**Hydrology and Earth System Sciences**

Discussions

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Interactive
comment

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

## Anonymous Referee #3

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General comments

The paper investigates assimilation of different measurement types in an integrated hydrological model using data from an artificial hillslope experiment. The paper is well written, and the material and results are scientifically sound and to the point. Assimilation of multi-source or multi-variate data in integrated surface-subsurface hydrological modelling is a research area that has gained increasing attention in recent years. The paper provides an interesting and valuable contribution to this research area. I recommend the paper to be published subject to minor changes given in the detailed comments below.

Detailed comments

1. Page 2, line 32. It would be good to elaborate on the trade-off problem in the introduction and refer to other studies that have investigated this problem, such as the recent studies by Zhang et al. (2016) and Zhang et al. (2018).

2. Page 3, line 25. Could you include a brief description or include a reference on the coefficient of uniformity used here.

3. Page 5, line 10. Use of dampening factor in the Kalman filter update is debatable. It is a factor that needs to be introduced to compensate for improper settings in the Kalman filter, including model and measurement uncertainty descriptions and ensemble approximations. Discussion of these issues should be included.

4. Section 4.2. It is not clear how the different model and measurement uncertainty parameters have been estimated. Are they based on preliminary sensitivity analyses?

5. Page 7, line 23-26. Why are the measurement error covariance matrix, anomalies and innovation vector normalised? There should be no need to normalise with the EnKF.

6. Page 8, line 13-14. Instead of the normalisation of RMSE used, one could normalise the RMSE by the Nash-Sutcliffe coefficient. That measure would be more appropriate for interpretation of the actual performance.

7. Section 5.4. Would be good to discuss these results in relation to other observations of trade-offs reported in the literature, such as in Zhang et al. (2016) and Zhang et al. (2018).

References

Zhang, D., Madsen, H., Ridler, M., Kidmose, J., Jensen, K.H., Refsgaard, J., 2016, Multivariate hydrological data assimilation of soil moisture and groundwater head, Hydrology and Earth System Sciences, 20, 4341-4357.

Zhang, H., Kurtz, W., Kollet, S., Vereecken, H., and Hendricks Franssen, H.-J., 2018, Comparison of different assimilation methodologies of groundwater levels to improve predictions of root zone soil moisture with an integrated terrestrial system model, Advances in Water Resources, 111, 224 – 238.