

Dear Professor Guadagnini,

Thank you and the reviewer for the insightful comments that led to further improvement of our manuscript. We revised the manuscript according to the reviewer's and your suggestions. Below please find a detailed response to all inquiries and a description of all changes made during the revision process.

All changes made in response to the reviews are highlighted in light green in the revised manuscript.

We hope that our revisions are satisfactory and the manuscript is now acceptable for publication in HESS.

Sincerely,

Markus Tuller

### **Editor**

---

**Comment 1:** I commend the authors for the set of extensive revisions they made to the original submission. There are still a few issues which have emerged and that I urge the authors to carefully consider at this time. The review involved provided a set of very detailed comments and I recommend addressing carefully all of them.

**Reply:** Thanks. All the comments raised by you and the reviewer have been carefully addressed in the revised manuscript. Please see the responses below.

### **Reviewer**

---

**Comment 1:** I have seen the latest version (2nd revision) of the manuscript and the comments of two reviewers and by the editor. I think this last round of revision has taken the manuscript to where it should be; it matured a lot. It reads well, it is organized properly, and I believe the added item of re-parameterizing the Ahuja et al. 1984 model was a good and demonstrative addition. The manuscript now addresses the most significant reviewer concerns, as well as the many small remarks. I saw a very welcome change in positioning the paper in the field of hydraulic property estimation, and an improvement in demonstrating its capabilities. Latter being said, I think that even if 'improvement' in estimations per se is not yet achieved, demonstrating very promising capabilities by the use of new technology and obtained data has its very legitimate place as a publication. I list a few remaining items to be addressed before the manuscript is accepted. Most of those are fallout of the recent revisions.

**Reply:** Thanks for the suggestions. All raised concerns have been carefully addressed in the revised manuscript.

**Comment 2:** I understand that the abbreviation of 'ksat' for 'saturated permeability' was put in place in response to reviewer comment. Now I see a bit of a confusing picture – partly as a result of that. Now Ksat and ksat are both used, and it may be wise to gently remind the reader not to mix them up. I think some will simply think about hydraulic conductivity under ksat as well, when this study is cited later. IN FACT, in this very study,

on P15, L8-22, the two are washed together by the authors themselves! The authors converted their data to sat\_perm from sat\_cond (stated on P11). Sat\_perm is identified by ksats (lowercase k) on P15, L8, and existing models that estimate sat\_cond are cited on L10-12 on the same page. Then on L12-15 the same models are identified as ksats (lowercase k) models that do not perform well. The case is taken further to the summary of this paragraph (L20-22) where these models are again cited to predict ksats (lowercase k). Please fix this throughout the paper very carefully, and state very clearly which of your data you have been using in each sub-chapter of your study, sat\_cond or sat\_perm – since you had both available. I don't expect any notable changes to the outcome of the study, but it should be clear what is what. If any terminology or abbreviation is changed, check also on Tables and Figures to remain consistent. To this end, according to the caption of Figure 4, those existing models predicted permeability, which is not the case. In some way this comment is still connected to the old comment on 'existing models' estimating Ksat, rather than Kw (now ksats).

**Reply:** To avoid this confusion altogether, we have replaced saturated permeability ( $k_{sat}$ ) with saturated hydraulic conductivity ( $K_{sat}$ ) throughout the manuscript including all tables and figures.

**Comment 3:** On linear/power regressions and the resulting figure (i.e. text on P13, Figure 8): (a) I don't see a single linear fit in Figure 8, i.e. wherever a regression was significant, it always ended up being a power model. Perhaps alter the text on P13 to say that while fitting a linear model was tried, a power model was always superior, where a significant regression model was found. Also check the caption of Figure 8. (b) There are two different reasons why some plots in Figure 8 only show one regression fit, but those are not separated by color or any other indicator. Plots d,g,h,k and l have one curve fitted because the other was not significant, while plots q and r have only one model because the two models did not differ significantly from each other. Consider noting this at least in the figure caption.

