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Discussions

Interactive comment on "The constraint of CO$_2$ measurements made onboard passenger aircraft on surfaceatmosphere fluxes: the impact of transport model errors in vertical mixing" *by* Shreeya Verma et al.

Anonymous Referee #2

Received and published: 31 August 2016

The authors have written a wonderful paper on the utility of CO2 observations from commercial aircraft and the impacts of uncertainties in vertical transport. I have listed a few suggestions below to consider during the revision process.

Pg 1, line 14: I would include a noun after a word like "this" or "these" so it is clear to the reader what you are referring to in the sentence. For example, "This [fill in here] highlights ...."

Pg 1, line 14: consider changing "the benefit" to "a benefit"

Pg 1, line 20: Suggested rewording: "with a reduction of posterior flux uncertainty of

about 7 to 10%."

Pg 1, line 22: add a comma before "and"

Pg 1, line 24: What does "these" refer to here? I would include a noun after "these".

Pg 1, line 28-29: Consider adding references to this sentence.

Pg 1, line 35: Consider adding references to this sentence.

Pg 2, lines 2-4: The observation network could be spatially uneven and could be temporally sparse or uneven (e.g., as is the case with some aircraft campaigns). This point could be worth mentioning here, depending on whether you think it flows with the text.

Pg 2, line 11-12: This point is true of short towers but not necessarily of tall towers (e.g., the NOAA tall tower network in the US).

Pg 2, line 14: Instead of "constraints", I would use a word like "limitations" ("... they have their limitations, too, which restricts their use for accurate flux ...."). The word "constraints" makes it sound like the satellite is constraining something (e.g., fluxes), not that the satellite has limitations.

Pg 2, line 41: Suggested rewording: "... investigate theoretical impacts of transport model ...."

Pg 2 lines 10-17: Some of the information here seems redundant with information in the previous two paragraphs. You may want to eliminate these lines or condense with the previous two paragraphs.

Pg 2, line 2: I prefer active voice (E.g., "section 3 presents results") over passive voice ("In section 2, the results are presented"). This wording could be a matter of personal preference.

Pg 2, line 29: A 4x5 degree resolution seems really coarse for CO2 simulations. At this juncture, I imagine it would be difficult to find a higher resolution model and re-run all of

the CO2 model simulations. However, somewhere in the paper (e.g., in a supplement), it might be useful to explain why you used this resolution and how the resolution affects your interpretation of the results.

Pg 2, line 31: I would include a noun after "following."

Pg 4, Eq. 2: How does f_post relate to the variables in this equation? Is "f_post" the same as "f"?

Pg 4, Eq. 4b: Many inverse modeling studies include an a priori covariance matrix that defines uncertainties in the prior and spatial/temporal covariances in these covariances. Instead, you have used a weighting factor (mu). It could be helpful to explain why you have chosen the latter approach over the former.

Pg 4, line 12: The symbol mu usually refers to the mean in statistics. A different variable name here could prevent confusion. Section 2.1.1: This section contains a lot of information about the fundamentals of Bayesian inverse modeling, and it appears that a lot of this information has already been published elsewhere. You could either condense this section or move the material to a supplement.

Pg 4, line 38: Are there many stations that have weekly flasks? I know of a number of stations with daily flasks. You could change this sentence to "... made once per day or once per week ...."

Pg 5, lines 1-5: Why use this approach instead of including covariances or off-diagonal elements in Q?

Pg 5, lines 5-24: You could condense this information or move it to a supplement if it has been published elsewhere.

Pg 5, lines 37-38: This definition of model-data mismatch is confusing. For example, what simulated spatial averages are you referring to here? Does this definition include or exclude temporal averaging? Also, I think this definition of model-data mismatch is different than the definition used in other inverse modeling papers (e.g., Michalak et al.

C3

2004, doi:10.1029/2003JD004422).

Pg 8, line 7: I would include a comma after "redistribution."

Pg 8, line 19: What does "this" refer to? I would add a noun after "this."

Pg 8, line 28: The word "constraint" is potentially confusing here. You could use a different phrase like "evaluate the utility of the aircraft measurements ...."

Pg 8, line 39: The phrase "cause a constraint" may not be the optimal wording here. Instead, you could use a phrase like the following: "West winds mean that observations in these regions are sensitive to boreal fluxes."

Pg 9, line 8: I would re-phrase "least constraint in the fluxes." Instead, you could try "least constrained by the combined network ...".

Pg 9, line 12: Throughout the article, the word "constraint" is used in a variety of different contexts with different meanings. I would use this word in a single context and choose different words in different contexts. In this line, I think the phrase "uncertainty reduction" might be more appropriate.

Pg 9, line 24: I would remove the word "however."

Pg 9, line 25-26: I think this sentence is a run-on. I would put a period after "network" and start a new sentence with the word "hence." Also, I would add a noun after the word "this".

Pg 10, lines 7 and 10: What do the words "this" refer to in each sentence? I would add a noun after the word "this" in each case.

Pg 10, line 22: I would change "reduce" to "decline".

Pg 10, line 28: This sentence contains a long clause that makes the sentence difficult to follow. Suggested edit: "We find that IGOS flights will likely provide a strong constraint on regional CO2 flux totals."

C4

Fig 4 caption: Some readers may not be familiar with Taylor diagrams. You could include once sentence that explains which corners of the Taylor diagram are "better" and which are "worse." (I had to stare at the diagram for a minute to figure out that orange dots in the lower right are a better fit than those in other regions of the diagram.)

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