

We thank the topical editor Klaus Gierens for very helpful final comments and remarks. We have changed the paper in response to these comments. Our detailed reply to all the comments is given below, with the editor comments shown in italics.

Reply to Editor review

Your paper is almost ready for publication. However, I have still two minor points that I would like to see improved. This is your description of the use of MOPITT on page 13. First you write “below about 4 km”, then “measurements at 500 hPa” and finally (page 14) you mention a “thick layer (200-700 hPa; 3-12 km). This is quite confusing, and I think that the question of one of the reviewers is not sufficiently addressed, namely whether because of the “thick layer” some of the missing convection is implicit in the initialisation. Please rewrite this part of the text to avoid confusion.

As suggested, we have rewritten this section to avoid confusion:

“Therefore, CO is prescribed in the lower troposphere at model levels at and below $\zeta = 200$ K (i.e., below about 4 km) based on measurements. Here, we use MOPITT measurements at 500 hPa, where MOPITT CO is most reliable (Deeter et al., 2004; Emmons et al., 2004). However, because of the rather wide averaging kernels of MOPITT (Fig. 1 in Deeter et al., 2004), the MOPITT values reported at 500 hPa are influenced by the CO values in a thicker layer (~ 200 – 700 hPa; 3–12 km) in the troposphere.”

Regarding the question whether some of the missing convection is implicit in the initialisation, we would like to point out that there is only limited information of CO from 200 hPa included in the MOPITT measurements at 500 hPa (see Fig. 1 in Deeter et al., 2004). More important however, is that any information on CO in the model initialisation is only present at $\zeta = 200$ K and below. Therefore, there cannot be ‘implicit convection’ at higher altitudes in the model. Finally, Fig. 1 in the paper shows the scale at which CO variability can be implemented in this version of CLaMS; we have pointed out this point clearly now:

“The spatial resolution of MOPITT and the processing described above allows some of the spatial variability of CO to be captured, albeit not at the scale of smaller scale convective events (Fig. 1). Further, due to the averaging procedure, the high and low extremes in CO in the measurements will be smoothed.”

The other point is on Page 21, last line. You say that pdfs cluster around

the 1:1 line. For me it looks that the pdf peaks below the 1:1 line, although not far below. This might be due to the reported underestimation of the effects of convection and you could simply state this without making the paper weaker.

We agree with this comment and have changed the sentence accordingly: “For the lowest mixing ratios of CO, below about 50 ppbv, the maximum values of the PDFs cluster close to, but somewhat below, the 1 : 1 line, indicating that simulated CO values are slightly lower than observed values under these conditions.”

Please also correct the following technical errors:

Page 2, l. 23. *The two statements are contradicting each other, "good agreement with observations" and "too rapid upwelling". Please insert something like "however", "in spite of" or similar between the statements in order to soften the harsh contrast. We agree; we have inserted 'although'*

Page 3, l. 25: *"Annual and quasi-biennial". Thanks – has been corrected.*

Page 5 *(and several other occasions). I know that the word "validation" is very often used in our business, but I do not like it. It suggests something that does not happen. A "validated" model has simply survived a test and then it is more plausible and justified to assume that it is useful for certain applications, but it is in no way "valid". There is no truth available to test whether a model gives valid, i.e. true, answers. Please think of replacing this word here and at other locations by something more modest (e.g. tested model...).* We agree, we have changed the formulation to: "...to assess the quality of transport and chemistry simulations in this version of CLaMS". We do not use validation in the context of model tests in the paper any more . We have retained the word ‘validation’ in the context of satellite data.

Page 8, l. 22: *Plural of "aircraft" is "aircraft" not "aircrafts". Thanks – has been corrected.*

Page 15, l. 22: *(and Page 16, line 4): replace "old" with "high" or "large". The age cannot be old, although the air mass can. Okay, changed to 'high'.*

Page 17, l. 15: *"the tape head is written" is probably wrong (auf Deutsch: der Schreibkopf wird geschrieben). Perhaps you can write "the tape head is located at*

this special level". We agree; we have reformulated: "...or where, in other words, the "tape head is located".

Page 18, l. 19: *remove comma after "CO"*. done

References

- Deeter, M. N., Emmons, L. K., Edwards, D. P., and Gille, J. C.: Vertical resolution and information content of CO profiles retrieved by MOPITT, *Geophys. Res. Lett.*, 31, L15112, doi: 10.1029/2004GL020235, 2004.
- Emmons, L. K., Deeter, M. N., Gille, J. C., Edwards, D. P., Attié, J.-L., Warner, J., Ziskin, D., Francis, G., Khattatov, B., Yudin, V., Lamarque, L.-F., Ho, S.-P., Mao, D., Chen, J. S., Drummond, J., Novelli, P., Sachse, G., Coffey, M. T., Hannigan, J. W., Gerbig, C., Kawakami, S., Kondo, Y., Takegawa, N., Schlager, H., Baehr, J., and Ziereis, H.: Validation of Measurements of Pollution in the Troposphere (MOPITT) CO retrievals with aircraft in situ profiles, *J. Geophys. Res.*, 109, D03309, doi: 10.1029/2003JD004101, 2004.