

The paper is extremely poorly written and is unacceptable in its current form. While I believe the analyses are interesting, I highly recommend the authors to review the text and rewrite as needed. Apart from the grammatical errors, there are also several errors in the introduction- which I would expect the senior authors to have addressed. I provide some examples from the Abstract and Introduction. I would be happy to re-review this paper if the manuscript is resubmitted.

[Reply] We thank Dr. Rastogi for carefully reading our work and providing thoughtful comments. We have tried our best to significantly improve the writing and also done extra analysis. Our replies are in black below each comment in grey.

Because the revisions are very significant throughout the manuscript, a revised draft is supplied with this reply for your reference, which will be further improved when we are allowed to revise it.

Abstract:

line 18: We show the model...

line 20: comparisons reveal these differences

line 21: define the acronym ACTM when first used

line 24: unclear, because of course 4 km is not representative of XCO₂ (which by definition is total column)

line 27: due to its coarse resolution and the higher resolution

[Reply] The abstract is rewritten completely. Hope it is easier to read now. Kindly check the revised draft.

Introduction:

line 44: majorly responsible for global warming

[Reply] We revised the sentence to: “*Atmospheric CO₂ is the most significant anthropogenic greenhouse gas (GHG) in the Earth's atmosphere, primarily responsible for global warming and climate change since the preindustrial era, circa 1750 (Bolin & Eriksson, 1959)*”

line 48: chemical transport model

[Reply] We changed the sentence to: “*These CO₂ measurements have very high accuracy (0.1 ppm in 400ppm) (WMO, 2020) and long-term records, making them widely used in Bayesian "top-down" estimation of surface CO₂ fluxes using atmospheric chemistry-transport models (Enting and Mansbridge, 1989; Tans et al., 1990; Gurney et al., 2002; Peylin et al., 2013)*”

line 52: perhaps data sparse is better than data void

[Reply] We have replaced "void" with "sparse" in the revised version, as suggested.

line 54: space-based satellites (not measurements). OCO-2 is a satellite that "measures" XCO₂, OCO-2 itself is not a measurement

[Reply] We agree with your comment. We have replaced “measurements” with “satellites”.

line 61: measurements have shown retrieval errors

[Reply] We revised the sentence to: “*OCO-2 version 10 retrievals of XCO₂ exhibit a mean bias (RMSE) of 0.24 (0.81) ppm over land and 0.43 (0.84) ppm over oceans globally when compared to the more accurate*”

WMO scale-maintained XCO₂ measurements (accuracy < 0.5 ppm) from surface-based Total Carbon Column Observation Network (TCCON) sites (Taylor et al., 2023) ”.

line 64: Wunch et al., 2017 is cited for OCO b10 but this study came out before OCO-2 b10 which was released in 2020/2021.

[Reply] We agree with the reviewer's comment. We have removed the citation from the text and new information are provided for improving clarity about data used in the analysis.

line 66: CO₂ fluxes at regional scales

line 68: Millet et al., 2007 isn't a great reference for this because observing systems and models have both tremendously improved since that study. Current precision requirements are below 1 ppm for inferring regional fluxes. See Feng et al., 2019 (JGR-A) and Rastogi et al., 2021 ACP.

line 71: Massie et al., 2021 show the impact of 3D cloud radiative impacts on XCO₂ (bias). This is different from cloud effects (which could mean no data over cloudy conditions).

line 73: estimates not estimations

line 75: This is incorrect. OCO-2 has always had a DEM. Jacobs et al., 2023 found that the choice of DEM lead to large systematic errors in high latitudes for OCO-2 b10.

line 77: transport not such kind

lines 78-80: needs to be re-written

[Reply] In the revised draft we have removed these unclear sentences from the introduction section to improve clarity and align better with the study's objectives, without compromising the article's content. Kindly refer to the revised draft as provided with this reply.

line 86: inversion estimates through...

[Reply] We changed the sentence to: *“Thus, assessing uncertainties linked with specific transport models through comparison of partial-column (layers of the atmosphere) CO₂ from near surface to upper troposphere using the aircraft CO₂ vertical profiles across the globe are desired.”*

lines 90-91: This needs to be clarified. Schuh et al., 2019 have examined the impact of transport related errors on flux estimates. Feng 2019 and Rastogi 2020 used aircraft profiles to understand combined flux and transport errors.

[Reply] Thank you for mentioning it. We find Rastogi et al. 2021 is a better reference because of direct use of OCO-2. Therefore, we changed the sentence to: *“Limited studies are available in literature to assess altitude-wise uncertainties of transport models using surface and aircraft CO₂ measurements over locations of OCO-2 samplings (Rastogi et al., 2021).”*

line 96: four specific aircraft sites

[Reply] We mentioned the site's name now. Revised text reads as *“four fixed sites (TEF, SAN, RBA, and ALF)”*

References:

Feng 2019: <http://dx.doi.org/10.1029/2019JD031165>

Rastogi 2021: <https://doi.org/10.5194/acp-21-14385-2021>

Schuh et al., 2019 [10.1029/2018GB006086](https://doi.org/10.1029/2018GB006086)

Citation: <https://doi.org/10.5194/egusphere-2024-3976-RC2>

All these references are cited in the revised manuscript.