Hydrology and Earth System Sciences Discussions

Hydrol. Earth Syst. Sci. Discuss., referee comment RC2
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Comment on hess-2022-311

Anonymous Referee #2

Referee comment on "Impact of parameter updates on soil moisture assimilation in a 3D heterogeneous hillslope model" by Natascha Brandhorst and Insa Neuweiler, Hydrol. Earth Syst. Sci. Discuss., https://doi.org/10.5194/hess-2022-311-RC2, 2022

This is a very clearly written, well-constructed article that documents a numerical study of data assimilation using an integrated numerical model. I found this article scientifically interesting, as I also think the readership of HESS would. I recommend publication pending minor revisions. I have some general and specific comments listed below.

General comments:

The integrated model used here incorporates overland flow. However, it's unclear what the role of overland flow was in the study as I don't believe it was used in the DA. Did the presence of overland runoff modify the soil moisture in some way (beyond acting as a boundary condition at the bottom of the hill slope)? Would the results be essentially the same with a Richards' only hill slope model?

The authors found that porosity was a particularly sensitive parameter in the DA. This makes sense, as they state (e.g. 615), as this limits the total amount of water available in the soil. However, this sensitivity is likely larger on the wet side of the soil moisture curve, on the dry side other parameters (processes) may play a larger role. The aridity of the simulations is driven by the meteorological forcing used in the experiment, did the authors consider the impact a different forcing dataset might have on these findings?

Specific comments:

Section 3.1.1: Are the random fields for ln(K), ln(alpha), phi and n spatially correlated? I realize they are correlated with each other, but are the fields disordered in space or correlated with some spatial correlation structure? There is a lot of evidence in the literature demonstrating the spatial correlation of random fields and this should be

discussed in the manuscript. If the fields are correlated, I recommend including some discussion of the correlation model and associated parameters.

Section 3.1/Table 2: For the numerical simulations were the random fields constrained in some way to prevent non-physical parameter values? Or even parameter values that would be outside the range of solution (VG parameters such as n that result in eqs 2, 3 being nondifferentiable).