Emission Factors of Black Carbon and Co-pollutants from Diesel Vehicles in Mexico City

Supplemental Material

This Supplemental Material document contains additional information on the instrumentation deployed during the measurement of emissions from the selected on-road vehicles as well as additional figures and tables that are discussed in the manuscript.

1. Instruments on-board the Aerodyne Mobile laboratory

Tables S1 and S2 show the characteristics of the instruments deployed by the ARI mobile laboratory and the remote sensing unit, respectively, during the on-road measurements.

Table S1. Characteristics of instruments deployed by the ARI mobile laboratory.

Instrument	Pollutants measured	Detection limit by pollutant
Quantum Cascade Tunable Infrared Laser Differential Absorption Spectrometers (QC-TILDAS)	Carbon monoxide (CO) and nitrous oxide (N_2O); ethane (C_2H_6); methane isotopes ($^{13}CH_4$ and $^{12}CH_4$), sulfur dioxide (SO_2), and acetylene (C_2H_2).	Typical detection limits are 0.1 ppbv in 1-s, each of the pollutants quantified in this work is detected in plume encounters well above the detection limit.
Proton Transfer Reaction Mass Spectrometer (PTRMS)	Oxygenates, aromatics.	Typical detection limits are 0.3 – 0.8 ppbv depending on compound in 1-s of integration time.
Soot Particle Aerosol Mass Spectrometer (SP-AMS)	70 nm – 1.5 µm aerodynamic diameter aerosol, composition resolved into black carbon; sulfate; nitrate; ammonium; chloride and organic PM.	300 ng/m^3 in 1-s integration time.
Thermo Electron 42i chemiluminescent detector	NO, NO_y	0.4 ppbv in 1-s integration time for each species.
LiCor 6262 Non-Dispersive Infrared (NDIR)	CO_2	300 ppb in 1-s integration time. Plume enhancements in excess 5 ppm were quantified.

Table S2. Characteristics of instruments deployed by the Remote Sensing (RS) unit.

Pollutants measured	Detection limit by pollutant
[1]CO_2 plume> 20%-cm	
CO [%]	±0.1 or ±10% of reading, whichever is greater
HC (as propane) ppm	±100 or ±10% of reading, whichever is greater
NO [ppm]	±150 or ±10% of reading, whichever is greater
Smoke number[2]	±0.05 or ±10% of reading, whichever is greater
[1]CO_2 plume< 20%-cm	
CO [%]	±0.15 or ±15% of reading, whichever is greater
HC (as propane) ppm	±150 or ±15% of reading, whichever is greater
NO [ppm]	±225 or ±15% of reading, whichever is greater
Smoke number[2]	±0.1 or ±15% of reading, whichever is greater

[1]Static background conditions and mean value. Source: RSD4600 NextGen Operator's Manual. Edition 1.0. Environmental Systems Products. 4-000-MAN1160.
[2] Units are ~ grams diesel particulate per 100-gram fuel.

2. Additional figures

The following figures are discussed in the text of the manuscript. It should be noted that the emissions of CO, NO_x, HC and PM for a Dina vehicle were further co-sampled using an AXION PEMS instrument (see Figure S1). Therefore, for this vehicle the chasing, cross-road remote sensing, and PEMS techniques were applied simultaneously. However, the results of the comparison are not included in this manuscript but will be discussed in a separate paper.

