



Authors response to comment on hess-2021-633

Anonymous Referee #1

Referee comment on "Mixed formulation for an easy and robust numerical computation of sorptivity" by Laurent Lassabatere et al., Hydrol. Earth Syst. Sci. Discuss., <https://doi.org/10.5194/hess-2021-633-RC1>, 2022

Manuscript: hess-2021-633

Title: Mixed formulation for an easy and robust numerical computation of sorptivity

Dear editor and authors. I read carefully the manuscript. The article is quite interesting and is well written and organized. The authors propose a new mixed formulation that scales sorptivity. The topic is relevant and gives valuable information about sorptivity. This hydraulic property is a key parameter, and there is a lack of information about it, especially in terms of the dependency with the soil water content. For these reasons, the manuscript fits into the journal's scope and would be relevant to the readers of Hydrology and Earth Systems Science. Additionally, this manuscript complements very well the previous study of Lassabatere et al. (2021), published in this journal. However, there is one major concern that must be addressed before publication. Soil sorptivity is a function of the initial and final soil water content. Since sorptivity is an expression of the capillarity forces, the highest value corresponds to the dry condition ($h=-\infty$) and decreases as the soil water content increases (in dry condition, the capillary forces domains the process, while near saturation there is no expression of capillarity). The authors included in the manuscript the Figures 1 and 2 in order to show an example of the mixed formulations. In these figures, the y axis corresponds to the sorptivity (estimated with the new mixed formulation function) and the x axis corresponds to the soil water content or water pressure head (h). The behavior of this function is the opposite to the expected one. This issue should be addressed in the manuscript. Additionally, the inclusion of hypothesis and objective will improve the manuscript. Also, it would be very interesting to include some figures with the sorptivity values as function of soil water content and water pressure head, calculated with the new mixed formulation. Below, I mention more detailed comments. I'm not English native speaker, then I will not correct language issues.

Authors: The authors warmly thank the reviewer for their careful review of the paper and positive comments on the proposed study. As required by the reviewer, the authors will provide a new version with a more straightforward presentation of the paper's objectives before the theory section and a strengthened conclusion. The revised version will also include an additional section at the end of the manuscript to describe the proposed mixed formulation's practical use and provide a sensitivity analysis of sorptivity as a function of the initial and final water contents.

Besides, the authors would like to clarify figures 1 and 2 and answer to the apparent inconsistency raised by the reviewer. In these figures, we plotted the integrand to be integrated for the computation of sorptivity. This integrand defines an increasing function with regards to the integration variable, θ . The computation of sorptivity involves the

integration of the integrand between the initial and the final water contents. Given that the integrand is positive, sorptivity defines a decreasing function with regards to the initial water content and an increasing function with regards to the final water content. This point is in full accordance with the reviewer's statement on sorptivity variation with water content. Furthermore, this result does not contradict figures 1 and 2. The reviewer might have gotten and thought that sorptivity was plotted instead of the integrand, which made him believe that our plots were inaccurate.

Detailed comments:

L 12-13: the first two sentences are exactly the same than the two first sentences of Lassabatere et al. (2021). Please modify.

Authors: The authors apologize and will change the two first sentences.

L 20: Equation (1): Please add more information about this equation. I couldn't find the same expression in Parlange (1975).

Authors: The authors will clarify the relationship between Parlange (1975) study and the integral expression defined by Equation (1).

L 21: initial and final water contents of the soil or the water source? More detailed information about the relationship between sorptivity and water content is needed.

Authors: The reviewer is correct. By final water content or water pressure head, the authors mean the conditions imposed at the surface (i.e., the water source). The revised manuscript will be clarified in this regard. The authors will add a section on the practical computation of sorptivity and its link to the initial and final water contents.

L 24: I couldn't find the same expression in Ross et al. (1996). Please give more details about the construction of this equation.

Authors: The reviewer is correct. This part is unclear and will be rewritten in the revised manuscript. Ross et al. (1996) did not clearly write the equation as it is mentioned in our study, even if he suggested in the text to express variables as water pressure heads. We will refer to more appropriate citations.

L 240-246: Please use these ideas to build hypothesis and objectives, and include them in the Introduction section.

Authors: The reviewer is correct. This part will be used to define clearly the objectives of the study at the end of the introduction of the paper.

L 363-371: this is not a conclusion. The inclusion of an explicit hypothesis will improve this section.

Authors: The reviewer is correct. The conclusion will be strengthened in the revised version of the paper, with more details on the taking-home message of our study and more insight into perspectives and further works.