

***Interactive comment on “How much does traffic contribute to benzene and PAH air pollution? Results from a high-resolution North American air quality model centered on Toronto, Canada” by Cynthia H. Whaley et al.***

**Anonymous Referee #1**

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General comments:

This paper summarizes a study in which the finely resolved (2.5x2.5 km) GEM-MACH-PAH model was employed to investigate contributions of motor vehicles to benzene and several PAHs in ambient air across northeastern North America. I found this paper to be a significant contribution to the field and of scientific merit, and had relatively few critical comments. I was particularly interested in the combined effects of removing benzene/PAHs at the same time as removing air quality criteria pollutants (precursors of compounds that degrade benzene/PAHs), and the differences in these effects in ru-

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ral versus urban locations. The study addresses several interesting questions on a very fine spatial scale, including: -How much do vehicles contribute to ambient benzene and PAH concentrations, and how does that differ between the warm and cold seasons and across urban versus rural locations? -How do reductions in vehicle emissions play out in actual ambient concentrations? -What are the combined impacts of removing benzene/PAH oxidant precursors and benzene/PAH emissions themselves on ambient benzene/PAH concentrations? -How does particulate fractioning respond when all vehicular emissions are removed? -How do benzene/PAHs respond in general to changes in oxidant concentrations? -How sensitive is the model to doubling and halving vehicular emissions? -How does human health risk change when vehicular emissions are removed?

Specific comments:

Line 121: Can examples of “off-road mobile sources” be provided?

Line 135: It would be helpful to have “close to unity” qualified so readers don’t have to dig back through the previous Whaley paper. Plus or minus what on average?

Line 155: Lower temperatures also increase partitioning to particles for PAHs. Does the decrease in degradation rates and decrease in dilution outweigh these effects?

Line 180-ish: It was mentioned in the intro that the adoption of ZEVs was encouraged in a variety of jurisdictions. Are there differences in this “encouragement” between US and Canadian cities that could also account for the higher contributions from on-road vehicles in US cities?

Figure S2. Is there a particular reason why the BENZ and BaP fall-winter plots are not shown? It would be handy to be able to compare seasonally for all four species chosen, or have an explanation as to why they are not shown. It is mentioned in the conclusions that future work aims to improve model representation of wintertime benzene and BaP, but (unless I missed it) I couldn’t find a discussion about why their representation wasn’t

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acceptable.

Lines 189-192: Would be helpful to quantify, based on model results, how much lower concentrations would need to go to reach these criteria, and whether the complete removal of on-road vehicle sources reverses exceedances, or if additional sources would need to be removed (hard to tease out from the plots).

Line 235: This is probably discussed in previous papers, but would be handy to have a clarification here: BaP is the ONLY PAH to react with O<sub>3</sub> on particles, even though partitioning to particles takes place for the other PAHs as well? Given the changes in O<sub>3</sub> in rural and urban areas and the impact on BaP in the “no mobile” case, can the authors comment on how including O<sub>3</sub> particle-phase oxidation for the other PAHs might impact their reductions? Would it be similar? How would the combination of changing OH and O<sub>3</sub> concentrations play out for semi-volatile species? If it's easy to test this, I suggest adding it to the study.

Sensitivity to oxidant experiments shown in the Supporting Info: This is a very interesting section of the paper and it's too bad it can't be highlighted in the main text. I think it would be helpful if the authors put a section in the methods that describe how the sensitivity analyses were conducted for making the S5 and S6 plots.

Technical Corrections:

The placement of the parentheses in the very first line of the Introduction (lines 29-31) makes the sentence difficult to read. I think it would help to have another descriptor after “air quality”, like “degradation”, or “problems”.

Line 124: Again, parentheses are oddly placed. I suspect automated citation management software was used, so suggest combing back through the paper and removing those interrupting parentheses.

Line 165: Should be “show” instead of “shows”

Line 183: Put a “to” between “concentrations” and “increase”.

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Line 339: Should it read “91% PAH” instead of “91% PHEN”?

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