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Vertical profiles of aerosol complex refractive index using a synergy between lidar and in situ measurements

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Vertical profiles of aerosol complex refractive index (ACRI), a crucial parameter driving optical properties and highly dependent on chemical composition of the particles, have been retrieved in the framework of both the Etude et Simulation de la QUalité de l'air en Ile-de-France (ESQUIF) and the LIdar pour la Surveillance de l'AIR (LISAIR) experiments that took place over the Paris area in July 2000 and May 2005 respectively. The advantage of estimating ACRI via remote sensing lies in the determination of optical properties of airborne particles under real atmospheric conditions.

Lidar inversion thanks to sunphotometer measurements enabled to retrieve the backscatter-to-extinction ratio (BER) of the entire aerosol vertical column with an iterative procedure. The determination of the real part of the ACRI is the result of a convergent method between various scattering cross-sections calculated in a Mie model and the scattering cross-section measured by the coupling of a nephelometer and a particle sizer. The determination of the imaginary part of ACRI and the single-scattering albedo lies on a comparison between the previous BER used to invert lidar data and different values of BER calculated from size distribution with the real part previously retrieved. These results are in good agreement with aethalometer measurements that give access to the absorption coefficient.

The merit of the methodology here presented is that it provides, for the first time, vertically resolved ACRI with a high vertical resolution close to 200m. Vertical extinction profiles can be retrieved from both ACRI and in situ measured size distributions, and lidar measurements. These two extinction profile retrievals appear to be coherent.