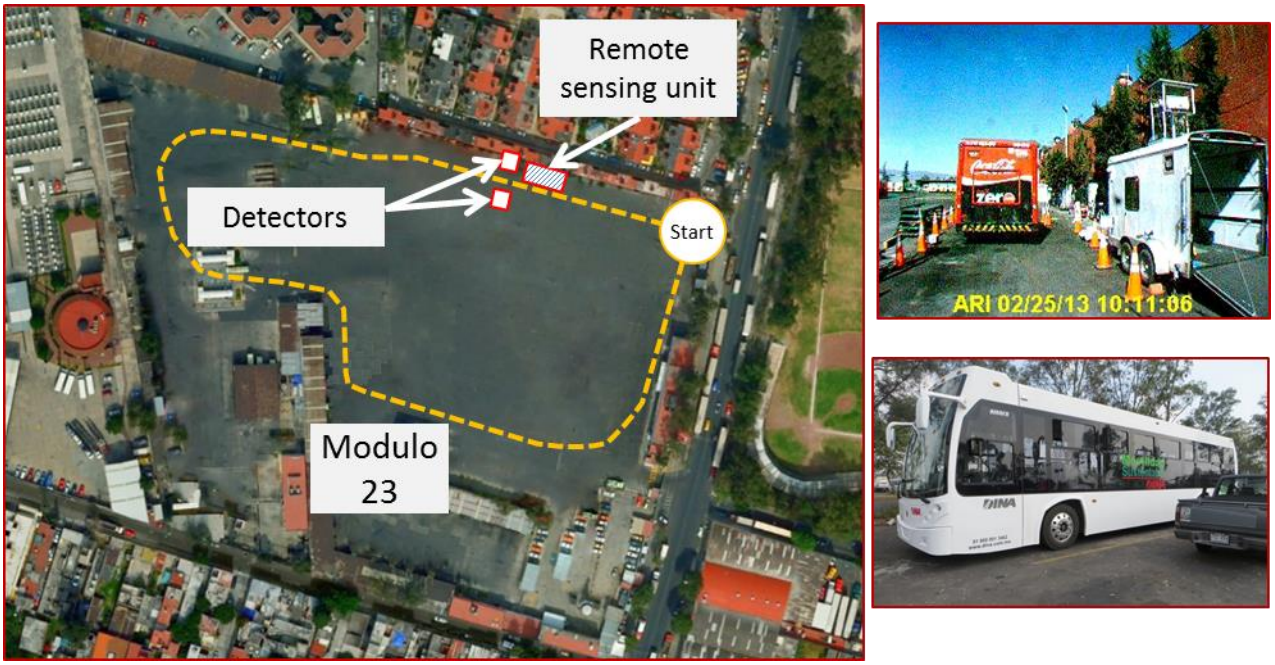

Figure S1. Left panel figure shows an aerial photo of the Modulo 23 of the RTP facilities indicating the location of the remote sensing unit and the area for the chasing experiments. Photos on the right show a service truck passing through the remote sensing detectors unit (top-right photo) and the Dina bus sampled with the mobile laboratory, remote sensing and PEMS techniques.

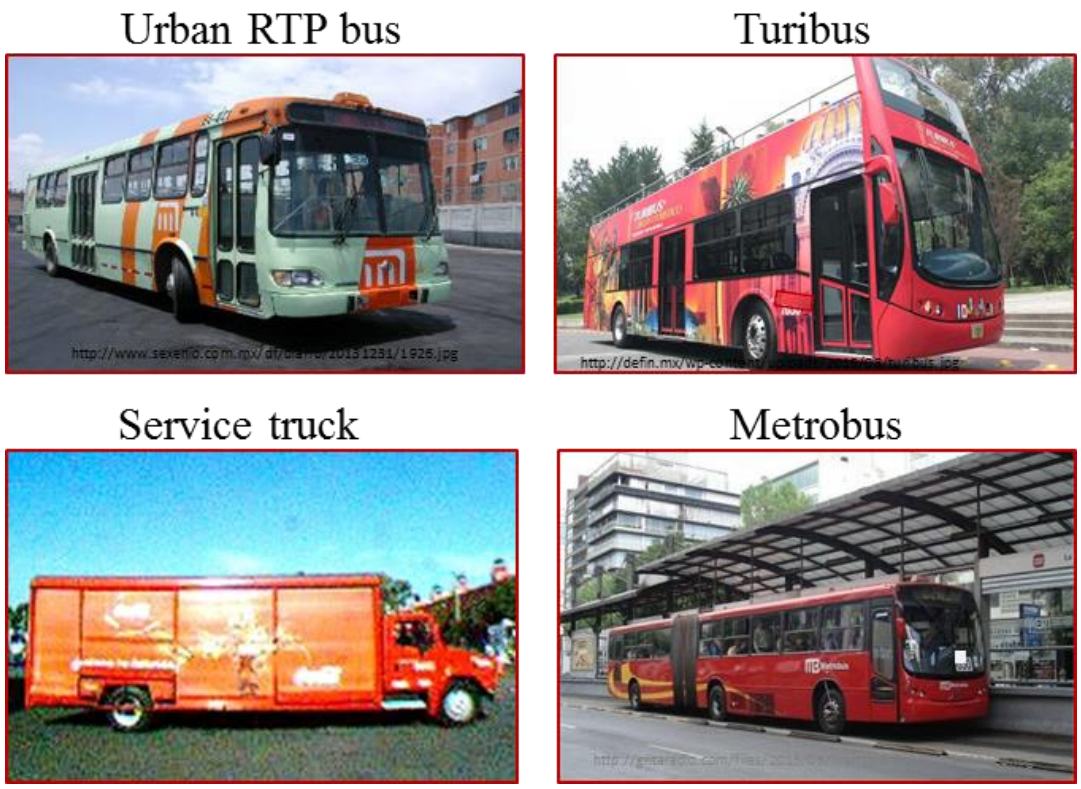

Figure S2. Examples of the four vehicle types (Metrobus, Turibus, urban RTP bus, and service truck) sampled in this pilot study.

