# Editor Decision: Publish subject to technical corrections (17 July 2017) by Kurt Roth

*Comments to the Author*:

*This manuscript took an unusually long path but now is an overall good contribution.*

*I am still concerned about the issue of a significant parameter dependence on the choice of the random generator's seed (hess-2016-42-author_response-version3.pdf, pg 3). Such a dependence is an alarming signal in my understanding of these methods and certainly warrants further exploration. Just having the proposed sentence*

*"This initial parameter ensemble is the same for all the assimilation methods."*

*in the manuscript neither addresses the source of the problem nor gives any hint to the reader. I am not content with this approach! Still, as far as I can see it, this does not have an impact on the message of this paper. I thus*

*1. ask the authors to take the chance and set things straight by at least mentioning the issue in the manuscript*

*2. other than that accept the paper as is for publication.*

# Reviewer I

*I thank the authors for answering the previously asked questions again.*

*I have one more comment about the changing results (compared to an earlier version of the manuscript). The authors state in their response, that this change happened due to a change in the random seed. I think it should be mentioned in the paper, that the results for that parameter change a lot with the seed.*

*I will leave the decision, if this is an issue to the editor.*

*Apart from this, I think the manuscript can be published.*

**Reply:** **Thanks for your work on the review. We are very happy to see the acceptance of this paper. Since these two questions are similar, we answer them together.**

**From our work, we repeated our experiments for several times with different random seeds generating initial parameter ensemble (i.e., initial parameter ensemble in this version differs from initial parameter ensemble in the earliest version), we found parameter evolution of EnKF-AGU, EnKF-DUAL and PF are slightly affected by the initial parameter ensemble (or random seeds) and parameter evolution of PMCMC is more affected by the initial parameter ensemble ( or random seeds) (comparing figures of parameter evolution in this version and the earliest version).**

**In PMCMC method, MCMC resampling step allows for relatively large moves in the parameter space which causes this method may have different results with different initial parameter ensemble. In the manuscript, we explained this issue with more details in the analysis of the parameter evolution in the assimilation period for VIC-3L model (line 695-702):**

*"PMCMC exhibits significant temporal dynamics. This is not surprising, and a consequence of the MCMC resampling step that is used to rejuvenate the parameter samples (e.g. Vrugt et al., 2013). In the first place, the DREAM-type proposal distribution that is used to create candidate particles allows for relatively large moves in the parameter space. Second, only a small LSM trajectory between two successive soil moisture observations is used to determine the acceptance probability of each candidate particle. With such a short (re)-simulation period, insensitive parameters are allowed to transition to very different values, as they do not affect the model output between the two observations, and thus likelihood of a candidate particle."*

**To address the effect of initial parameter ensemble on the parameter evolution, we added new sentences in the new manuscript (line 702-704):**

*"Altogether, this also contributes to a stronger dependency of PMCMC on the initial parameter ensemble. This collection of parameter vectors is drawn randomly from the prior parameter distribution and differs per trial depending on the random seed."*