

## ***Interactive comment on “Macropore flow at the field scale: predictive performance of empirical models and X-ray CT analyzed macropore characteristics” by M. Naveed et al.***

### **Anonymous Referee #3**

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Review of “Macropore flow at the field scale: predictive performance of empirical models and X-ray CT analyzed macropore characteristics” by Naveed et al. This work compares hydraulic tests on air and water permeability and gas diffusion properties performed on cm-scale, relatively-undisturbed soil cores; and analysis of macropore properties of these cores performed using X-ray CT. Correlations are analyzed and regression models in which the CT derived variables estimate hydraulic properties are suggested. The inability of pedotransfer functions to estimate the hydraulic properties (except gas diffusion coefficient in low water saturation) is demonstrated, and

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reveals the fact that the variability of macropore properties controls the variability in hydraulic properties in this case where matrix properties are quite homogeneous.

Although it does not seem to have much novelty in results or methods of analysis, the paper is a solid piece of experimental work that the professional readership should be exposed to, therefore I recommend acceptance following significant changes suggested below.

Comments 1) Title 1. “Macropore flow at the field scale:” lets the reader expect that observations or models of flow are at the field scale whereas all observations in the paper are made on cm-scale cores. The field scale has also nothing to do with the second part of the title on the predictive performance. Further more, the high values observed for the hydraulic properties of the cores (and the large variability) are due to samples with connected pores with a linear length of 3.5 cm. It is most probable that at the field scale the biopores will not dominant the large scale flow and matrix properties will be more relevant. Therefore the term” field scale” should not appear in the title.

2) Title 2. The “empirical models” are the less exciting part of the work and if included in the title they should be seconds to the “CT analyzed” which proved better.

3) As a hydrologist the term “saturated water permeability” is a little annoying, because at saturation (i.e. single phase flow) the permeability is a characteristic of the porous medium regardless of the fluid. Perhaps the results – higher air permeability in an incompletely dry soil than water permeability in a supposedly saturated soil (means in table 1) drove the authors to use this terminology. Nevertheless, if not changed, the use of this term should be explained.

4) The use of the term “diffusivity” for the ratio between the diffusion coefficient in the porous medium and the diffusion coefficient in free air (if I understood correct), is also not the best choice I think. As far as I know the term diffusivity is given to parameters with the dimensions  $[L^2/T]$  that fit the diffusion coefficient in the diffusion equation (e.g. in groundwater hydrology Transmissivity/Storativity (T/S) or K/Ss).

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- 5) Use  $K_a$  (-30) rather than  $K_a -30$ ,  $D_p/D_0$  (-100) rather than ,  $D_p/D_0 -100$  etc.
- 6) P 12094 L 8-9 delete “arrival time” it’s included in breakthrough.
- 7) P 12096 L 1 change “energy level” to electrical tension or electric potential difference.
- 8) P 12098 L 6 start a new paragraph before “After”
- 9) P 12098 L 10 add of after "potentials”
- 10) P 12098 L13 5hPa is pressure not a pressure gradient
- 11) P 12098 L 17 correct the dimensions of  $\Delta p$  to  $[M/LT^2]$
- 12) P 12099 L 1-2 use capital K for hydraulic conductivity
- 13) P12099 L 8 change “SD” to standard deviation (SD)
- 14) P 12100 L 5, How can the median be dominated by extreme values? I would discard this sentence altogether.
- 15) CV of 218% does not describe the variability as good as acknowledging the 5 orders of magnitudes spread of the saturated permeability.
- 16) In addition to table 1, I recommend to add a histograms of the hydraulic properties (or at least of the saturated permeability) for the interested readers in the hydraulic data.
- 17) Table 1, add a row of statistics of the saturated hydraulic conductivity in cm/hr easier for hydrologists and soil scientists ‘to know where we are living’. Permeability in square microns is not intuitive to most of us.
- 18) P 12101 L 1-2 delete the sentence “This is quite . . .”
- 19) 12101 L 20 change “decade“ to 2 decades
- 20) P 12103 L 26-28 It’s the other way around: macropore flow is controlled by connectivity; matrix flow is controlled by pore-diameter distribution.

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