Geoscientific Model Development Discussions

Geosci. Model Dev. Discuss., referee comment RC2
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Comment on gmd-2021-173

Anonymous Referee #2

Referee comment on "An improved carbon greenhouse gas simulation in GEOS-Chem version 12.1.1" by Beata Bukosa et al., Geosci. Model Dev. Discuss., https://doi.org/10.5194/gmd-2021-173-RC2, 2021

Review of "An improved carbon greenhouse gas simulation in GEOS-Chem version 12.1.1" by Beata Bukosa et al.

This paper simulated CO2, and CO2 production by oxidation of CH4 and CO using 3 different types of OH fields. The topic of research is important for better estimation of CO2 sources and sinks on the Earth's surface. The distribution of OH is heavily concentrated over the tropical region, where CO2 would be added to the atmospheric CO2 due to oxidation of CO and CH4. If ignored this CO2 chemical production, biased source of CO2 is needed from the tropical land and ocean regions by inverse modelling. I very much liked the idea of this research, but unfortunately wasn't able to read through the whole manuscript due to poor execution of the research idea, in my opinion. Thus I cannot recommend publication of this work in Geoscientific Model Development in the present form or anything close to this. It is better to rerun the model and submit a newly prepared manuscript.

Here are some of my major concerns:

Table 1: For eaxmple, "Coupled only" : I do not understand - are all CO are produced from CH4 oxidation ? If so you are going to underestimate CO. If not, is CO in L(CO) and P(CO)ch4 are different entities, then there is a good chance of double counting

Formulation of Eq. 1 & 2 (also for CO): Not correct !!, I think Eq. 1 and Eq. 2 are not separable in a chemistry-transport model, except for “tagging”. Please clarify or rectify errors

Figure 2: Quite large differences in OH. Acceptable? May be you should run CH3CCl3

tracer of checking your OH.

Figure 5 (left column): the P(CO)ch4 and P(CO2) are apparently not consistent with the OH fields in Figure 2.

This where I had to stop going forward or read the text carefully. I am extremely sorry, but this has to be solved first before interpreting the results.
You have about 20% higher OH for the red and purple lines, compared to blue, both at the surface and at 500 mb when averaged over a year (Fig. 2).
But here in Fig. 5, we find the blue line is close to purple than the red line for P(CO2), and also I cannot explain the relative values of P(CO)ch4 as expected from the OH fields.
I understand that the OH level is affecting the concentrations of CO and CH4 and then you get very mixed pictures for P(CO) or P(CO2). But these are not realistic, because we only have one state of CO and CH4 concentration distributions (strictly).
If you are checking the effect of OH then design experiments accordingly, and so on.
Please consider.