**Atmospheric
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Discussions**

Interactive
Comment

Interactive comment on "Global CO$_2$ fluxes estimated from GOSAT retrievals of total column CO$_2$" *by* S. Basu et al.
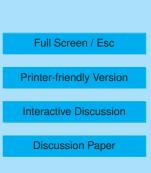
Anonymous Referee #1

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This manuscript presents one of the first attempts to use GOSAT XCO2 data to infer global CO2 fluxes. Overall, the manuscript strikes a reasonable balance between discussing the aspects of their analysis that the authors believe to be robust, while at the same time being honest about the many shortcomings the current GOSAT L2 data and of their analysis. Although this paper does not provide any substantial innovations in methodology nor in our understanding of the global carbon cycle, it does present an analysis of what is still a rather novel dataset. As a result, I believe that it should be published.

My main concern with the manuscript stems from a few aspects of the inversion methodology that is employed:

- The fact that fluxes are only estimated monthly is a major limitation, and the majority

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of recent studies have used much finer temporal discretization. This is important not only for the purpose of defining flux updates on a finer temporal scale, but also for the purpose of avoiding temporal aggregation errors, analogous to the spatial aggregation errors that have led to finer and finer spatial resolutions for inversions over the years. The CarbonTracker fluxes that the authors cite, for example, update fluxes weekly, and many recent inversions use even finer temporal scales.

- p. 4547 and Table 1 The temporal correlation lengths assumed for the land fluxes seem unreasonable. If T=3 months, that means that the correlation coefficient decays to 0.05 after 3T=9 months, meaning that the terrestrial fluxes are assumed correlated for almost a full year. Similarly, for the ocean fluxes, the L of 3000km appears unreasonably long, with an implied correlation length of 3L=9000km.

- p. 4549: The error model R includes observational error and representation error, but what about estimated transport model error, and spatial and temporal aggregation error?

These factors are likely to have a major impact on the estimated fluxes. I recommend that the authors substitute a more reasonable setup. At a minimum, the temporal resolution at which fluxes are estimated and the covariance parameters should be examined in additional sensitivity tests in Section 3.4.

A few more minor points:

- The fact that the analysis is based on the RemoTeC algorithm should be mentioned in the abstract, as the results only apply to that retrieval algorithm.

- p. 4537 Clarify the distinction between the "older" missions/instruments (e.g. AIRS, TES, etc.) that were not designed for measuring CO2 and missions that are specifically designed for this purpose (e.g. GOSAT, OCO-2). Otherwise, comparing them to one another is misleading.

- p. 4543 line 10 – Make it clear that you are referring to correlations between errors,

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not the process values being observed.

- The conclusion in p.4564 lines 15-18 is too strong. What constitutes a "definite demonstration"? Why do the other works cited by the authors using TES, AIRS, etc. data not qualify? I believe it is rather a matter of degree, not a matter of "definite" vs. not.

- At some point in the manuscript, it would be appropriate to at least briefly mention / describe the existence of the several other retrieval algorithms actively being developed and used for GOSAT XCO2.

Interactive comment on Atmos. Chem. Phys. Discuss., 13, 4535, 2013.