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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Secondary organic aerosol production from diesel vehicle exhaust: impact of aftertreatment, fuel chemistry and driving cycle" *by* T. D. Gordon et al.

Anonymous Referee #1

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Gordon et al., present data from smog chamber experiments investigating the SOA formation from the photo-oxidation of dilute emissions from medium and heavy duty diesel vehicles. The study focussed on the role of after-treatment technologies (including DPFs, SCRs and DOC), and investigated the effect of different types of fuels on SOA formation. An attempt to estimate an effective SOA formation potential of emissions from a heavy duty diesel vehicle has also been made. The manuscript contains good data, which was obtained using an array of well-established methods and techniques. Overall the manuscript is suitable for publication in ACP provided that the authors address the following comments.

General comment: My main concern with the manuscript is related to the difficulty in separating the influence of any of the after-treatment technologies on the emissions and SOA formation characteristics from the variability caused by using different vehicles with different engines and histories. The authors have not really emphasis this point enough in the manuscript and should do so in the revised manuscript. How much of the observed differences are due to the after-treatment technologies employed and how much is due to the variability of emissions and composition among the chosen vehicles.

Specific comments: Page 24231, lines 12-14: Was the dilution air used for the first stage of dilution also filtered for gaseous impurities (i.e. VOCs)? It seems that an activated charcoal filter was not used for this stage of dilution. If so, what effect did this have on your experimental results? Page 24231, line 25: more details of on the UV lights should be provided: what was the overall intensity of the used lights? what was there spectral characteristics including JNO2 and JO1D values? Page 24231, line 25: It is mentioned that up to 4ppm of propene was used to adjust the VOC:NOx ratios in the experiments. A comment on the possible effect of including this large amount of propene on the results of the experiments should be added (also page 24233, lines 1-5) Page 24231, lines 25-26: No rationale or comments were made on why UV lights were used for the MDDV experiments while sun light was used for the HDDV ones? Was this determined by availability of space or was it motivated by a different factor? Was the intensity of light characterised in the HDDV experiments? Page 24232, line 13: Was this variability in T and RH within each experiment or was it between different experiments? Please clarify. Page 24233, line 14: This assumes complete combustion of the fuel. The authors made a statement that this is a robust assumption without verifying their claim. Do the CO and CO2 data verify this assumption? Page 24233, line 19-20: How high were the OH levels at the start of the experiments? Page 24234, line 16-20 (and supplementary material): The discrepancy between the SMPS and AMS mass measurements was attributed to the AMS. No quantitative discussion was provided for the assumptions about particle shape and density made for the SMPS mass

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calculation. Scaling the AMS mass data to the SMPS surely introduces an error in the mass estimation that should be discussed as it has an impact on the results presented in the main manuscript. Page 24235, line 7: what is meant by highly uncertain? Is this due to lack of measurements of the different VOCs or is it due to their wall loss characterisation? Matsunaga and Ziemann (2010) showed that this could be significant for larger VOCs. The authors should clarify their statement in this regard? Page 24235, line 12: It could also be caused by the lack of activated charcoal filtration of the CVS air. See related comment above. Page 24237, line 11: Are there any diagnostics or reference measurements that could be used to determine the state of the DOC during the experiments (whether it was malfunctioning or not)? On the other hand, the comparison between D4.1 and D5.3 should not be expected to tell us anything conclusive about the role of DOC in reducing the emissions of VOCs given that the two cars are of different age and engine characteristics. Could the analysis of the gas phase samples from the CVS help identify any potential differences in composition? This is partly included in Figure 4b but not discussed in this part of the manuscript.

Minor corrections: Page 24237, line 12: change “due differences” to “due to differences”

Interactive comment on Atmos. Chem. Phys. Discuss., 13, 24223, 2013.