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Estimation of the mass absorption cross section of the organic carbon component of aerosols in the Mexico City Metropolitan Area

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Abstract. Data taken from the MCMA-2003 and the 2006 MILAGRO field campaigns are used to examine the absorption of solar radiation by the organic component of aerosols. Using irradiance data from a Multi-Filter Rotating Shadowband Radiometer (MFRSR) and an actinic flux spectroradiometer (SR), we derive aerosol single scattering albedo, $\varpi_{0,\lambda}$, as a function of wavelength, λ. We find that in the near-UV spectral range (250 to 400 nm) $\varpi_{0,\lambda}$ is much lower compared to $\varpi_{0,\lambda}$ at 500 nm indicating enhanced absorption in the near-UV range. Absorption by elemental carbon, dust, or gas cannot account for this enhanced absorption leaving the organic carbon component of the aerosol (OA) as the most likely absorber. We use data from a surface deployed Aerodyne Aerosol Mass Spectrometer (AMS) along with the inferred $\varpi_{0,\lambda}$ to estimate the Mass Absorption Cross section (MAC) for the organic aerosol. We find that the MAC is about 10.5 m^2/g at 300 nm and falls close to zero at about 500 nm; values that are roughly consistent with other estimates of organic aerosol MAC. These MAC values can be considered as "radiatively correct", because when used in radiative transfer calculations, the calculated irradiances/actinic fluxes match those measured at the wavelengths considered here. For an illustrative case study described here, we estimate that the light absorption by the "brown" (organic) carbonaceous aerosol can add about 40% to the light absorption of black carbon in Mexico City. This contribution will vary depending on the relative abundance of organic aerosol relative to black carbon. Furthermore, our analysis indicates that organic aerosol would slow down photochemistry by selectively scavenging the light reaching the ground at those wavelengths that drive photochemical reactions. Finally, satellite retrievals of trace gases that are used to infer emissions currently assume that the MAC of organic carbon is zero. For trace gases that are retrieved using wavelengths shorter then 420 nm (i.e. SO_2, HCHO, halogenoxides, NO_2), the assumption of non-zero MAC values will induce an upward correction to the inferred emissions. This assumption will be particularly relevant in polluted urban atmospheres and areas of biomass burning where organic aerosols are particularly abundant.

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