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Atmospheric Chemistry and Physics Discussions

Interactive comment on "The impact of biomass burning on upper tropospheric carbon monoxide: A study using MOCAGE global model and IAGOS airborne data" *by* Martin Cussac et al.

Anonymous Referee #2

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This study presents analyses of carbon monoxide (CO) distributions in the upper troposphere and lower stratosphere in connection with its sources over different regions using the global chemistry transport model, MOCAGE and also SOFT-IO, which calculates Lagrangian backward trajectory of the air parcels. The surface emissions inventory used in this study is GFAS and the model results are compared with the comprehensive airborne measurements obtained from IAGOS. My main comment is about the motivation and background of this study. Why is CO important in the upper troposphere? Has there been an issue with the injection height in global chemistry transport models in general? I believe improving the goals and motivations of this study will improve the quality of the manuscript significantly.

General Comments:

1. Motivation and expectation - It would be nice to see the plume injection height has been an issue in representation of CO in the global chemistry transport model, which can provide strong motivation for this work. 2. It is important to discuss the importance of UTLS CO. Why do you want to look at UTLS? Importance of UTLS CO distribution? CO in the UTLS must depend not only the emissions but also the convection in the model. 3. Results - GFAS plume rise parameters do not improve the simulation significantly. Does this mean the plume injection height is not important in general? Focus on the case where injection height makes difference instead of presenting all the cases. 4. Writing can be improved. Some of the detailed comments are provided below.

Specific Comments:

P1, L13 - This was done by comparing simulations 'were' -> Could this be 'with' instead?

P2, L12 - hydroxyl (OH) radicals -> hydroxyl radical (OH)

P2, L15 - CO can also be a way to discriminate air from the troposphere and the stratosphere, since it is only found in very low amount above the tropopause. -> This is somewhat misleading. CO decreases rapidly right above the tropopause and increases due to chemical production (For example, see Fig. 9 of Schoeberl et al., 2008JGR).

P2, L17 - transported up to the -> transported in to the

P2, L19 - thanks to deep convection -> due to deep convection

P3, L3-4 - . . .the sensibility to the injection of CO from biomass burning. . . -> This sentence is not complete. Please consider revising.

P3, L5-7 – The reference (Deeter et al., 2013) is more appropriate for the MOPITT data. Either use MOPITT instead of IASI as an example or revise the sentence here.

P3, L10 – air planes –> airplanes

P3, L14-16 – I recommend revising this sentence for clarity. For instance, what does 'source appointment' mean?

P3, L17 – discriminate sources of CO anomalies encountered by the aircraft -> identify. . .the aircraft measurements?

P3, L22 – It would be helpful to include why considering plume injection height matters here in addition to the citation.

P4, L18 - Carbon monoxide measurements begun -> were begun

P5, Figure 1 – A description of Figure 1 should be included in the text.

P5, L3-4 – The complete method. . .features. -> The complete description of the method can be found in Sauvage et al. (2017). Here is the summary of its main features.

P5, L5-L9 – References for FLEXPART, ECMWF and MACCcity should be included here.

P5, L13 – attribute to

P6, Figure 3 – It should be mentioned how the CO_anomaly is calculated and what it represents here. Does it represent one plume? Why is it called anomaly?

P7, L1 – Does 'superior' mean anything larger than the anthropogenic sources even if the difference is very small?

P7, Table 1 – Are those 6 regions chosen as they have the largest numbers of plumes out of 14? It has to be mentioned in the text.

P8, L11 – What does 'impact of climate' refer to? Is this a current climate or change for the future?

P8, L20 – important fires -> fires

P8, L21 – Here a different study. . .exploring -> Our study explores

P8, L24 – taken here from – taken from

P9, L3-4 – References for GFAS and MODIS should be included.

P9, L13 – I think the injection height not only depends on the latitudes but the kinds of fires, e.g., forest fires, bush fires and etc.

P15, L5 – carbon monoxyde –> carbon monoxide

P16, Figures 10 & 11 – I don't think the differences between the Figs. 10 & 11 are significant. Either including one of them or emphasize the differences.

P20, Figure 13 – Here, results from the MOCAGE INJH runs are compared with IAGOS data. I am curious how MOCAGE BASE would look like.

P21, L6 – Around the equator -> Near the equator P21, L18-19 – and transport. . .troposphere. -> Needs a reference for this statement.

P23, L10-12 – Needs citation here.

P24, L8-10 – I would like to see the examples of contribution from the biomass burning is poorly represented in the UTLS to make this as a strong case.

Full names for all the acronyms should be provided in the manuscript. So, please double check.

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