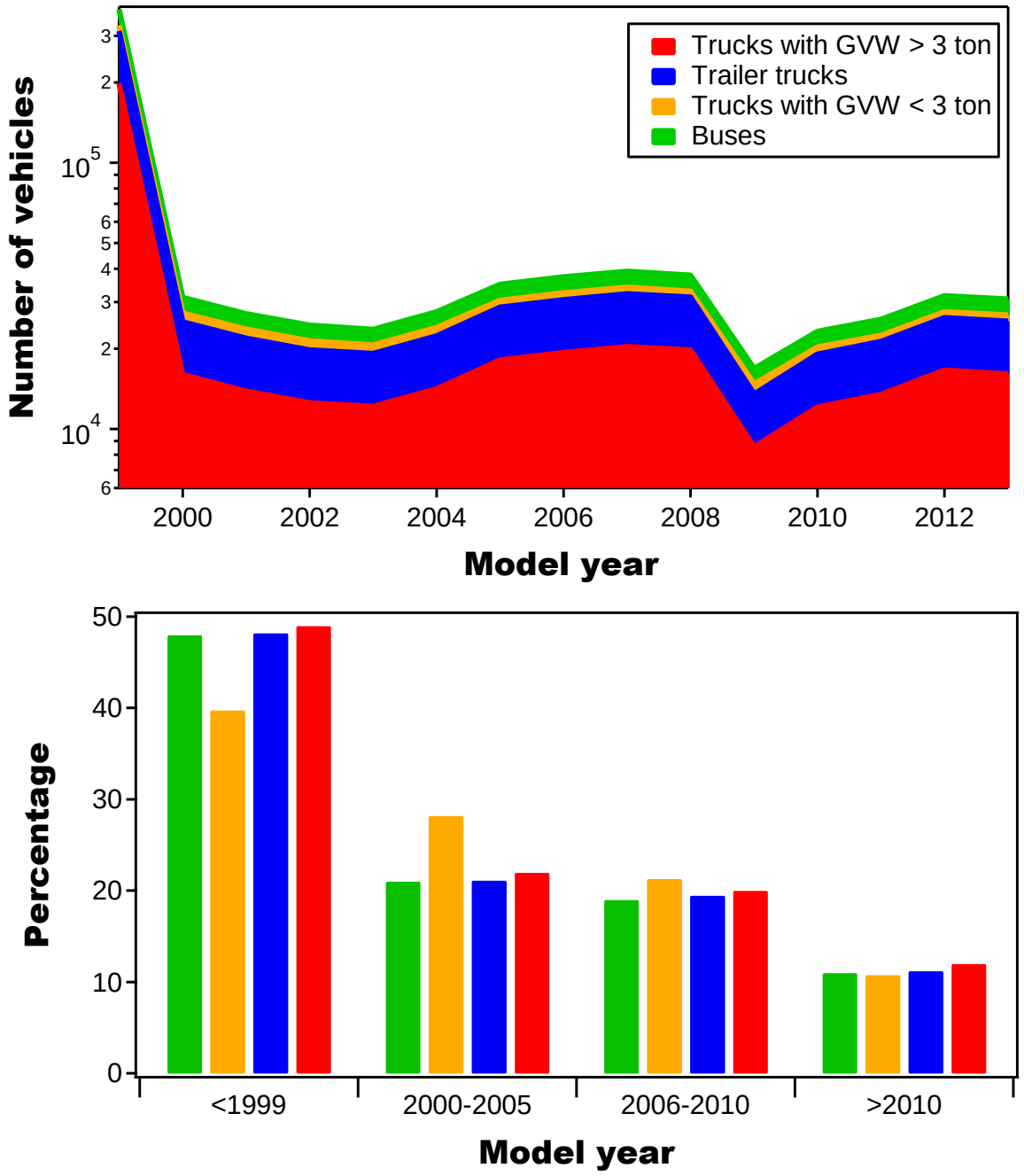

Figure S3. Top panel shows the number of diesel-powered vehicles by model year for the Mexican fleet for the year 2013. Trucks are classified by gross vehicle weight (GVW). Bottom panel shows the corresponding percentage of the number of diesel powered vehicles by model year. Source: prepared from data from the 2013 Mexican Nacional Emissions Inventory (SEMARNAT, 2015).

