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Measurement of urban aerosol optical properties by ground counter-look elastic lidars

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Many lidar systems have been developed and implemented for measurements of aerosol optical properties and for air pollution studies in urban areas. However, most of these lidar systems are elastic lidar. In order to retrieve aerosol optical properties from elastic backscatter lidar returns, it is necessary to assume some hypotheses that directly regard the nature of the particles, such as lidar ratio.

In this paper, a new elastic lidar, named counter-look elastic lidar, will be presented. This counter-look elastic lidar utilizes two identical elastic lidars to measure aerosol optical properties without any hypotheses. The two elastic lidars are located at different places and face to each other. Each lidar receives the return signal scattered by the same aerosol and molecules in laser irradiation path between two places. Then a simple retrieval method can be used to calculate the aerosol optical properties between the two places. Compared to Elastic-Raman lidar and High Spectral Resolution Lidar, the proposed counter-look elastic lidar can use low power eye-safe laser and all available wavelengths. The counter-look elastic lidar is low cost and can be used in both day time and night time. With this lidar, urban aerosol optical properties and their spatial distribution can be directly measured, including backscatter coefficient, extinction coefficient and lidar ratio.

To demonstrate the proposed measurement, a couple of counter-look elastic lidars have been developed and tested by using 532nm wavelength laser and elastic receiving channels. In this experiment, two elastic lidars were put in two different places to across an urban area. Lidar return signal has been acquired in both day and night time and urban aerosol optical properties have been calculated directly basing on those signals. According to aerosol optical properties, the characterization of aerosols was obtained and the aerosol of anthropic and natural origin can be distinguished.