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Geoscientific
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Discussions

Interactive comment on "A methodology for estimating seasonal cycles of atmospheric CO_2 resulting from terrestrial net ecosystem exchange (NEE) fluxes using the Transcom T3L2 pulse-response functions" *by* C. D. Nevison et al.

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We thank both reviewers for their insightful comments. Below are our detailed responses:

Response to Reviewer 1 The main comment here is that more sophisticated matrix multiplication methods have been computed in previous studies and that our methodology is therefore not really new. To address this comment, we have done the following:

1. We have removed the word "new" from our Abstract and Introduction.

2. We have revised the last line of the Introduction to highlight the strengths of our methodology, "Here we present a methodology, based on publicly available input functions from 13 different ATMs, that allows the atmospheric seasonal cycle in CO2 resulting from terrestrial NEE to be quickly and efficiently estimated while providing an estimate of the range of ATM uncertainty in the signal."

3. We have added the sentence at line 3 of the Methodology about the easy availability of the Transcom pulse-response functions. "These functions are available at http://transcom.project.asu.edu/."

4. We have added the following sentence to our discussion of uncertainty associated with spatial distribution of fluxes within Transcom regions. "Other matrix multiplication methods avoid the uncertainty associated with the spatial distribution of surface fluxes aggregated over large regions by using finer-scale, gridbox-resolved Jacobians derived from running the adjoint of a given atmospheric transport model [Kaminsky et al., 1999; Sitch et al., 2003]."

Thus we acknowledge the existence and superior resolution of the Kaminsky et al. method. However, we believe that our method is still useful and relevant for the following reasons:

Our purpose is to present a simple and efficient method for evaluating the atmospheric CO2 signal corresponding to a given set of NEE fluxes, to understand in a broad regional sense which areas are responsible for the cycle at a given station, and to evaluate whether the differences in the simulated CO2 cycle due to a wide range of transport models transcend the discrepancies with observations.

In our case, the pulse-response functions generated by the Transcom modelers are readily and publicly available as netcdf files on Kevin Gurney's website. In contrast, our reading of Kaminsky et al. 1999 suggests that the Jacobian must be generated for a given TM2 model set-up using a tangent linear adjoint model compiler, which will be difficult for unfamiliar readers to create for other models. In sum, the calculations presented by Kaminski clearly work at a finer-scale resolution and thus provide a superior estimate of the atmospheric CO2 cycle for ATMs for which such Jacobians are available. However, our simpler method is more accessible, relatively easy to reproduce from the detailed information presented in our paper, covers a wide range of ATMs, and is adequate for many purposes (i.e., providing a rough estimate of the atmospheric CO2 cycle corresponding to a set of surface NEE fluxes and how sensitive that cycle is to ATM uncertainty).

With respect to the Houweling et al.,1999 reference suggested by Reviewer 1, we respectfully have not included it in our paper's discussion because it is primarily an inverse modeling study focused on methane and thus seems less directly relevant.

Interactive comment on Geosci. Model Dev. Discuss., 5, 2789, 2012.