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Comment on acp-2022-130

Anonymous Referee #2

Referee comment on "Oxygenated volatile organic compounds (VOCs) as significant but varied contributors to VOC emissions from vehicles" by Sihang Wang et al., Atmos. Chem. Phys. Discuss., https://doi.org/10.5194/acp-2022-130-RC2, 2022

Wang et al. present an analysis of VOC emissions measured from vehicle dynamometer testing for vehicles designed under different emission standards (China I - IV). The authors evaluate total and speciated VOC emissions from both gasoline, diesel, and LPG under a variety of conditions (cold start, warm start, speed, etc). The authors detail the different emission factors between each vehicle, and observe a distinct difference between the OVOCs emitted by gasoline and diesel engines. The latter produces significantly higher fraction of OVOCs than by gasoline, which appears to be at least partly associated with the pollution control technology.

I found the paper to be very well-written, well-reasoned, and full of good information. I appreciated the study as a nice piece of work describing fossil fuel emissions from motor vehicles in China.

My only substantive comment is that I don't have a sense of the fuel composition and how this might contribute to the high OVOCs observed in diesel exhaust. And how do the OVOC emissions compare against diesel exhaust studies reported elsewhere? Gentner et al. (2013) also see elevated OVOC emissions in diesel compared to gasoline. Are these differences comparable to what is observed here, or is there something different between the aftertreatment or fuels that could contribute to any differences?

Comments:

Line 70 - 71 Based on the reference, I presume that the authors are specifically noting the decline of VOCs in urban regions in China? For clarity, I would suggest re-writing this sentence to say "Furthermore, VOC emission significantly decreased in China due to stricter emission standards."

Line 76: Could the authors provide some context on the China VI emission standard? I recognize that the standard is dependent on power ranges, but a few sentences on VOC emissions at max power output would be useful. This would also be useful in the methods (lines 112 - 122) to give readers context as to what the China I - IV standards represent in terms of VOC emissions.

Line 81: Would suggest modifying "group" to say "class of compounds"

Line 80 - 83: Are the authors primarily discussing VOC measurements from dynamometer studies, or tunnel studies, or ambient studies? I think the distinction matters given that results from laboratory, tunnel, or ambient measurements can be interpreted differently given differences in co-emitted sources that can convolute the measured signal from tailpipe emissions

Lines 268 - 271: Are there also differences in the aftertreatment that might lead to higher OVOC emissions? The authors note the temperature of the device at line 240, and I'm curious if previous work has looked at VOC speciation under different aftertreatment conditions.

Figure 1: It would be useful to see the acronyms (LDDT, MDDT, HDDT, and BUS) defined in the caption as a reminder to the reader.

Title of Section 3.2: The title doesn't quite reflect the discussion that follows. Might I suggest "Analysis of PTR-ToF-MS mass spectra to evaluate VOC speciation"?

Lines 320 -323: This is a nice result, and partially addresses my question at lines 268-271. Could the authors point to this figure and discussion to demonstrate that the changes to the VOC distribution isn't significantly different between cold start and normal operation?

Lines 424 - 425 : I like the discussion in this section on using the aromatics to delineate between diesel and gasoline. I agree with the authors that these ratios might be difficult to assess in the ambient owing to additional sources of aromatics (e.g. solvent emissions) and secondary production of formaldehyde and acetaldehyde. Are there any unique masses, with high enough signal in ambient air, that could be used to more definitively separate gasoline vs diesel emissions? I also wonder if ratios to CO or other combustion markers might be insightful.

Figure S6. The intercomparisons are nice for the fast time-resolution systems, but there are significant differences between the GC and PTR for toluene - is this due to differences

in sampling techniques (e.g., grab sampling artifacts vs real-time sampling), or something due to fragmentation in the PTR to produce a signal at m/z 93? I believe the other reviewer also commented on this, and I agree that some explanation is warranted here.