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Interactive comment on "Technical note: A geostatistical fixed-lag Kalman smoother foratmospheric inversions" *by* A. M. Michalak

Anonymous Referee #2

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General Comments

The technical note "A geostatistical fixed-lag Kalman smoother for atmospheric inversions" by A.M. Michalak presents a method for producing multi-year geostatistical flux estimates without incurring the prohibitive computational expense that a batch-type grid-scale inversion would require. Unlike for the traditional Bayesian-synthesis inversion, the geostatistical technique uses prior information about trend of the unknown mean and spatial/temporal correlations of the fluxes rather than assuming potentially biased distributions for the mean fluxes. The geostatistical technique is a significant tool for the estimation of fluxes of atmospheric trace species, and this technical note presents a method where it will be feasible to perform multi-year inversions with it.

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One issue that could be mentioned in this note is that even though the computation becomes feasible for multi-year runs, there is still an issue related to computation of the sensitivity matrices. An adjoint model must be run for each observation and as more data become available there will be a lot of computational overhead involved as well as maintenance of an adjoint model, which is not trivial. (Maybe the next technical note could discuss an ensemble geostatistical method!).

Specific Comments

P 7756, L 22 - I can see why the assumption of uncorrelated errors is more invalid at grid scales, but I'm not sure I see why the unbiasedness of priors is more problematic at small scales.

P 7761, L20 - The subscripts rapidly become difficult to follow. I think it would help readers if there was a table that could be quickly consulted giving the definitions of the variables mentioned in this paragraph.

P 7762, Eq 11 - Is s_p the vector of parameters (s_j) from the previous iteration?

P 7762, L 20 - I think Figure 1 is very useful, but I'm unsure of what the example presented in blue means. I think it would help if the caption had more information, especially regarding what the colors mean.

P 7768, L 14 - I'm not sure why choosing an unrealisticaly low standard deviation for the data would magnify the differences between the batch and the smoother, though I can see why one might want to use the same errors for both calculations. It seems to me that use of such a small error would give the impression that the data used in both techniques constrain more than they would in a more realistic problem.

P 7770, L25 - It's an interesting difference from the Baysian synthesis framework that the results are more different for underconstrained regions. For the former, it seems to me that the prior would be represented most strongly in the solution for both techniques.

Technical Comments

P 7758, Eq 1 - I think that the beta on LHS of this equation should be a subscript. Also, it would be good to say somewhere what p" is.

P 7763, L5 - It would be good to put "(Eq. 11)" after "objective function" here because there are several objective functions in the paper.

P 7763, L 9 - "is" rather than "," after the H=....

P 7765, Eq 20 - The k's should be subcripts in this equation.

P 7766, L17 - "The", rather than "the".

Interactive comment on Atmos. Chem. Phys. Discuss., 8, 7755, 2008.

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