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Interactive comment on "Do surface lateral flows matter for data assimilation of soil moisture observations into hyperresolution land models?" *by* Yohei Sawada

Anonymous Referee #1

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The author of this paper used a synthetic case and indicated that topography-driven lateral surface flows induced by heavy rainfalls do matter for data assimilation of hydrological observations into hyper resolution land models. Although this paper reads well and the author provided a long discussion on results, these results are only based on a few deterministic measures, the author needs to clarify more detail and use additional matrices to evaluate his results. All the figures and tables are appropriate. This manuscript can be considered for publication after carefully addressing all of my concerns.

Minor Lines 62-63: "...by the data assimilation of microwave brightness tempera-

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ture observations. . .” should be “. . .by assimilating microwave brightness temperature observations. . .”

Major: Line 203-206: please use some mathematical relationship to elaborate more what is van Genuchten relationship and how it has been used as H operator to convert pressure head to soil moisture. Parflow does not estimate the soil moisture directly? Lines 210-217: why did you use this approach to identify the closeness of the two PDFs, this seems a very old technique. It would have been much better before using each method you had explained the reason and necessity of using that approach. As this is the synthetic case and you are generating the pressure head and soil moisture observation accordingly, I am not sure how this study can be done on a real-case problem, which is very important, as its result would be more convincing. The author used only a few deterministic measures (e.g., RMSE) to assess the performance of the DA for all the assimilation scenarios in this study. Speaking of uncertainty quantification, both probabilistic and deterministic measures should be used to evaluate the effectiveness and usefulness of the EnKF model. These metrics although show how the simulated quantities could accurately match the observations, it does not provide any insight on the reliability of the predicted values. Therefore, I recommend using the following paper, in which the authors provided a comprehensive description of different probabilistic performance measures, such as Reliability and 95% exceedance ratio (ER95). These measures have been extensively used in many studies to evaluate the quality of the posterior distribution. Abbaszadeh, P., Moradkhani, H., & Daescu, D. N. (2019). The Quest for Model Uncertainty Quantification: A Hybrid Ensemble and Variational Data Assimilation Framework. Water Resources Research,55, 2407–2431. https://doi.org/10.1029/2018WR023629.

Lines 622 and 623: “Although particle filtering in a high dimensional system suffers from the “curse of dimensionality”, please highlight that this can be resolved through improvements of importance sampling in PFs, and therefore it provides the potential for data assimilation application in large-scale systems” for more discussion the

readers can be referred to the following papers: P. Van Leeuwen. (2009). Particle Filtering in Geophysical Systems. Mon. Weather Rev., 137 (12), pp. 4089-4114. https://doi.org/10.1175/2009MWR2835.1 Lines 633-634- How do you convince that this “In addition, in the virtual experiment of this paper, I neglected some of the important land processes such 634 as transpiration, canopy interception, snow, and frozen soil.” is a correct pre-assumptions.

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