suggest: 'a better prediction at -1500 kPa was provided by point PTF' Page 7, lines 242-243: I would suggest: 'explained by difficulties in linking water retention properties of the soil samples with their particle size distribution as...' Page 7, line 244: I would suggest: 'After textural grouping, MLR and MNLR PTFs developed are...' Page 7, line 247: I would suggest: 'In the MNLR PTFs' instead of 'Into the MNLR' Page 7, line 259: 'fractions' instead of 'fraction' Page 7, line 260: 'observed' instead of 'observe' Page 7, line 268: 'in all texture classes' instead of 'on all texture classes' Page 7, line 269: 'in the validation dataset' instead of 'in the dataset of validation' Page 7, line 275: 'increases' instead of 'increase' Page 7, line 280: 'low sand content' instead of 'small sand content' Page 8, line 283: 'This is the second most influential variable' Page 8, line 285: 'bulk density' instead of 'the bulk density' Page 8, line 289: 'highly related' instead of 'hugely related' Page 8, line 291: Vertisols Page 8, lines 299-300: 'has a major influence' instead of 'is a major influence' Page 8, lines 301-302: I would suggest: 'predicted values very close to the experimental results are obtained' Page 8, line 303: I would suggest: 'depends on the type of regression techniques' Page 8, line 309: 'PTFs' instead of 'PTF' Page 8, line 312: 'with Clay (%)' instead of 'with the Clay (%)' Page 8, line 315: 'than' instead of 't' Page 8, line 319: I would suggest: 'at high and medium soil water potentials' Page 8, lines 321-322: I would suggest: 'textural grouping' Page 9, line 323: I would suggest: 'The lowest values were recorded' Page 9, line 324: 'of' should be deleted Page 9, lines 330-331: I would suggest: 'textural grouping' Page 9, lines 331-332: I would suggest: 'by the poor OM content in the Algeria soil samples' Page 9, lines 331-332, 333-334: Sometimes 'OM', sometimes 'organic matter'. Please be consistent Page 9, line 333: I would suggest: '...water retention. Danalatos et al. (1994) attributed it to...' Page 9, lines 337-338: I would suggest: 'to

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predict  $\theta_s$  values' instead of 'to predict saturated soil water contents' Page 9, line 348: 'Indeed' should be deleted Page 9, line 354: I would suggest: 'textural grouping' Page 9, line 355: 'classes' instead of 'class' Page 10, lines 359-360: I would suggest: 'with clay content > 60%' Page 10, line 361: I would suggest: 'textural grouping'

Tables and figures Tables Table 1: - I would suggest as title: 'Soil characteristics of the development and validation datasets' - I would suggest PSD (particle size distribution) instead of Granulometry - 'CV: coefficient of variation' is reported three times on the same table' Table 2: - the line separating MLR and MNLr PTFs is not at the right place - 'Point PTFs' instead of 'Points PTF' - 'multiple R<sup>2</sup>' instead of 'R<sup>2</sup> multiple' - a, b, c,...j are not clearly explained. It would be good to write a general equation with a, b, c,...j as coefficients for more clarity -  $\alpha$  should be in kPa<sup>-1</sup> - (respectively) should be deleted Table 3: - I would suggest as title: 'Evaluation criteria of water retention pedotransfer functions at -33 kPa and -1500 kPa' Table 4 is missing Table 5: - I would suggest as title: 'Variation of first order sensitivity index along different textural classes' - What does 'Abs' mean? Table 6: - I would suggest as title: 'Pearson correlation matrix between basic soil characteristics in the validation dataset of 53 soil samples'

Figures Each figure caption should be located beneath the respective figure Figures 1, 2, 4, 5 and 6: ',' should be replaced by '.' Figure 2: - I would suggest as title: 'Particle size distribution of xx soil samples from Algeria according to the FAO textural triangle' Figure 3: - Figure 3 is not mentioned in the text Figure 4: - I would suggest as title: 'Root mean square error (RMSE) values calculated for different textural classes' Figure 5: - I would suggest as title: 'Variation of first sensitivity index with RMSE after textural grouping' Figure 6: - Police sizes on the 2 graphs are not the same - 'Point PTF' instead of 'PTF point' - 'Parametric PTF' instead of 'PTF parametric' - 'point' instead of 'ponit'

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Interactive comment on SOIL Discuss., doi:10.5194/soil-2016-18, 2016.