Atmos. Chem. Phys. Discuss.,
https://doi.org/10.5194/acp-2018-150-RC1, 2018

Atmospheric Chemistry and Physics Discussions

Interactive comment on "Forecasting Carbon Monoxide on a Global Scale for the ATom-1 Aircraft Mission: Insights from Airborne and Satellite Observations and Modeling" *by* Sarah A. Strode et al.

Anonymous Referee #1

Received and published: 18 April 2018

The authors use the GEOS-5 chemical forecast system to simulate the CO distribution and the timing of CO enhancements observed during the Atom-1 aircraft mission in July-August 2016, using tagged CO tracers to attribute modelled CO to non-biomass burning and biomass burning (BB) sources from different regions. The authors also use multi-year satellite measurements (MOPITT and MODIS) of CO and AOD to verify if August 2016 is representative of typical boreal summer conditions. One of the goals of Atom is to derive a chemical climatology over the ocean. The paper is well written and the authors have conveyed their results and findings clearly. The methods used

to derive the results are sound and thorough. I recommend this paper to be published with some clarification and improvements, detailed below.

Specific comments

1. My major concern is that the authors combined BB emissions from Europe and from Northern Asia into one tagged CO tracer, which I think leads to difficult attributions of the simulated North Atlantic CO to emissions in these two regions. One would suspect that European BB emissions have a more direct impact on North Atlantic CO peaks than the Asian BB emissions. Moreover, the text seems to imply that BB emissions from Southern Asia and Australia are not included in the simulation, which might lead to the underestimation of simulated South Pacific CO peaks.

2. Can you add to the map showing the Atom flight route the names of locations mentioned in the text and the labels of flight numbers?

3. L116-118: How do you justify adding 20% fossil fuel and 11% BB to CO emissions? What is the basis, and do you have a reference for the scaling factors? Please also show the effective CO total emissions, after scaling, in Table 1.

4. L119-120: Which regions? Methane is well-mixed, and is oxidised in all regions. Could you clarify?

5. L152-154: Could you elaborate why the observed peaks in Figure 1d are not captured by the GEOS-5 analysis? Could it be due to the underestimation of Asian BB or/and non-BB in the inventory?

6. Did you include biomass burning from South Asia and Australia in your CO simulation? If these are not included, would this lead to the underestimation of the peaks in observed CO in Figure 1f? This is related to the comment above.

7. L194-196: It is somewhat surprising that this region has notable Asian non-BB influence; could it be the case that the majority of this influence originates from Europe or Central Asia rather than from the Far East?

8. L197-198 and Figure 2f: Would it more precise to attribute the observed CO plumes here to European BB? Could N. American BB contribute to the plumes? Separating European and Asian BB emissions could shed more light on this.

9. L212-213: “An underestimate of Eurasian biomass burning contributes to the model underestimates in the North Pacific and North Atlantic, . . .” – same comment as above.

10. Figures 5 and 6: I suggest to use the same scale between the 2 panels in each figure.

11. L364-369: The negative trends are not necessarily associated with the lower than average value of 2016. Often, IAV is larger than the trend. Whether 2016 is extreme or not should be defined based on statistical metrics.

Technical corrections

1. L22: add “boreal” before “summer”

2. L293: replace “summer” with “boreal summer/austral winter”

3. L335: replace “autumn” with “September to November”

4. Figure 8: please tidy up the label on the x-axis.

5. Figures 11 and 12: please add “August” in the caption.

6. Table S1: flights are labelled from 0 to 10 – should it be 1-11?

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