

Interactive comment on “Improved method for linear carbon monoxide simulation and source attribution in atmospheric chemistry models illustrated using GEOS-Chem v9” by Jenny A. Fisher et al.

Anonymous Referee #1

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The manuscript implemented a major improvement to the representation of secondary CO production in the CO-only simulation. The improved CO-only simulation resolves the discrepancy between the full chemistry and CO-only simulations in both the magnitude and spatial distribution. It also includes a new capability of source-region tagging of secondary CO produced from oxidation of non-methane volatile organic compounds. These two improvements help us get a better understanding on CO sources and transport over the remote regions. In general, I found the main points and the structure of this manuscripts are clear. But some of discussions are weak and unclear. Below are

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my comments for making the manuscript more concise. I recommended the paper to be published with revision.

Main comments:

Section 4: global evaluation with observations

I understand that the observational data used in this paper is the same data used to benchmark new version of the full GEOS-Chem model. However, it is not proper of using observed climatology to justify model improvements in reference to the original simulation and the standard chemistry simulation. The observed climatology is normally used to do an initial sanity check of simulated mean and seasonality. The authors argue that Figure 4 does not help illustrating the improvements of the new scheme because of the larger observation-model mismatch. To me, the failure of figure 4 is also partly because we are referencing orange to apple. The results would be convincing if the authors compare monthly mean of simulated CO in 2009 to that of GMD surface CO over the same year. What is the measurement frequency for GMD surface CO? The authors should also plot the continuous monthly mean of model output as well as the mean calculated from dates with GMD measurements.

The comparison would probably not change significantly using the observed monthly mean from 2009, but at least that gives us a quantity evaluation of CO simulation in GEOS-Chem full chemistry run and CO-only run.

Please modify Figure 4 as follows:

- 1) The title should be surface CO instead of CO vertical profiles.
- 2) The lon and lat of Crozet should be: (-46, 52). Please double check whether this is just a typo in the caption, or extracted from the wrong grid box (-46, -52).
- 3) It is hard to distinguish the blue and purple lines. please use another color, dark green?

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4) Use the monthly mean and standard deviation of GMD surface CO data for 2009 as discussed above.

In addition, I suggest the authors use specific names (instead of original or improved CO-only simulation) for these two versions of CO-only simulation.

Detailed comments:

P4 Line 3: We use the GEOS Chem CTM version 9-01-03 as the based version.

P4 Line 6: Goddard Earth Observing System, Version 5

P6 Line 11: It is not surprise to see the total CO in improved CO-only simulation improves significantly when comparing to the full chemistry CO simulation, since the P(CO) are same in these two runs.

P7, Line 19: China and India also show large overestimate in the surface in the original CO-only run. What causes that?

P7, Line23: For the remote region: dose CO from NMVOC represent 1) CO produced locally through NMVOC transported from source region or 2) transported CO from source region which was produced there or 3) a combination of them?

P7 line 31: similar overestimates seen over Tibetan Plateau, probably related to the deep convection storms in summer time

P11, line 2: largest differences between two CO-only simulations

P11 Lin32: Not sure if it is necessary to discuss the comparison with IASI here.

P12 Figure 4 caption: specify the year range of multi-year monthly mean

P15 Figure 6: For overlapping period, the light purple and dark purple circles look same to me.

P16 Line 7-8: Can you be more specific on the NMVOCs setting in these two version runs? I understand how CO from NMVOCs emitted by biomass burning or anthro-

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pogenic emission is in the NMVOCs contribution in the new scheme. But I am confused with the setting of these sources in the old scheme.

P18 Figure 8: adding labels for the locations of three stations in Figure 7.

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