

## ***Interactive comment on “Global atmospheric carbon budget: results from an ensemble of atmospheric CO<sub>2</sub> inversions” by P. Peylin et al.***

**Anonymous Referee #2**

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General comments:

Peylin et al. collected eleven CO<sub>2</sub> flux inversion results and compared their flux estimates over the entire globe and aggregated regions (also in time). Unlike the well-known TransCom work (e.g. Gurney et al. 2002), inversions were not implemented under a specified protocol. This added an additional difficulty in interpreting differences in flux estimates in the intercomparison. This work however managed to provide a good summary of flux estimates from a cloud of current state-of-the-art inversion systems, and revealed common features (also difference) in flux estimates. From inversion study point of view, this work provides timely information, given inversions of satellite-observed CO<sub>2</sub> from carbon observing satellites such as GOSAT and future

C1824

OCO-2 are emerging. It is very useful to have a summary of the current state-of-the-science related to atmospheric CO<sub>2</sub>, before adding new information to inversions. The information provided by this work will be a useful reference to establish satellite-based inversions. That being said, I would recommend this manuscript for publication after minor corrections.

In my opinion, as being a most up-to-date inversion comparison work as well as a part of RECCAP, this work has a good opportunity to make a suggestion for future inversion (and intercomparison) works (e.g. how this kind of intercomparison could be improved). To nail down an inversion intercomparison, one might need to think about using criteria which participating inversions should meet. One thing the authors (and the inversion community) might want to discuss is the given fossil fuel emissions. Although fossil fuel emissions are assumed to be known (and not optimized) in all inversions, the inversions are imposing different fossil fuel emissions and do not even agree on a global total (meaning, strictly speaking, the inversions are not solving the same CO<sub>2</sub> budget problem - even ignoring some missing pieces in current inversions, which are pointed out by Prof Enting in his post). The comparison shown in this study frequently uses "fossil correction". Although it is "corrected", the interpretations for flux differences cannot be absolute. I don't think people must use the same fossil fuel emissions data for their own research. But I believe it would be nice to share the information given to inversions. The degree of complexity in the models (prior land and ocean and transport models) used in inversions has increased. Also, the wide spectrum of observational data to be inverted has become available. To work with those emerging tools and data, we might need to think about how to organize future intercomparisons (for instance, define a common setup) well in advance before each inversion work gets more unique. This is of course not mandatory (off from the purpose of the manuscript!), but it is a point I would personally like the authors to address.

Line-by-line comments:

P5304, L9: atmospheric CO<sub>2</sub> efforts -> atmospheric CO<sub>2</sub> inversion efforts

C1825

P5304, L11: fossil emission -> fossil fuel emission (correct the rest of the manuscript accordingly)

P5304, L21: 22 regions, better to mention 11 land and 11 ocean for the general audience of Biogeoscience.

P5305, L9: Add a last access date to the URL if needed for Biogeoscience.

P5305, L11: CO2 fluxes -> CO2 flux estimates

P5305, L22: Section 3 -> Sect. 3 (keep the consistency)

P5306, L6: "including natural and anthropogenic", this might be confusing for the general audience of Biogeoscience (anthropogenic is prescribed). Rephrase if appropriate.

P5306, L14: representativeness (of what? flux aggregation error?)

P5307, L11: parameters, can you be more specific (like ecological parameters). Rephrase if appropriate.

P5307, L12: CCDAS, I thought this is a name for the model developed by Rayner et al. (2005).

P5307, L17: above -> above-mentioned

P5309, L4: Add a proper citation for GLOWBALVIEW-CO2.

P5309, L7: under-sampled, I do know what you want to say, but it might be unclear to the general audience. Please rephrase.

P5309, L8: air mass representative of ... -> air mass representing ...

P5309, L9: You might want to use parenthesis with e.g.?

P5309, L21: flux relationships -> flux covariations

P5310, L7: The process included in models do not matter?

C1826

P5310, L12: Emissions from cement production are also often included in fossil fuel emissions.

P5311, L3: inverse -> inversion

P5311, L8: fossil-fuel -> fossil fuel (keep the consistency)

P5311, L11: Define RECCAP.

P5311, L12: It would be better to define each inversion here (even briefly), although we can find the definitions of inversions in the supplement.

P5311, L18: chose to make this a single submission -> consider this as a single submission

P5312, L5: Define IAV here rather than later.

P5312, L13: positively quality controlled, what do you mean by this?

P5312, L17: raw, do you mean they are not averaged?

P5312, L24: the several groups, which groups?

P5313, L2: representation uncertainty -> representation error (if stick to Kamiski paper)

P5313, L9: A citation for TM5 is missing.

P5313, L11: vertical mixing -> vertical mixing schemes

P5313, L12: interannually varying -> interannually-varying

P5313, L12: a single year of winds, do you mean a fixed wind field?

P5314, L21: varying, do you mean time-varying or a wide variety of prior fluxes?

P5315, L13: From the supplement information, I imagine BP is used just for extrapolation.

P5315, L16: I would suggest to describe if they included int'l bunker emissions in the

C1827

supplement information.

P5316, L6: 4-D-var, this needs to be defined.

P5317, L15: care -> a care

P5352, Fig. 1. I would suggest to include observation maps for all the inversions (in the supplement document) as it is a critical information to interpret each inversion result.

< Supplement material >

P1, L28: Piao et al., 2009 -> Pial et al. (2009)

P3, L81: EDGAR v4, v4.x?

P6, L160: Patra et al., 2005 -> Patra et al. (2005)

P6, L166: Define SPO. Would be helpful for the general audience of Biogeoscience

P6, L167: interannually varying -> interannually-varying

P6, L168: Define pre-subtracted fluxes.

P7, L176: Transcom -> TransCom

P7, L176: real observation, I imagine you want to say the data is not averaged. Please rephrase.

P7, L177: extended to which year?

P7, L178: What kind of modifications were done?

P7, L179: and monthly resolution -> on monthly basis

P7, L184: Here you can use "SPO".

P7, L184: fossil fuel with. . . -> fossil fuel emissions

P7, L189: Define CONTRAIL if not defined yet.

C1828

P7, L189: this inversion -> the NICAM inversion shown in this study (or something like that)

P7, L190: limited aircraft measurements, what do you mean by that?

P7, L191: TRANSCOM -> TransCom

P7, L194: The ocean flux partitioning -> The ocean flux region partitioning (or definition), please consider.

P8, L200: A citation for further details of the aircraft data?

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C1829