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Assessment of vertically-resolved PM_{10} from mobile lidar observations

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Abstract. We investigate in this study the vertical PM_{10} distributions from mobile measurements carried out from locations along the Paris Peripherique (highly trafficked beltway around Paris), examine distinctions in terms of aerosol concentrations between the outlying regions of Paris and the inner city and eventually discuss the influence of aerosol sources, meteorology, and dynamics on the retrieved PM_{10} distributions. To achieve these purposes, we combine in situ surface measurements with active remote sensing observations obtained from a great number of research programs in Paris area since 1999. Two approaches, devoted to the conversion of vertical profiles of lidar-derived extinction coefficients into PM_{10}, have been set up. A very good agreement is found between the theoretical and empirical methods with a discrepancy of 3%. Hence, specific extinction cross-sections at 355 nm are provided with a reasonable relative uncertainty lower than 12% for urban (4.5 m^2 g^{-1}) and periurban (5.9 m^2 g^{-1}) aersols, lower than 26% for rural (7.1 m^2 g^{-1}) aerosols, biomass burning (2.6 m^2 g^{-1}) and dust (1.1 m^2 g^{-1}) aerosols The high spatial and temporal resolutions of the mobile lidar (respectively 1.5 m and 1 min) enable to follow the spatiotemporal variability of various layers trapping aerosols in the troposphere. Appropriate specific extinction cross-sections are applied in each layer detected in the vertical heterogeneities from the lidar profiles. The standard deviation (rms) between lidar-derived PM_{10} at 200 m above ground and surface network stations measurements was ~14µg m^{-3}. This difference is particularly ascribed to a decorrelation of mass concentrations in the first meters of the boundary layer, as highlighted through multiangular lidar observations. Lidar signals can be used to follow mass concentrations with an uncertainty lower than 25% above urban areas and provide useful information on PM_{10} peak forecasting that affect air quality.

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