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Interactive comment on "Multi-source data assimilation for physically-based hydrological modeling of an experimental hillslope" *by* Anna Botto et al.

Anonymous Referee #1

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Manuscript title: Multi-source data assimilation for physically-based hydrological modeling of an experimental hillslope. Authors: A. Botto, E. Belluco, and M. Camporese Manuscript # hess-2018-18

The authors present an application of the Ensemble Kalman Filter (EnKF) combined with a variably saturated flow model (CATHY) to invert soil parameters by assimilation of pore pressure, soil moisture, and discharge rate data. The application is very interesting in that it uses a dataset obtained with a laboratory experiment conducted on an artificial hillslope, where boundary conditions can be controlled. The parameters of interest are the hydraulic conductivity and the coefficients of the soil moisture and

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relative hydraulic conductivity profiles, modelled as van Genuchten's functions. In my view, the manuscript is well-written and organized. Results are scientifically sound and the paper should be accepted after minor revisions. First, I wonder if, in the interest of clarity, it would be possible to reduce the number of scenarios presented (as many as 19!) while preserving the main conclusions drawn in the study. Second, since an EnKF algorithm is used, it might be worthwhile to assess - perhaps by applying a restart-EnKF in some key scenarios - the effects of numerical inconsistencies introduced when updated, and thus statistically modified, states and parameters are merged into the flow model at the data assimilation times. Additional minor comments, requests for clarification and proposed changes are provided in the attached document.

Please also note the supplement to this comment:
https://www.hydrol-earth-syst-sci-discuss.net/hess-2018-18/hess-2018-18-RC1-supplement.pdf

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