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Using ground-based solar and lunar infrared spectroscopy to study the diurnal trend of carbon monoxide in the Mexico City boundary layer

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Abstract. Carbon monoxide (CO) is an important pollutant in urban agglomerations. Quantifying the total burden of this pollutant in a megacity is challenging because not only its surface concentration but also its vertical dispersion present different behaviours and high variability. The diurnal trend of columnar CO in the boundary layer of Mexico City has been measured during various days with ground-based infrared absorption spectroscopy. Daytime CO total columns are retrieved from solar spectra and for the first time, nocturnal CO total columns using moonlight have been retrieved within a megacity. The measurements were taken at the Universidad Nacional Autónoma de México (UNAM) campus located in Mexico City (19.33° N, 99.18° W, 2260 m a.s.l.) from October 2007 until February 2008 with a Fourier-transform infrared spectrometer at 0.5 cm^{-1} resolution. The atmospheric CO background column was measured from the high altitude site Altzomoni (19.12° N, 98.65° W, 4010 m a.s.l.) located 60 km southeast of Mexico City. The total CO column within the city presents large variations. Fresh CO emissions at the surface, the transport of cleaner or more polluted air masses within the field-of-view of the instrument and other processes contribute to this variability. The mean background value above the boundary mixing layer was found to be $(8.4\pm0.5)\times10^{17}$ molecules/cm^2, while inside the city, the late morning mean on weekdays and Sundays was found to be $(2.73\pm0.41)\times10^{18}$ molecules/cm^2 and $(2.04\pm0.57)\times10^{18}$ molecules/cm^2, respectively. Continuous CO column retrieval during the day and night (when available), in conjunction with surface CO measurements, allow for a reconstruction of the effective mixing layer height. The limitations from this simplified approach, as well as the potential of using continuous column measurements in order to derive top-down CO emissions from a large urban area, are discussed. Also, further monitoring will provide more insight in daily and weekly emission patterns and a usable database for the quantitative validation of CO from satellite observations in a megacity.

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