

## ***Interactive comment on “Evaluating a 3-D transport model of atmospheric CO<sub>2</sub> using ground-based, aircraft, and space-borne data” by L. Feng et al.***

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The manuscript considers calculating global CO<sub>2</sub> fluxes based on the output from Geos-Chem transport model driven by fields from GEOS-4 and GEOS-5.

The EnKF setup described in Feng et al. (2009) seems sensible, and I can see no problems with using the EnKF methodology as such. It is known that for linear perfect-model systems the ensemble square root filter is equivalent to Kalman filter, subject to sufficient ensemble rank and the initial factorisation of the state error covariance.

My main concern is about the nature of the performed inverse modelling. The transport model with 22 geographical regions is rather crude, with a big numerical diffusion.

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From my experience with the inverse transport modelling, even with known inputs it is impossible to match observations with any transport between the model cells. The inverse solution of the transport problem, while unable to match the cell-averaged observations exactly, does its best to compensate for the model deficiency and minimise the effects of the numerical diffusion.

In a situation with a given transport and unknown sources (fluxes) one can indeed inverse model the fluxes to match observations to any degree of precision. I am therefore not surprised by the good fit to observations obtained in the paper. But how reliable are these results? This is not clear.

I suspect that the obtained solution can be very sensitive to both the uncertainties in transport and imperfections of the transport model. With the crude grid used, the calculated fluxes may be rather compensating for model defects than represent the real values.

It seems to me that the manuscript would gain in its value if the authors presented at least some twin experiments to demonstrate the reliability of the methodology used. For example: take a good 3D atmospheric model, specify some sensible fluxes, run forward, simulate observations. Then try to inverse model those with their methodology and compare with the "truth".

Taking the above recommendation probably signifies recommending a major revision of the manuscript.

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A minor issue:

It seems that in the reference to Li et al. (2003) the title needs to be corrected -see <http://www.agu.org/journals/ABS/2003/2002JD003075.shtml> .