

## ***Interactive comment on “Ensemble Kalman filter versus ensemble smoother for assessing hydraulic conductivity via tracer test data assimilation” by E. Crestani et al.***

### **Anonymous Referee #3**

Received and published: 15 January 2013

This paper assesses the performance of two data assimilation algorithms (ensemble Kalman filter (EnKF) and ensemble smoother (ES)) for deriving hydraulic conductivity fields based on the assimilation of time lapse concentration data for a relatively simple synthetic 2D-test case. The authors also apply three different transformations to tracer data and evaluate their effect on the performance of EnKF and ES.

In general, the paper is well written and organized. The authors present interesting results which could help to improve the understanding of subsurface characterization with data assimilation techniques. There are a few issues that could maybe enhance

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the presentation of the paper and I pointed them out below:

p.13088, line 22: How much variability do you assign to the measurements? Are the utilized variances comparable to the real-world measurement errors of geophysical methods?

p.13091, line 14-17: You mention that computational demand for ES is expected to be lower than EnKF. Did you measure computation times for your simulations? I think it would be interesting to have such a comparison of EnKF/ES in the results/ conclusions section.

p.13092, line 16: Maybe you could also indicate the total simulation time. I guess it is 4T (line 17), but is is not mentioned explicitly.

p.13093, line 24 – p.13094 line 3: You compare results for EnKF and ES mainly in terms of the mean field of hydraulic conductivities. Could you also indicate if there is a significant difference with respect to variance? How did variance for EnKF evolve over time? Did you observe any effects of filter divergence in your application?

p.13094, line 4-6: Could you provide an example how much the pdf's for your simulations deviate from Gaussianity? This could help to judge the effect of the different transformations.

p.13094, line 6-12: Did you also try to run ES a second or third time on the updated (and restarted) ensemble? It would be interesting to see if this could improve the estimation of hydraulic conductivities for ES.

p.13095, line 9-19, p.13097, line 20-25: Maybe you could introduce and summarize the normal score transform and the previous work on it already in the methodology section.

p.13097, line 5-7: It would be interesting to also mention the cross-correlation structure for the modified normal score transform. Is it similar to the cross-correlation of scenario 1?

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Figures 1-12: Font size is relatively small.

Figure 3: Replace 'untrasformed' with 'untransformed' in figure caption.

Figure 9: How much did the different scenarios improve for 'C RMSE' compared to the initial ensemble?

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Interactive comment on Hydrol. Earth Syst. Sci. Discuss., 9, 13083, 2012.

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