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Biogeosciences Discussions

Interactive comment on "North American CO_2 exchange: intercomparison of modeled estimates with results from a fine-scale atmospheric inversion" *by* S. M. Gourdji et al.

Anonymous Referee #2

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The paper compares flux estimates from a geostatistical inversion at a high spatial and temporal resolution with those from other inversions as well as with bottom up estimates. Instead of prior fluxes, in contrast to other inversions the geostatistical inversion uses auxiliary variables such as fossil fuel emission inventories and evapotranspiration and other variables from the North American Regional Analysis (NARR) at 3 hourly resolution.

One of the key advantage of Bayesian or geostatistical inversions is their ability to quantitatively propagate uncertainties from the observational data into the posterior flux estimates. Unfortunately, the results presented in the manuscript do not incude

any posterior uncertainty estimates, as they where regarded unrealistic (P6787, L 18). This is specifically unfortunate, as the authors attempt to falsify bottom-up model estimated fluxes. The authors should reconsider if a posterior uncertainty estimate can be provided. Given that all uncertainties are optimized in the geostatistical inversion model (GIM), and that they have an impact on the outcome of the inversion, this should be possible.

A further shortcoming is related to the choice of linear coefficients for environmental variables, which uses the full year. Given that the growing season dominates the fluxes and their variance, may be a specific choice needs to be made to better capture dormant season fluxes. This choice of annual coefficients also has very likely an impact through aggregation on respiratory fluxes, e.g. as seen in the stronger sources seen in GIM inversions for the temperate grass/savannah/shrub biome. Together with the fact that no posterior uncertainties are available, the claim that process models need to better account for management should not be based on the comparisons to GIM inversion results. This should be formulated more carefully.

In addition, the authors emphasize the unprecedented spatial scale of the inversion, but do not provide any comparison to eddy covariance data. Thus the claimed reduction in aggregation error remains largely speculative. It should be clearly stated why a comparison to flux observations is not possible, even though the spatiotemporal resolution is significantly higher compared to previous studies.

I also agree with the referee #1 regarding the presentation of the major driving environmental variables: their impact on the flux estimates should be clearly visualized.

Minor revision of the manuscript is needed before it can be accepted for publication.

Specific comments: Fig. 2a: The footprints should be calculated for the selected measurement times from each location as specified in supplement B, as the data density is different for the locations, impacting on the spatial pattern. This should be mentioned in the text.

P 6790, L 1: Not using remotely sensed vegetation indices just because they are reported on weekly rather than 3 hourly time steps seems arbitrary. Vegetation indices are not expected to change on such small timescales, so technically they could be included by using a simple temporal interpolation to the desired time step. Why has this not been done? NARR evapotranspiration and canopy conductance are indirectly influenced by AVHRR green vegetation fraction, however a climatology is used rather than actual data in the Noah LSM; thus using NARR fields is not a real alternative to using weekly specific fields of vegetation indices.

P 6790, chapter Fossil fuel inventory: presubtracting, uncertainty in modelled fossil fuel signals? Ok, may be by optimizing R specific for each observation location and month. . . Was an impact seen, e.g. by plotting station specific uncertainties against the fossil fuel signal or its variance?

P6794, L16: The fact that canopy conductance was not selected as a significant variable might be related to the fact that its information is largely contained evapotranspiration fields. Has this been assessed?

P6795 L15: Similar to the fossil fuel inventory, which contains average diurnal cycles of specific activity factors such as emissions from transport, also fire emission inventories exist that have information on sub-diurnal variance. Those could have been incorporated.

Fig. 4, right column: rather than highlighting the biospheric model with the closest agreement to the GIM fluxes, the median of the biospheric models should be shown as done in Fig. 3.

P6802 L : The south eastern forest plantations are probably not well constrained in the inversions, either, when looking at the footprint (Fig. 2a).

P6807 L16: Attributing the spread in inversion results for the North American carbon budget to differences in CO2 mixing ratios of air entering the country rather than to

differences in prior somewhat contradicts the argument made on P6806 L29 regarding the temperate grass/savannah/shrub biome, which is responsible for a large fraction of the North American carbon budget.

P6808, L22: The comparison of bottom-up with top-down estimates is not new.

Technical comments

Fig. 5: which are the results for GLOBALVIEW, and which for CT boundary conditions? Should be included in the figure caption.

Supplement B, page 2, 2nd paragraph: replace “is subject other challenges” by “is subject to other challenges”

Supplement C, page 3, there is a reference (probably to a figure) missing regarding the model domain

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Interactive comment on Biogeosciences Discuss., 8, 6775, 2011.