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Interactive comment on "Physical pedotransfer functions to compute saturated hydraulic conductivity from bimodal characteristic curves for a range of New Zealand soils" *by* Joseph Alexander Paul Pollacco et al.

Anonymous Referee #3

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Please find the following comments attached in pdf format to see special characters, subscripts, etc.

General comments The topic of the manuscript is very up to date, authors present a modified bimodal model to describe the water retention curve and couple it with a novel bimodal saturated hydraulic conductivity model. They consider models of Kosugi (1996), Romano et al. (2011) and Pollaco et al. (2013) in the model development. In most of the soil hydrological models bimodal characterization of soil hydraulic properties is not considered, although computation efficiency is enough advanced to allow to

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improve that part of the models, therefore it is time to make a step forward in this field. It is very plausible that authors provide a soil physical explanations with the mathematical equations. I would recommend to consider modifying the title, because the presented method is closer to a model describing the Ks than to a PTF. For a PTF easily available soil properties are needed as input to calculate an unknown soil parameter. It is clear that at the end Ks is calculated from other parameters so it could be called as PTF, but in that case it would be very important to summarize what measured parameters are needed for the prediction and list the steps of calculations. If we call this procedure a PTF van Genuchten model could be called PTF as well because with that we can compute water content at any matric head (h), but for that we need data which is not easy/fast to measure. Therefore I would recommend to call these functions a type of "Ks fitting model", but even in that case it would be important to highlight which measured parameters are needed to calculate Ks. Further to this important issue the manuscript needs some minor revision prior to publication listed hereinafter.

Specific comments TEXT Line 11: here and in the entire text instead of "moisture release" "moisture retention" is more frequently used in the literature, therefore it might be more preferable to use. Line 18: here and in the entire text please use "structured soil" instead of "structural soil" if soil having aggregates is referred. Line 42: please refer to more recent PTFs. Line 94-95: it would be helpful for the reader to highlight what r and rm means. If rm refers to the mean of soil-pore radius I would suggest to write r with overbar. If σ means the variance of the log-transformed soil-pore radius, please make it clear in the notation. Line 104: it might worth to give a number for the equation r=Y/h, than it is easier to refer it in 8b. Line 107: it might increase the readability/understanding if another notation would be used for the mean and standard deviation of ln(hm_mac). If first ln of hm_mac is calculated and then the mean and standard deviation of the transformed hm_mac, than the present notation does not tell it. Please check it. Lines 134-146: I hope that I didn't miss anything in Eq. 7-8b, if yes, sorry, just would like to clarify it. It seems that you have a small mistyping in the numbering of the equations, in line 146 you refer to Eq. 8 which is Eq. 7 in the text,

Eq. 8 is missing. Please correct it in the entire manuscript. If Se equals to 1 in Eq. 7 as mentioned in line 146, why is it included after Ks which in theory tells already that it is a saturated state because you use the notation “s”? If it is needed to follow the mathematical logic, a possible solution might be to add Se=1 under Eq. 7. If it is stated could Eq. 8a, 8b, 11a-14b, 19 be simplified? Lines 154 and 174: I would suggest to use “bimodal water retention curve” instead of “bimodal characteristic curve” to make it completely clear for the readers that you have to deal with both water retention curve (Θ(h)) and hydraulic conductivity curve (K(Θ)). Line 162: please give the terminology of Hmac too – as you did it for Rmac . Line 167: same as in line 107. Please check it. Line 226: maybe I miss something, for me it is not clear why 2 and why not 1.5. Can you please describe it? Line 235: Please describe shortly or rephrase what do you mean by main horizon? Lines 236, 237: in case of undisturbed samples please provide the volume of the core. Lines 247,248: please use cm also here. Line 251: please refer which method was used to measure particle density. Line 259: please use cm also here. Line 262: point a) does not fit into the uncertainty due to measurement error. It increases the error of the model, therefore better to mention it later when the performance of the bimodal model is analysed. Line 279-280: “anthropogenic disturbance and biological activity” might cover better the disturbances influencing soil porosity. Line 287: Eq. 10c is called “modified Romano bimodal” curve, why is it called unimodal Kosugi here? Line 290: please describe shortly how you optimized Ks_uni and Ks_bim models. Which measured parameters did you use? Line 302: could you provide reference or short explanation on why power was set to 6? Lines 307: instead of K(Θ) is not it more correct to write Ks? If yes, please rephrase sentence in lines 308-309. Line 321: please include if the difference is significant between unimodal and bimodal Ks models. Line 322-324: please include it in “materials and methods” section. Lines 319-322: it might worth to rephrase this section or include them separately under the subsections. Lines 326-330 and 332-335 are not totally in line, please harmonize them. Lines 341-344: is the improvement significant – overall or only in case of subsoils? Please include it in the text. Line 410: there is a mistyping, please

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delete “improved” before “Romano ïĄś(h)”. Please include the results of the modified bimodal model (10a) compared to Romano’s model under “results” section too. Line 424: please include for what kind of soils you suggest to use the presented model and what are the limitations of its use.

TABLES Line 540: please rephrase, possible solution: “Θ5 which is”. Why is Θ5 the minimum value of Θs? Lines 545-546: “When ïĄť3 increases the connectivity of the soil increases”, it seems to be in contradiction with lines 150-151 a 5th row of Table 3. Lines 555-558: please rephrase title of the table and its content because it is not clear in present from without reading the main text of the manuscript.

FIGURES Figure 3 and 4 has similar content, please consider to include them under 1 figure caption maybe including a) and b) figures.

Technical corrections Just a small suggestion, in Eq. 11a-11c and 12-13 maybe you can start with models regarding the macropore and then follow with the matrix similarly to Eq. 10a-10c, 14a-14b and 19, in this way you would have the same order in the equations in the entire manuscript. Please check Eq. 11a, 11b and 11c, because they have different size that other equations. Line 322: please put log10 in subscript.

Please also note the supplement to this comment:
http://www.hydrol-earth-syst-sci-discuss.net/hess-2016-636/hess-2016-636-RC3-supplement.pdf

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