Combining size distribution spectrums of ambient aerosols using equivalent optical properties of nanosized particles – selected examples from the Bay of Kotor

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Abstract. Atmospheric aerosols in urban areas typically consist of particles of different diameters, which can range in size from a few nanometers to a few micrometers and can have a strong impact on human health [1,2]. This motivates the need to measure aerosol concentration accurately, but it is often also necessary to combine results from several instruments, with fundamentally different measurement principles. In this work, methods based on the measurement of the electrical mobility of particles, for the range of diameters from 10nm to 420nm, and the measurement of the equivalent optical diameter, for the range of diameters from 300nm to 10um, were used. Combining the overlapping region in two size distribution spectra can be used to infer equivalent optical properties of the ambient aerosol, and examples of measured and combined spectra in several urban hot spots in Bay of Kotor are analyzed in some detail. These examples will illustrate several aspects of urban aerosol properties not readily available in a typical regulatory monitoring setting, such as distribution of modes in number and mass concentration, as well as optical properties of measured aerosol. As the main result, examples of combining particle size spectrums are presented. In the process of combining the particle size spectra, it is possible to modify the distribution obtained by optical measurements by searching for the optimal value of the refractive index of the particles to obtain the best possible agreement with the size distribution obtained by measuring the electrical mobility. An equivalent refractive index as well as the equivalent shape factor of the ambient aerosol is obtained using Mie scattering theory as a theoretical framework [3]. The measurement results from the mobile monitoring campaign in Bay of Kotor in 2017 were used to elucidate the main principles of size spectrum combination, as well as to showcase diversity of equivalent optical properties of urban aerosols.

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Keywords: electrical mobility; equivalent optical diameter; Mie scattering; log normal distribution

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