

Hydrol. Earth Syst. Sci. Discuss., author comment AC2
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Reply on RC2

Laurent Lassabatere et al.

Author 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-AC2>, 2021

Dear Reviewer,

*The authors thank you for your very positive review and the time dedicated to reviewing
the paper.*

Detailed answers to comments.

*Regarding the two main comments, we will revise the paper to make it clear that
sorptivity has two parts, the unsaturated sorptivity that corresponds to cp' and the
saturated part that corresponds to $2|ha^*|$. The saturated part is related to the air-entry
water pressure head $|ha^*|$ that equals unity only for the Delta and the BC functions. In
that case, the saturated part equals $2*|ha^*|=2$. Note that by convention, for the Delta
and BC functions, the scale water pressure head, hg , is taken equal to the air entry
pressure head, so that $|ha^*|=1$. For the other hydraulic functions, $|ha^*|=0$, and the
saturated part of sorptivity is null. We will implement the reviewer's suggestions on
discussing both parts of the sorptivity as a function of the shape indexes and revise Figure
3.*

Comment 1 by Reviewer RC2. 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 cp on the hydraulic functions (see section 4.4). However,
sorptivity as defined in Eq 22 also varies with $|hg|$ and $2|ha^*|$. Indeed, the authors
defined a variable $cp' = cp - 2|ha^*|$. Therefore, consider deriving shape indices for cp' .

Authors' answer: *In the result section (section 3.2), we plotted the scaled dimensionless
sorptivity, cp , as a function of shape indexes. For the Delta and BC functions, the scaled
sorptivity lumps the saturated parts, equal to $2|ha^*| = 2$ plus the unsaturated part, cp' .
For the other functions, the scaled sorptivity corresponds directly to the unsaturated part,
 cp' , since $|ha^*|$ and the saturated part of sorptivity are null. We will insist on this point
and discuss the evolution of the unsaturated part cp' as a function of the shape index, as
suggested by the reviewer. Note that the computation of dimensional sorptivity with
equation 22 requires both the saturated and unsaturated parts of sorptivity.*

Comment 2 by Reviewer RC2. What is the value of ha ? I suspect it is equal to hg for
the Delta and BC models and zero for the others. If that is the case, $|ha^*| = 1$ for the
former two and 0 for the others (see the top of Page 5). Thus, $cp' = cp - 1$ or $cp' = cp$. If

you plot cp' , the curves for cp, d' and cp, 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.

Authors' answer: *The reviewer is correct to state that $|ha^*| = 1$ by convention for the Delta and BC functions and zero for the other hydraulic functions. Thus, the unsaturated part of the sorptivity equals $cp' = cp - 2$ for the Delta and BC functions and $cp' = cp$ for the others. We will add cp' for the BC hydraulic functions in Figure 3a and discuss this point in the revised version of the paper.*

Detailed answers to the reviewer's suggestions.

We will carefully search for typos and revise the manuscripts. We will rewrite the inappropriate sentences. More importantly, the reviewer suggested changing the structure of section 2.1 with the presentation of first all the dimensional equations before the scaling procedure. The authors will investigate his proposal and attempt to revise this section.

- **Reviewer:** In the first line of the introduction, verify if sorptivity is actually used for desorption. **Authors:** *Regarding sorptivity and its definition (line 22 of the manuscript), it corresponds to the following description of sorptivity proposed by Minasny and Cook (2011): "Sorptivity is a measure of the capacity of the medium to absorb or desorb liquid by capillarity." The concept of sorptivity can be considered regarding the two sides of the same coin, i.e., water adsorption and desorption, with hysteresis effects.*
- **Reviewer:** Eq (4), Eq (5), and elsewhere there is no need to show the detailed step-by-step derivation of straightforward algebraic manipulations. **Authors:** *We will carefully look at equations and simplify them when necessary. Our goal is to help the reader to retrieve all equations and derivations. When the derivations were relatively simple, all the steps were kept. When derivations were more complicated, we tried to keep only the main steps.*
- **Reviewer:** (i) In the last paragraph of Page 3, rewrite the sentence that starts with "Secondly, ..." // (ii) In the same paragraph as above, define "BEST." // (iii) In the same paragraph as above, introduce hydraulic functions starting with the delta function to be consistent with how the equations are presented. **Authors:** *we will rewrite this paragraph and address these points.*
- **Reviewer:** Rewrite equation (6) using the Heaviside function since H is defined underneath and later references use H as well. **Authors:** *we will rewrite the equation accordingly.*
- **Reviewer:** (i) Postpone the introduction of the scaling parameters section 2.1, where they are used // (ii) Consider moving Eq (23) (definition of cp) to just after Eq (15), where cp is initially introduced. Also, provide more information of what assumptions were used by Haverkamp et al. in deriving cp . **Authors:** *we will rewrite section 2.1 accordingly.*
- **Reviewer:** Edit the incomplete first sentence of section 2.2.2. **Authors:** *we will rewrite the sentence.*

Again, the authors thank the reviewer for his suggestions and contributions.

Best regards,

Laurent Lassabatere on behalf of the authors.