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Improving our understanding of the relationships between ozone formation and ozone precursors in Mexico City

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The gridded photochemical model CAMx was employed to investigate the sensitivity of ozone production to precursor emissions under five different meteorological conditions in the Mexico City Metropolitan Area (MCMA) during the MCMA-2006/MILAGRO field campaign, and the results were compared with the findings from MCMA-2003. Precursor emissions were constrained by routine measurements of an air quality monitoring network and the intensive field measurements during the campaign. Simulated plume mixing and transport were examined by comparing with the G-1 aircraft measurements during the MILAGRO campaign. The observed concentrations of ozone precursors and ozone were well reproduced by the model. The effects of emissions reductions on the ozone production were examined for three representative emission control scenarios. A 50% reduction in VOC emissions led to 7 to 22 ppb decrease in daily maximum ozone concentrations, while a 50% reduction in NOx emissions leads to 4 to 21 ppb increase, and 50% reductions in both NOx and VOC emission decrease the daily maximum ozone concentrations up to 10 ppb. These results along with a chemical indicator analysis using the chemical production ratios of H2O2 to HNO3 demonstrate that the MCMA urban core region is VOC-limited for all meteorological episodes, which is consistent with the results from MCMA-2003; however the degree of the VOC-limitation is higher in the MCMA-2006 due to a lower VOC/NOx emission ratio and a lower VOC reactivity. The indicator analysis also shows that ozone formation in the surrounding mountain/rural area is mostly NOx-limited, but can also be VOC-limited, and the size of the NOx-limited or VOC-limited areas varies depending on the meteorological condition.