

Reply to Reviewer #1

We thank the reviewer for the helpful comments and addressed all comments below. The reviewer comments are in grey, our responses in black.

The authors have addressed my final major concerns with satisfaction. I also appreciate the improved figures provided with the new manuscript. I recommend the paper to be accepted after the final remaining minor issues are resolved (see below). I concur with the other reviewer that some parts are hard to follow. In particular for someone who is reading it for the very first time. I suggest the authors and perhaps the Copernicus typesetters have a final careful look at some of the sentence structures.

Line numbers refer to the acp-2022-120-ATC2.pdf difference document

- Line 19: “balanced” => balancing Corrected Line 17
- Line 19: “the match of CO₂ observations” => the constraints provided by CO observations. The sentence only refers to CO₂ inversions and not CO, so we corrected the sentence Line 17 with “Consequently, the differences observed in the NEE posterior emissions are a result of the balancing with fires and the constraints provided by CO₂ observations.”
- Line 25: “is better” => performs better Changed Line 23
- Line 26: “A major result of this work, that we can observe at global scale, is the strong constraint and influence of the CO₂ assimilated data among the inversions, on the net fluxes. ”
=> We observe the assimilated CO₂ data has strong influence on the global net fluxes among the different inversions. Changed
- Line 26: “have closer emissions each other and so are more influenced by observations ” => have more similar emissions, mostly as a result of the observational constraints, and to a lesser extent because of the fire prior used. We changed the sentence with “Inversions using OCO-2 (or IS) data have similar emissions, mostly as a result of the observational constraints, and to a lesser extent because of the fire prior used.
- Line 38: “and historically different efforts” Start as a new sentence. Changed Line 35
- Line 255: “representativeness” => representation error. We prefer to keep representativeness error as this term has been used in several previous studies (Bergamashi et al., 2010, Hooghiemstra et al., 2012, Boersma et al., 2016) using chemistry transport model (such as TM5 and GEOS-Chem).
- Line 266: “the relative strengths of ” Leave this out. Changed
- Line 293: “in GFED versions” => of the GFED versions Changed
- Line 305: “in general easily quantifiable by careful calibration of instruments. ” This sounds like it only includes instrument errors. Do you take into account atmospheric transport errors? I can imagine that those errors can have significant correlations among the different observations.

How large are the errors assumed in matrix \mathbf{R} ? Please elaborate in the paper. This sentence line 295 is included in the section 2.3.1.a “CO parameterizations”, there is only one set of observations here which is MOPITT measurements. The \mathbf{R} matrix does not include only instrument errors. It includes also transport model errors. We changed the sentences “In the observation covariance matrix \mathbf{R} , we only assume uncorrelated errors, meaning we only have errors along the diagonal. The \mathbf{R} matrix includes two errors: instrument errors and transport model errors. This can be assumed since observation error is in general easily quantifiable by careful calibration of instruments.” by “The observation covariance matrix \mathbf{R} includes two errors: instrument errors and transport model errors. In this matrix \mathbf{R} , we only assume uncorrelated errors, meaning we only have errors along the diagonal. This can be assumed since observation error is in general easily quantifiable by careful calibration of instruments.”.

- Line 320: “For better comparison and as the OCOCMS product (we will introduce later) used the emission factor of Andreae and Merlet (2001) and Akagi et al. (2011), ”
=> For better comparison we applied the same emission factors used by OCOCMS product (based on Andreae and Merlet, 2001, and Akagi et al. 2011), and not the more recent emission factors provided by Andreae (2019). Done
- Line 489: “Further investigations are then needed to study this region” => Further investigations are therefore needed for this region to make more conclusive remarks. Done line 464
- Line 525-645. For readability sake this section needs to be broken up into smaller paragraphs. Done
- Line 590: “Focusing on the Tropical...” start new paragraph here Done line 503
- Line 598: “Very large differences between the...” start new paragraph here Done
- Line 602: “For Northern Tropical Africa, net...” start new paragraph here Done
- Line 606: “Examining Fig. 6, we ...” start new paragraph here Etc. etc. etc. Done
- Line 624: “north” => North Done line 562
- Line 636: “data constraint” => data constraints Done line 611
- Line 661: “with the IS data ” you can leave this out. Done line 573
- Line 831: “biases of the priors ” => start new sentence Done line 725
- Line 873: “GtC” => PgC Done line 762