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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Comparison of emission ratios from on-road sources using a mobilelaboratory under various driving and operational sampling modes" *by* et al.

et al.

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The authors would like to thank the referee for the comments, which helped to improve the manuscript. Below are the descriptions of the changes made in the manuscript according to the reviewer's suggestions.

The authors report the results of mobile laboratory-based sampling of on-road motor vehicle emissions in Mexicali (in Mexico near the California border) and Austin, Texas. These results are compared with previous measurements of vehicle emissions from Mexico City made by the same investigators. A strong point of the paper is the use of advanced instrumentation to measure a long list of important pollutants, some of which have not been extensively studied previously.

It would be preferable to report the results as emission factors rather than pollutant ratios to CO2 as these authors have done. Related recent papers on this topic are reporting emission rates as mg or g of pollutant emitted per kg of fuel burned (see Imhof et al ACP 2006; Burgard et al ES&T 2006; Grieshop et al Atmos Environ 2006; Bishop and Stedman ES&T 2008; Ban-Weiss et al Atmos Environ 2008). Reporting in consistent units will facilitate comparisons with other studies. Though the CO contribution to total carbon in exhaust is not large on average, ignoring CO emissions and just using ratios to CO2 in the emission factor calculation will lead to systematic high bias. This could be especially problematic for the high-emitting gasoline engines that have high CO levels in their exhaust.

[Response] Thanks for this suggestion, we have transformed the units of the reported emission ratios in Table 1 from ppb/ppb-CO2 to grams of pollutant by kilogram of fuel to allow an easier comparison with other studies. The comparisons show that CO and NO emission factors measured in Mexicali (60-147 g/kg and 2.7-13.7 g/kg, respectively) are within the ranges of measurements of the late 1990s in U.S. cities but smaller than those measured in Mexico City and Monterrey in the early 1990s. It is true that ignoring CO in the total carbon exhaust may result in a systematic bias. We point this assumption in the paper and note that measured emissions levels of exhaust plume CO and VOCs are small compared to the levels of emitted CO2 (i.e. generally >90% of fuel carbon is emitted as CO2).

The various operational modes of the mobile lab used in this study provide different information about vehicle emissions: fleet-average results, individual vehicle plume snapshots in roadside mode, and information on variability for a single vehicle while operating in chase mode. The sample sizes acquired in the roadside sampling mode do not appear to be large enough to characterize the distributions of emissions 8211; it would require at least several hundred vehicle sample to accomplish that objective.

[Response] The points made by the reviewer are correct: roadside stationary sampling and individual -dedicated- chasing experiments are not large enough to charac-

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terize the distribution of emissions. We have clarified this in the paper and noted that these measurements can still be useful for understanding the emission characteristics of various types of vehicles but not for fleet average emissions determinations. During the fleet-average sampling mode; however, the plume-by-plume analysis technique used with the mobile laboratory allows capturing information on thousands of individual plumes. When the analysis is done according to the criteria described in the paper, information on fleet average characteristics can be obtained.

The point of comparing vehicle emissions among various locations is unclear. Why would one expect Mexico City and Mexicali vehicle emissions to differ? Why is this important to study? (p 8064, line 7-8). The authors wait until much later in the paper (p 8076, line 14) to acknowledge altitude effects on emissions may be an important factor. The altitude of Mexico City should be stated. The reader is left wondering whether (a) the differences between locations are statistically significant, (b) the differences are due to altitude effects, vehicle fleet differences, or other causes. From the data available, it does not seem possible to separate different contributing effects.

[Response] The characteristics of the vehicle fleet in the Mexican cities are very different, particularly in the age of the fleet (older for Mexicali). It was not possible to find information on the fraction of vehicles with catalytic converters in Mexicali but it is presumably higher than in Mexico City. This is consistent with our results, where the comparison of fuel-based emission factors in both cities shows that these are significantly higher in Mexicali than in Mexico City and certainly much higher than current U.S. cities. We have now included a more thorough discussion of the possible effects of external factors, including ambient conditions and altitude, in the comparison of our results. Ambient conditions between the two cities are not large enough to explain the observed differences.

Minor/Editorial comments: Table 2: it is difficult to know what to make of these numbers as the populations and amount of vehicle activity are different in each region. I recommend presenting the emission factors rather than emissions. It seems the fuel

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use was rather uncertain for Mexicali, so presenting the emission factors rather than tons/day emissions might be more definitive and insightful in terms of comparisons.

[Response] The information in the table has been kept in emissions units as a way to present our estimates of mobile emissions in Mexicali, for which there are no previously reported measurement-based mobile emissions estimations. The table has been modified to present population and vehicle fleet size of the cities. The resulting comparison indicates that on a vehicle-per-vehicle basis the fleet in Mexicali is 1.4 to 2 times more polluting, probably due to difference in the fleet age. We have removed the information about San Diego as this added little value.

At p 8072, line 1, why are fuel N emissions mentioned in the context of vehicle emissions? The nitrogen content of gasoline and diesel fuel is of negligible importance for NOx emissions from on-road vehicles.

[Response] The statement didn8217;t mean to imply that fuel-N is important for determining NOx emissions from on-road vehicles, but we agree that it may add confusion to this respect so we have removed it.

Repetitive text appears on p 8061 (lines 10-12, lines 14-15), p 8063 (lines 21-22), p8077 (lines 25-26). The verbatim reuse of the same text should be removed when the paper is revised.

[Response] We have removed the unnecessary use of repetitive text.

*P 8059, there is a typo in affiliation 1: Molina Center for *the* Energy and the Environment*

[Response] Thanks for catching the typo.

At line 24 on p 8068, the anticorrelation between CO and NOx is not apparent in Figure 2 as claimed, because of the way the axes were selected in this figure 8211; CO and NOx emission ratios were not plotted against one another.

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[Response] It is true that due to the selected axis the anti-correlation between CO and NOx is not apparent. The text has been modified accordingly. The figure shows the co-emission nature and variability of various pollutants for a given vehicle type (gasoline versus diesel) from individual vehicles sampled in stationary measurement mode.

At line 26 on p 8069, 56 m/hr should be km/hr

[Response] Thanks, this has been corrected.

At line 8 on p 8073, a reference is needed for the statement that fuel-based HC emissions increase with high-load engine operation.

[Response] We have added Kean et al., (2003) as a reference to this statement.

At line 9 on p 8081, cited author surnames have spurious "a" following Wang, Chan, Cheung, and Leung.

[Response] Thanks for catching this typo.

Interactive comment on Atmos. Chem. Phys. Discuss., 8, 8059, 2008.