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Interactive comment on "Modeled and observed ozone sensitivity to mobile-source emissions in Mexico City" *by* M. Zavala et al.

M. Zavala et al.

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The authors would like to thank the reviewer for helpful comments and suggestions. Our response to the comments and appropriate changes made in the paper are presented below:

This paper analyzes the trend of air pollutants in Mexico City between 1990 and 2005, and discusses the impact of surface emissions on the trend of ozone. The paper is well written and organized. The paper discusses an important scientific issue regarding air pollution control strategy in large polluted cities. As a result, this paper has scientific merits to be published in ACP. I suggest publishing this paper after some revisions.

Comments (1) In section 2.3, it said that the NOx emission factors do not show any strong trend. However, the measurement of NOx emission factors is only available

between 2000 and 2005. During this period, the trend of CO emission factors is also small. The only strong trend of CO emission factors occurs between 1990 and 2000. This statement is somewhat misleading, and should be revised.

[Response] We have stated in the paper that because there were no fleet-average NOx emission measurements available prior to 2000; it is possible that there are simply not sufficient measurements in the time span of Fig. 4c to observe any trend in NOx emissions. However, other pieces of information that we use to asses changes in NOx emissions in the studied time period are: 1) analysis of the long-term NOx ambient levels, and 2) trends in the early morning CO/NOx ratios. For the first point, Fig. 2 shows that the variability of the mean NOx concentration profiles in recent years is not different from the early years (the opposite being observed for CO), suggesting that the balance between sources and sinks of NOx has not changed significantly over this period. For the second point, Fig 4d indicates that the decrease in the CO/NOx ratio (of about 4.6) has been mainly the result of reductions in CO.

(2) From Table 1, it shows that the automobile emission factors for CO and NOx are large (99.3% and 83.8). It needs more clearly discussion why CO is dramatically decreased between 1990 and 2005, while NOx only has a minor change during this period. This can be a very important point of the paper for the application in air pollutant control strategy.

[Response] Although it is not the main purpose of the paper, we have listed some possible explanations for the different decreases of CO and NOx emissions. Here we list them and explain them in more detail:

1) One possibility is that vehicle technology has apparently been more effective in

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controlling CO and HC than NOx levels in the MCMA. Vehicle technology is directed by the establishment of emission standards. The first emission standards, particularly during the 90s, for new vehicles in the MCMA were focused on aggressively reducing HCs and CO as compared to NOx. Similarly, for in-use vehicles, in 1999 the Inspection and Maintenance (I/M) Program mandated a maximum HC limit of 300 ppm for all light-duty gasoline vehicles model year 1990 and older, with a limit of 200 ppm for 1991-1992 vehicles, and 100 ppm for 1993 and later models. The CO limit was set at 3.0 vol % for vehicles up to the 1990 model year, 2.0 % for 1991-1992 models, and 1 % for 1993 and later cars. In January 2000, for the first time in the MCMA, limits of 2500 ppm were fixed for NOx emissions for old vehicles up to 1990 model year, 1500 ppm for 1991-1992 model year, and 1200 ppm for 1993 and later models. Moreover, 1993-1995 model years were required to replace their used three-way catalyst to meet the 2000 I/M exhausts limits.

2) Different decreases in efficiency for reducing NOx than for oxidizing HC and CO emissions by catalytic converters. It is possible that emission control technologies, (i.e. catalytic converters) which are, in a way, a response respond to the implementation of emission standards, may be losing their ability to reduce NO faster than their ability to oxidize CO and HC. It is also possible that the lifetimes of catalytic converters are significantly affected by fuel quality. Shorter life of NOx emission control devices (about 5 years for catalytic converters) may help to explain the shorter cycles of increase-decrease NOx levels originated by the continuous renewal of the fleet.

3) Faster growth rates of the diesel fleet than the gasoline fleet. Since diesel vehicles, in general, are significantly higher NOx emitters than gasoline vehicles, this would imply increases of annual NOx emissions that may balance the effect of the introduction of new lower-emitting gasoline vehicles.

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(3) The authors should add some focus on what are the main factors which lead to the long-term ozone trend between 1990 and 2005. They should use the measured CO and NOx trends to show how these trends affect the ozone trend. In addition, they also should make some assumptions based on the CO measurement for the VOC trend. There are also lacks of discussions on what is the role of CO trend on the ozone trend in this paper.

[Response] We indicate [p. 14998] that CO (and NOx) levels are dominated by anthropogenic (mostly mobile) emission sources in Mexico City. As a result, the observed variability and trends of CO (and NOx) are likely to be significantly influenced by changes in the emission characteristics of mobile sources. We have further pointed out [p, 15007.19 and section 2.3] that the observed trends in ambient pollutants and normalized emission factors are related to changes in vehicle technology and the introduction of emission control devices, among others. On page 15008.4-27 we discuss the relation between CO levels and CO and HC normalized emission factors and the basis for the assumption that changes in CO levels should be accompanied by changes in HC levels.

(4) Some editorial errors need to be corrected. For example, in the caption of Figure 1, c) and d) need to be bolded.

[Response] This and other typos have been corrected.

Interactive comment on Atmos. Chem. Phys. Discuss., 8, 14991, 2008.

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