

## ***Interactive comment on “A Bayesian Consistent Dual Ensemble Kalman Filter for State-Parameter Estimation in Subsurface Hydrology” by B. Ait-El-Fquih et al.***

**Anonymous Referee #1**

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General evaluation:

This paper is of potential interest to HESS. In general, the paper is well written and organized. The results support the proposed improved methodology. I have only one major concern. This is the difference with the paper of Gharamti et al., 2015 in Journal of Hydrology. I understand that the methodology is already introduced there, and that now the mathematical-statistical basis of it is improved. In addition a new rigorous synthetic study was carried out. The authors should exactly point out what is new in this paper and motivate why this warrants a new publication. If answered satisfactory, the paper can be published with minor revisions.

Detailed comments:

C1

L40: “have been proposed” instead of “has been proposed”.

L64: “was given” instead of “was carried”

L99-L101: Rephrase.

L109-L110: Change to: “( . . . ) various experiment settings and observation scenarios.”

L122: this should be  $t(n-1)$  to  $t(n)$ ?

L203-L206: This was not found in Song et al. (2015, VZJ). There Dual EnKF performed worse, and only a rigorous Restart EnKF gave better results. Reformulate.

L377-L378: The pumping rate is unfortunately unrealistic low. It would have been better if the authors would have worked with a more realistic case.

L587-L592: I do not see many differences and these are probably related to the initial conditions after the assimilation phase. Reconsider this text part.

Caption Figure 1. Change to: “The reference log-conductivity field was obtained ( . . . )”

Caption Figure 9. Why does AAE not decrease for joint EnKF and dual EnKF for small observation errors? Please comment.

Caption Figure 9: “are obtained” is not correct.

Caption Figure 10. Why do you use lines in the figures? The legend is not clear.

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