**Reply:** (a) This was corrected (P11 L19-22)

(b) The explanation is now provided in the caption of Figure 8 (P34 L24 to P35 L2)

**Comment 4:** The introduction of the Ahuja model parameterization is good. I would like to ask to consider three improvements to its presentation: (a) On P12, under the introduction of the modeling part, it would be good to introduce what effective cylindrical diameter is equivalent to -33 kPa, that is originally used by the Ahuja model, and how that relates to the image resolution and the derived properties. An alternate placement for this can be the discussion part on this subject. (b) Is data available to calculate effective porosity and then actually present the results by the original Ahuja model for these soils? It would be great to show the comparison of the conventionally parameterized and the newly parameterized models, and discuss the improvement, if any. (c) Figure 9 – whether expanded by the original Ahuja model's predictions or not – could present at least the  $R^2$ , but perhaps also the RMSE, if found meaningful. It is for future reference, so that studies remain quantitatively comparable.

**Reply:** (a) This has been added now in the introduction of the modelling section of the manuscript (P10 L21 to P11 L8).

(b) Yes the data is available to calculate effective porosity at -30 kPa instead of -33 kPa, and based on this the results by the original Ahuja model are now provided in Figure 9 and Table 3. The comparison of the results obtained using conventionally parameterized and the newly parameterized models have been discussed on [P19 L5 to P20 L2](#).

(C) RMSE and bias are now provided in the Figure 9.

**Comment 5:** P16, L21-23 and Figure 6: Instead of only stating that the two metrics 'agreed well', can at least the R2 be provided, or also the RMSE? It is for future reference, so that studies remain quantitatively comparable.

**Reply:** RMSE and bias are now provided in Figure 6.

**Comment 6:** P18, L15-17: This sentence appears to be in reference of Figure 8a. There does not appear sufficient data support to say that the two branches actually merge. They do approach, that is clear, and likely merge at some point. I also noticed that now there is only a single use of the 'two-branch data trend' phrase - good. With or without that term replaced, I suggest the following alternate sentence here: "Two data branches are observed at lower imaged macroporosity, which approach towards a single branch as imaged macroporosity increases."

**Reply:** We reworded the sentence, [P16 L22-23](#).

**Comment 7:** P8, L6: ...containing 100 to 1000 biopores per m2. (need to state unit twice?)

**Reply:** Corrected, [P6 L17](#).

**Comment 8:** P15, L24: that -> those and herewith -> thereby

**Reply:** We reworded the sentence, [P14 L2-3](#).

**Comment 9:** P17, L8: delete 'absolutely'?

**Reply:** Corrected

**Comment 10:** P17, L9: 'accuracy of the employed': replace with 'applicability of the applied'?

**Reply:** Corrected, [P15 L14](#).

**Comment 11:** P18, L13: See comment 2a above. Not a single linear model seems to be shown in Figure 8, so perhaps delete it from the sentence here.

**Reply:** Corrected, [P16 L19-20](#).

**Comment 12:** P18, L22: I think it is better to say 'Distinct significant' (as on P20, L8) rather than the other way around. If agreed, change it here as well as on P19, L16.

**Reply:** Corrected, [P17 L5](#) and [P17 L23](#).

**Comment 13:** P19, L17: ...i.e. those with biopore-dominated flow and with matrix-dominated flow.

**Reply:** We reworded the sentence, P17 L24-25.

**Comment 14:** P20, L25: of the Kozeny-Carman.

**Reply:** Corrected, P19 L7.

**Comment 15:** P22, L14: i.e. presented biopore-dominated flow.

**Reply:** We reworded the sentence, P20 L19.

**Comment 16:** P22, L17: by splitting soil columns into a group of matrix-dominated flow columns and a group of biopore-dominated flow columns.

**Reply:** We reworded the sentence, P20 L22-23.

**Comment 17:** P22, L18: performance of the Ahuja...model.

**Reply:** Corrected, P20 L23.

**Comment 18:** P22, L22: A and B of the Ahuja...model.

**Reply:** We reworded the sentence, P21 L2-5.

**Comment 19:** Figure 9 caption: performance of the Ahuja...model.

**Reply:** Corrected, caption Figure 9, P35 L3.