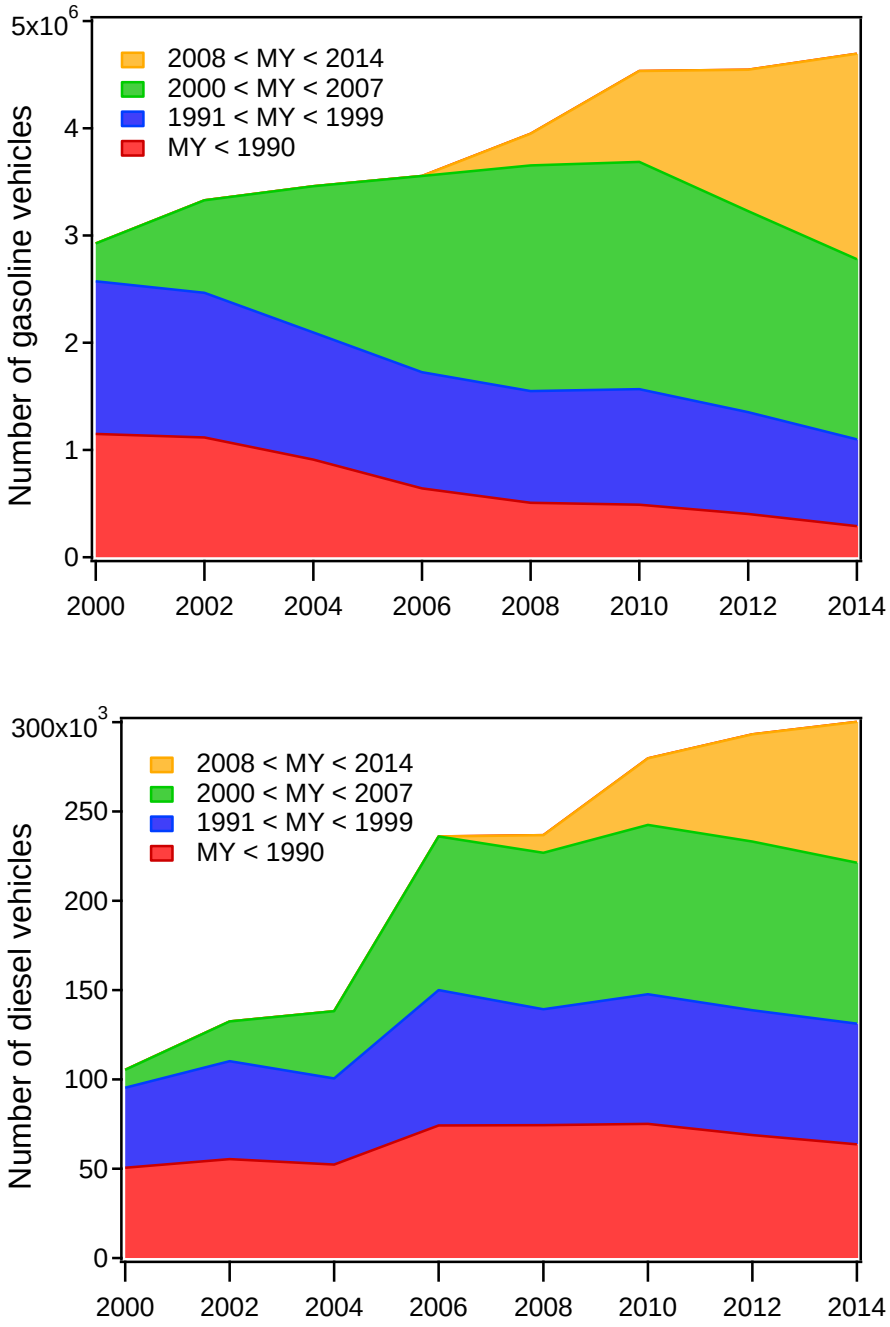

Figure S4. Top and bottom panels show the time evolution of number of gasoline-powered vehicles and diesel-powered vehicles, respectively, by model year (MY) in Mexico City. The figure shows a more rapid decline in the number of older gasoline vehicles than of diesel vehicles. Thus, older diesel vehicles remain in-use in the fleet for much longer periods than the gasoline vehicles. Source: prepared from data from the 2014 Mexico City Metropolitan Area Emissions Inventory (SEDEMA, 2017).