**Atmospheric
Chemistry
and Physics
Discussions**

Interactive comment on "Sensitivity tests for an ensemble Kalman filter for aerosol assimilation" by N. A. J. Schutgens et al.

This paper describes a series of sensitivity tests for an Ensemble Kalman Filter that optimizes aerosol mixing ratios. Different configurations are studied with real observations and comparisons are shown with independent measurements. The paper is rather well-written and lively despite its technical nature. I doubt that the results are generic enough to guide the set-up of data assimilation systems different from this version of this specific system, but there is something to be gained from the honest and extensive description of its tuning. I unenthusiastic recommend publication, provided the following issues are addressed properly:

1. With a relatively small local patch size, we may wonder about the benefit of the flow-dependency of the prior errors. Does the EnKF actually perform better than a simple application of Eq. (1) of paper I with clever static prior errors?

2. Throughout the text, the authors use the word "optimization" to describe the tuning of the parameters of their ensemble filter. This is confusing since the word is also used in the data assimilation community to describe the inference of variables in a statistically-optimal sense. An alternative should be found. Maybe "tuning"?

3. Experiment names are obscure and should be replaced by explicit ones.

4. p. 5949, l. 23: "ease of implementation" is not a property that the paper highlights: the whole paper is devoted to the tuning of just 3 technical parameters. This quality for ensemble filters may have actually been oversold in the past.

5. p. 5951, l. 11-12: do the authors only perturb emissions and not the prior mixing ratios? This point is not clear even in paper I and should be explained. Not perturbing the mixing ratios would be wrong at many locations downstream source regions.

6. p. 5951, l. 22-23: the authors leave the error of their observation operator H out of the observation error budget. This should justified. If this term cannot be neglected with respect to representation and retrieval errors, all conclusions of the paper could be modified.

7. p. 5958, l. 28: the reason for the instability should be found, or the experiment should not be reported.

8. p. 5959, l. 8: "more than enough" is actually correct only in the studied observation system. It could be completely wrong when assimilating satellite retrievals, or with a different spatial resolution, or with different prior/observation errors for instance.

9. p. 5965, l.18: "A unique feature of ensemble Kalman filters is the possibility to use..." could be replaced by, e.g., "In ensemble Kalman filters, it is possible

to use...". Indeed the possibility to estimate the analysis error is a specificity of Bayesian systems in general. The way it is done in EnKFs is just a numerical trick and may not be highlighted as a "unique feature".

10. Conclusions and abstract: it should be clearly stated that the conclusions are not generic and depend on the optimality system that has been studied.

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