Comment on hess-2021-150
Anonymous Referee #2

Referee comment on "A scaling procedure for straightforward computation of sorptivity" by Laurent Lassabatere et al., Hydrol. Earth Syst. Sci. Discuss., https://doi.org/10.5194/hess-2021-150-RC2, 2021

This is an excellent paper that provides scaling equations to estimate sorptivity for a wide range of hydraulic functions as well as initial and final soil moisture status. The mathematical derivation is thorough and accurate to the best of what I was able to follow. I have two main comments and a few minor corrections.

Comment 1. Eq. (22) gives rise to contrasting values of sorptivity for the different hydraulic conductivity functions. The authors attribute this difference to the dependence of the parameter $c_p$ on the hydraulic functions (see section 4.4). However, sorptivity as defined in Eq 22 also varies with $|h_g|$ and $2 |h_a^*|$. Indeed, the authors defined a variable $c_p' = c_p - 2 |h_a^*|$. Therefore, consider deriving shape indices for $c_p'$.

Comment 2. What is the value of $h_a$? I suspect it is equal to $h_g$ for the Delta and BC models and zero for the others. If that is the case, $|h_a^*| = 1$ for the former two and 0 for the others (see the top of Page 5). Thus, $c_p' = c_p - 1$ or $c_p' = c_p$.

If you plot $c_p'$, the curves for $c_{pd}'$ and $c_{p, BC}'$ in Figure 3 would be lowered by 1 and the in (a) and (c). This would reduce the dissimilarity between the various hydraulic functions a bit.

Other Small Comments

- In the first line of the introduction, verify if sorptivity is actually used for desorption.
- Eq (4), Eq (5), and elsewhere there is no need to show the detailed step-by-step derivation of straightforward algebraic manipulations.
- In the last paragraph of Page 3, rewrite the sentence that starts with "Secondly, ...".
- In the same paragraph as above, define "BEST."
- In the same paragraph as above, introduce hydraulic functions starting with the delta function to be consistent with how the equations are presented.
- Rewrite equation (6) using the Heaviside function since $H$ is defined underneath and later references use $H$ as well.
- Postpone the introduction of the scaling parameters section 2.1, where they are used.
- Consider moving Eq (23) (definition of $c_p$) to just after Eq (15), where $c_p$ is initially
introduced. Also, provide more information of what assumptions were used by Haverkamp et al. in deriving $c_p$.

- Edit the incomplete first sentence of section 2.2.2.