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Biogeosciences Discussions



# *Interactive comment on* "Recent global $CO_2$ flux inferred from atmospheric $CO_2$ observations and its regional analyses" *by* F. Deng and J. M. Chen

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This study uses monthly-mean $CO_2$ concentration measurements from a small number of sites to infer the global distribution of $CO_2$ sources and sinks at coarse resolution, using new compilations of fossil fuel burning and biomass burning emissions as auxiliary data. The results and their possible implications for biosphere response to climate are interesting, but the authors need to provide more details about their methodology in order for readers to understand what its uncertainties are and how much confidence should be placed in the reconstructions of the location and interannual variability of fluxes.

1) The authors correctly state that "large diurnal variations of PBL at continental sites could have caused large diurnal variations of $CO_2$ concentration and hence can pro-

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duce substantial biases in the inversion result if a transport model is used without considering the diurnal variations". They need to provide more detail on how they overcome this when they are using monthly $CO_2$ concentrations from GLOBALVIEW. In theory this is feasible because GLOBALVIEW provides the fraction of contributing observations collected during each hour of the day, but even weighting by this distribution will miss synoptic-scale fluctuations in $CO_2$ concentrations, as well as the impact of sampling preferentially by wind direction or other criteria intended to limit "local influences".

2) Along the same lines, what do they do about sites for which there is no data for a given month, and the GLOBALVIEW value is entirely extrapolated? If stations with no observations during part of the period were included in the inversion, it could play havoc with their attempted localizations of interannual variability; if they were included only for months when some threshold frequency of observations was reached, the changing observing network again raises the question of whether the interannual variability seen is real.

3) Uncertainties such as $\pm$0.25 Pg C/y for the northern land sink are difficult to credit. The quoted $\pm$6% uncertainty in fossil fuel emissions, assuming 5 Pg C/y from northern land regions, would by itself lead to a $\pm$0.30 Pg C/y uncertainty in the sink even if the gross flux were perfectly known. Even assuming that the estimated fluxes are computed from reasonable estimates of the concentration and prior flux uncertainties, they do not include transport model error and thus are valid only for an imaginary perfect model. With results from the Transcom intercomparisons available, there is no reason not to include estimated transport uncertainty as part of the posterior flux uncertainty (the transport error could also be estimated from an ensemble of basis functions generated by the same model but driven with different reanalysis fields); the uncertainty as presented is misleading.

4) The analysis of drought impacts on regional carbon fluxes is potentially the most novel part of this work but is limited to qualitative comparisons between time series in



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a few regions. The authors might consider some statistical testing of this relationship, along the lines of what was done by Schwalm et al. ("Assimilation exceeds respiration sensitivity to drought: A FLUXNET synthesis", GCB, 2010) for carbon fluxes measured from towers, and perhaps comparing their inversion with the eddy covariance results.

5) Figures 6-9, showing a profusion of time series, are cumbersome to interpret. I suggest replacing them with simpler versions and/or a graphic that provides some sort of global perspective on the argued connection between drought and reduced carbon uptake.

6) The study period is inconsistently given as 2001-2007 or 2002-2007; please clarify.

7) Typographic:

Eq. 1: should be $Q^{-1}$

3501 l. 17: a priori *estimate*

3502 l. 4: GLOBALVIEW

3502 l. 12: *basis* regions

3502 l. 14: carbontracker.noaa.gov

3504 l. 16: at the upper bound

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Interactive comment on Biogeosciences Discuss., 8, 3497, 2011.



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