

Interactive comment on “Global-scale combustion sources of organic aerosols: Sensitivity to formation and removal mechanisms” by Alexandra P. Tsimpidi et al.

Anonymous Referee #1

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Tsimpidi et al. quantify the global-scale contributions of combustion emissions to organic aerosols using a global model. Rather than a single value, the authors provide a range utilizing various inputs and parameters reported in the literature for modeling organic aerosols. Those sensitivities include variation in emissions (volatility of emissions, high estimates of IVOCs, an alternative POA emission inventory) alternative OA aging schemes, and alternative OA solubility parameters. The authors then compare results from the various sensitivity simulations against AMS measurements at rural locations.

The paper is generally well written and the analysis robust. I recommend the paper for publication but first would like to see a few clarifications and additional points listed

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below discussed.

General Comments:

In recognizing there is a computational expense in a more explicit parameterization, are there benefits to utilizing different chemistry/aging schemes for anthropogenic and biogenic OA (e.g. Koo et al., 2014)?

Specific Comments:

There appears to be some inconsistency as to how the authors define IVOCs. On line 153, IVOCs are defined as having a C^* between 10^4 and $10^6 \mu\text{g m}^{-3}$. But on line 188-190, when discussing biomass burning emissions, the authors state:

“Biomass burning emissions are assumed to cover a range of volatilities from 10^{-2} to 10^4 (May et al., 2013a), therefore, no IVOC emissions are assumed from biomass burning sources. . .”

Then, in the low volatility simulations, emissions of IVOCs are assumed to be zero. However, biogenic emissions in the reference simulation, which includes 10^4 emissions, and the low volatility simulation are identical (28.4 Tg yr^{-1}).

In the low volatility simulations, how are the emissions from the 10^4 bin that are not considered IVOCs redistributed to the lower bins? e.g. Total biogenic emissions are identical in the reference and low volatility simulations.

Line 219 and 220: The wording here makes it sound as if only emissions in the 10^4 and 10^6 bins are being increased by a factor of 1.5. Instead, I would recommend rewording this sentence to provide clarity. For example “increased by an additional factor of 1.5 times the POA emissions and then distributed in the volatility bins. . .”. Also, how are they distributed, equally in the 10^4 and 10^6 bins? I’d also suggest making it more clear the total emissions in this case, that total anthropogenic emissions are 4x the POA inventory (1x L/SVOCs and 3x IVOCs) and biogenic emissions are 2.5x the

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POA inventory (1x L/SVOCs and 1.5x IVOCs).

What is the reasoning to perform a model simulation with added IVOC emissions (C^* of 10^6) from biomass burning if measurements only support emissions up to a C^* of 10^4 ?

Line 448-451: Underestimates of IVOCs could be one cause of underpredictions, but could it also be other factors like uncertainty in yields (e.g. wall loss) or other missing precursors and/or pathways?

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