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Interactive comment on "Improved calibration of Green-Ampt infiltration in the EROSION-2D/3D model using a rainfall-runoff experiment database" *by* Hana Beitlerová et al.

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Dear Prof. Vanderborgh, thank you very much for your comment on our paper and the discussion upon it. We understand your concerns about the treatment of the water potential at the wetting front, however, we are sure, that the implementation of the Green-Ampt approach (GA) in EROSION-3D is correct as we show below. For numerical efficiency there are many different explicit implementations of GA, all bringing larger or smaller errors. Our intention was not to dig into the theory of GA (we agree that it would be a problem to choose a model where GA is wrongly implemented), but to improve the calibration of GA in the practical relevant context of a soil erosion

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model. Our research shows an approach of predicting the calibration parameters from easily measurable parameters based on experimental data to systematically improve the model results. The possibility to analyze the error source is a benefit of the used statistical methods and one of the aims of the study. The fact that it can lead to detection of specific shortcoming in a model we see as an added value of the study and this discussion, not as reason to choose another model. On one hand it can trigger future development of the model and close the gap, on the other hand it makes the user aware of the model limits and gives him a way to compensate for it. EROSION-3D belongs among used and respected models and we find it reasonable to choose it for such study. At the same time we believe that the approach can be transferred to other models and lead to their development and achievement of better results.

We will fully respect your decision regarding publishing in SOIL. We understand if a more theoretical research would fit better to the journal scope. However we believe it has its place among scientific papers and will find interested readers.

Please, see more detailed explanation regarding the GA implementation in EROSION-3D.

As we tried to figure out in our response to reviewer 2, the water potential at the wetting front is not necessarily independent of the initial soil moisture. There might be cases in which this simplification is sufficient, but in general we don't think that the wetting front suction can only be a function of soil texture. As a matter of fact when completely following this suggestion, a given soil would be assigned with one value for wetting front suction and one value for saturated hydraulic conductivity, without considering any dependency on initial soil water content. The whole variance in modelled infiltration rates would then result from the difference of fillable pore space and initially water filled pore space. We don't think that this variance can sufficiently reflect the variance found in natural or simulated rainfall events. The still decreasing modelled infiltration rates, which can be seen at points where experiment already shows more or less steady conditions, are caused by the applied method of model calibration. By cal-

ibrating only hydraulic conductivity (and not matrix potential) a better fit from modelled to experimental curves is not achievable. From a comparison of the implicit example for the Green-Ampt model given by Dingman with the EROSION-3D algorithms we are pretty sure the Green-Ampt algorithms implemented in EROSION-3D are correct (see also attached figure). The explicit function used in EROSION-3D might not be the best approximation, but reflects the general characteristics of the Green-Ampt model sufficiently. Assuming that we use always the saturated hydraulic conductivity to run Green-Ampt models we would always limit the steady infiltration to this value. By doing so we would not be able to account for a reduced hydraulic conductivity under unsaturated conditions. If one input unsaturated hydraulic conductivity (with a lower value) this will be the value the modelled infiltration rate will asymptotically approach. For our understanding this is a general shortcoming of all Green-Ampt implementations, unless a dynamic adaptation of wetting front suction, hydraulic conductivity from initial unsaturated conditions toward saturated conditions is implemented. Regarding the Hydrus-1D model, we see the value of such a comparison but as explained above, this would lead away from our approach to use experimental data as a fitting target to a more theoretical asset of the Green-Ampt model. As we see the Green-Ampt implementation in EROSION-3D as not perfect, but valid, we prefer to stay on our intended research layout.

Regarding the two fitting strategies you propose in your last paragraph - Basically we followed the second one in our paper, to fix the water potential at the wetting front to the water potential of dry soils and fit the Ksat values via the skinfactor on our experimentally derived infiltration curves. Your suspicion that GA is then not able to model steady state conditions, is proved by the figure provided in response to reviewer 2.

On behalf of all co-authors, Yours sincerely Hana Beitlerová

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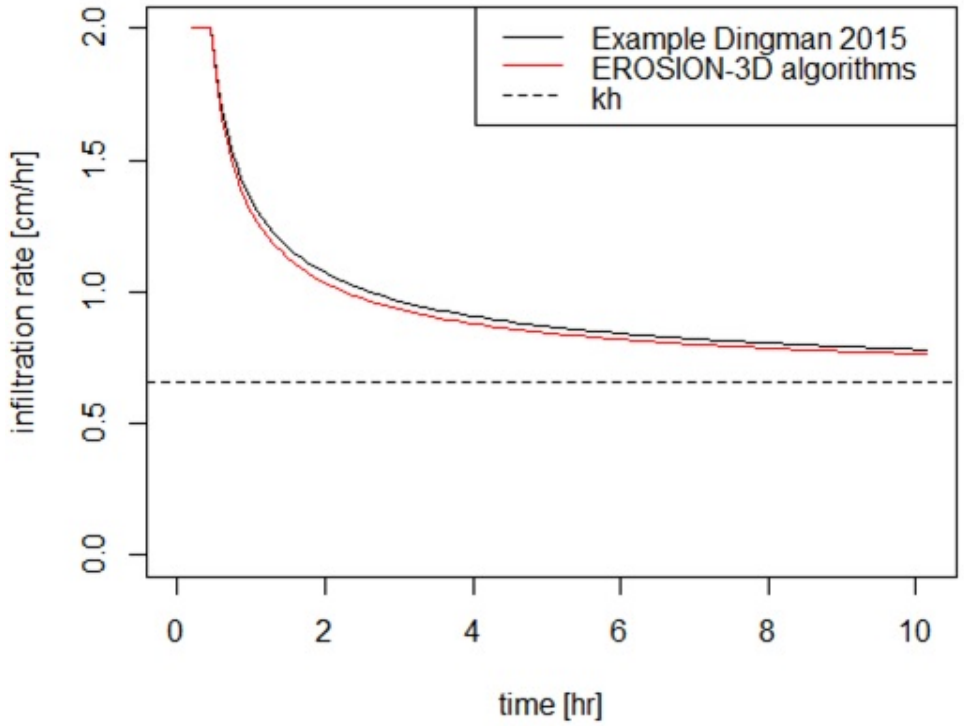

Fig. 1. Soil infiltration curve simulated based on Dingman (2015) and EROSION-3D algorithms

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