**Atmospheric
Chemistry
and Physics
Discussions**

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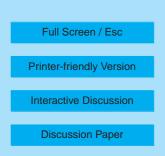
A. M. Michalak

Received and published: 29 July 2008

Referee #2 provided helpful input that contributed significantly to improving the revised Technical Note. The referee's general comment is addressed first, followed by replies to the specific comments, and the technical comments. The replies to the specific and technical comments are labeled consistently with the labeling used by the reviewer.

Reply to General Comments

The implementation of the approach does indeed require the calculation of sensitivity matrices, and this point has been emphasized in the revised version of the technical note. Variational and ensemble methods get around this requirement, and offer further computational savings. However, as is mentioned in the manuscript, the price paid for the reduction in computational cost is the loss of part of the information about the

Full Screen / Esc

Printer-friendly Version

Interactive Discussion

Discussion Paper

a posteriori uncertainties associated with the estimated fluxes. The fixed-lag Kalman smoother approach is not meant as the perfect approach for all inversions. The goal is to provide computational savings relative to a batch inversion, in cases where the accuracy of the estimated uncertainties is of sufficient interest to warrant a computational approach that provides this information. This point was discussed in Bruhwiler et al. (2005), and is also emphasized in the revised Technical Note.

Replies to Specific Comments

P 7756, L 22 When fluxes are estimated at finer scales, it is more likely that the prior estimates for certain individual gridcells will be systematically above or below their true average fluxes, yielding biases in the prior estimates. This is less likely for large regions, where current understanding of the global carbon cycle provides better information about the mean fluxes. In order to avoid confusion, however, the reference to unbiasedness has been removed, because the correlation in the errors is likely to be a larger issue.

P 7761, L20 In an attempt to keep the length of the manuscript down to that of a technical note, a table was not added, but the use of subscripts was clarified in the revised manuscript.

P 7762, Eq 11 The reviewer is correct: The "prior" estimate ($\mathbf{s}_p$) for each consecutive iteration through the Kalman smoother is the *a posteriori* estimate from the previous iteration ($\widehat{\mathbf{s}}_j$). This point has been clarified in the revised manuscript.

P 7762, L 20 The caption has been expanded to refer to each color in the figure.

P 7768, L 14 It is true that using a low model-data mismatch would "give the impression" that the data can constrain fluxes better. This point has been further emphasized in the revised manuscript. The point of this particular manuscript, however, was to compare two numerical approaches that had the same information content. If high model-data mismatch had been selected, then the estimates would have reverted back to the

Full Screen / Esc

Printer-friendly Version

Interactive Discussion

Discussion Paper

model of the trend more strongly ($\mathbf{X}\beta$), in a similar way as with Bayesian inversions reverting to the prior flux estimates, with high uncertainties. These high uncertainties, which would have been strongly controlled by $\mathbf{Q}$, which is given *a priori*, would have masked the way in which each of the two approaches update the error covariance matrix. Therefore, using a lower model-data mismatch, which requires a larger update to the error covariance matrix, provides a better test of the behavior of the smoother. The fact that the precision of the estimated fluxes for this particular test case is higher than what would be expected had more realistic model-data mismatch been used has been emphasized in the revised manuscript.

P 7770, L25 This is an interesting observation, although this was not explicitly tested in the paper by Bruhwiler et al. (2005). Therefore, this point was not added to the current manuscript, but will be verified in future analyses.

Replies to Technical Comments

P 7758, Eq 1 The β has been changed (this error was introduced during the copy-editing process), and the *a posteriori* pdf (p_J) has been explicitly defined.

P 7763, L5 This has been changed per the reviewer's suggestion.

P 7763, L 9 This has been changed per the reviewer's suggestion.

P 7765, Eq 20 This error was introduced during the copy editing process, and has now been fixed.

P 7766, L17 This word is part of a two phrase sentence, and the lower case was kept.

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

Full Screen / Esc

Printer-friendly Version

Interactive Discussion

Discussion Paper