

The T1-T2 study: evolution of aerosol properties downwind of Mexico City, with emphasis on black carbon specific absorption

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Abstract. As part of a major atmospheric chemistry and aerosol field program carried out in March 2006, a study was conducted in the area to the north and northeast of Mexico City to investigate the evolution of aerosols and their associated optical properties in the first few hours after their emission. The focus of the T1-T2 aerosol study was to investigate changes in the specific absorption α_{ABS} (absorption per unit mass, with unit of $\text{m}^2 \text{g}^{-1}$) of black carbon as it aged and became coated with compounds such as sulfate and organic carbon, evolving from an external to an internal mixture. Such evolution has been reported in previous studies. The T1 site was located just to the north of the Mexico City metropolitan area; the T2 site was situated approximately 35 km farther to the northeast. Nephelometers, particle soot absorption photometers, photoacoustic absorption spectrometers, and organic and elemental carbon analyzers were used to measure the optical properties of the aerosols and the carbon concentrations at each of the sites. Radar wind profilers and radiosonde systems helped to characterize the meteorology and to identify periods when transport from Mexico City over T1 and T2 occurred. Organic and elemental carbon concentrations at T1 showed diurnal cycles reflecting the nocturnal and early morning buildup from nearby sources, while concentrations at T2 appeared to be more affected by transport from Mexico City. Specific absorption during transport periods was lower than during other times, consistent with the likelihood of fresher emissions being found when the winds blew from Mexico City over T1 and T2. The specific absorption at T2 was larger than at T1, which is also consistent with the expectation of more aged particles with encapsulated black carbon being found at the more distant location. In situ measurements of single scattering albedo with an aircraft and a ground station showed general agreement with column-averaged values derived from rotating shadowband radiometer data, although some differences were found that may be related to boundary-layer evolution.