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Lidar-derived mass concentration profiles in urban environment

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At urban scale, issues addressing atmospheric pollution concern pollution peaks forecasting and validation approaches of parameterizations used in the models. Particulate pollution levels are mainly expressed in terms of PM10 values determined close to the surface in Europe. Modeling those concentration levels is however dependent on the knowledge of stratifications of aerosol vertical concentration profiles in the lowest troposphere. Lidar measurements are the good and accurate tools in order to answer such an issue.

We investigated the optical to mass relations from in situ measurements. We therefore combined observations of the aerosol size distribution, scattering and absorption coefficients and PM10 concentrations. This study enabled us to retrieve specific extinction cross sections for different aerosol types: urban, periurban, rural, biomass burning and dust particles. Such an optical to mass conversion coefficients were applied to lidar measurements, allowing the determination of spatiotemporal evolution of aerosol mass concentrations in the different layers: boundary layer, residual layer, nocturnal layer, layers advected in the free troposphere by long range transport. The lidar has been embarked in a small vehicle to follow the aerosol distribution over Paris ring and to assess the spatial gradient between Paris streets and its suburbs. In particular, this study has highlighted strong gradient on the mass concentration of aerosol in the first meters above the surface. This suggests a better consideration of aerosol vertical profiles in air quality models taking into account the transfer function between the surface emission and the mixed layer.