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Pulsed Scheimpflug Lidar for Range-Resolved Measurement of Broadband Fluorescence Decay Time of Aerosols

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We reported observation of fluorescence from atmospheric aerosols using a multi-channel lidar spectrometer in our previous publications and showed that Asian dust emit fluorescence [1]. However, it was not clear whether the fluorescence was from biological organic material on dust particles or from mineral itself. They can be distinguished if fluorescence decay time is measured, because fluorescence decay time of biological organic materials is short (~ 10 ns), and that of minerals is long (> 1 μs) [2]. It is, however, difficult to separate fluorescence decay and spatial distribution of the target using backscattering lidar configuration, because they are convoluted in the time domain.

Here, we propose a new method for range-resolved measurement of broadband fluorescence decay time of atmospheric aerosols. It is a Scheimpflug lidar using a pulsed ultraviolet laser and a time resolved array detector such as a multi-anode photomultiplier tube. The basic concept of the method is a pulsed bistatic lidar that receives fluorescence from a certain height range. The target volume is defined by the optical geometry of the bistatic lidar, and the fluorescence decay from the volume is measured with a time-resolved detection system. When the concept is extended to consecutive multiple target volumes using a single receiving telescope, the positions of the detector elements follow the Scheimpflug principle. So we may call it a kind of Scheimpflug lidar, although it is different from a usual Scheimpflug imaging lidar [3] that employs a cw laser and an image sensor.

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