Simultaneous Observation of Temporal and Spatial Distribution of Atmospheric Aerosol by Means of Slant-Path and Plan Position Indicator Lidars

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First Author	Aminuddin, Jamrud; Manago, Naohiro; Lagrosas, Nofel;
Last Author	Kuze, Hiroaki
Authors	Aminuddin, J; Manago, N; Lagrosas, N; Okude, S; Kuze, H;
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Abstract	The influence of aerosols to the atmosphere has been discussed in the context of the Earth radiation budget and global climate change. Therefore, precise monitoring of aerosol parameters is important for better understanding of their real characteristics and impacts on the environment. In this study, we report on a novel method of concurrent measurements of aerosol near the surface level by means of slant-path (SP) and plan position indicator (PPI) lidars. The SP lidar utilizes a diode-laser-pumped Nd:YAG laser operating at 532 nm, while the PPI is based on a Nd:YLF laser at 349 nm. The PPI system including the laser transmitter and telescope section is rotated over 360 degrees for covering all the horizontal directions with the maximum observation range up to around 3 km. At the same time, the SP lidar is employed for monitoring the near surface region that cannot be covered by vertical observation lidars. Furthermore, the backscattered signals recorded by both PPI and SP lidars are analyzed using the Fernald method to retrieve aerosol extinction coefficient by employing lidar ratios for 349 and 532 nm. These values of lidar ratio are estimated by adjusting and fitting parameters in the Mie scattering calculation (mode radius, variance, and both real and imaginary parts of refractive index) to real data from ground-based sampling instruments, namely, the scattering coefficient, absorption coefficient, and size distribution observed with an integrating nephelometer, an aethalometer, and an optical particle counter, respectively. Real-time values of the extinction coefficient inside the atmospheric boundary-layer are derived as the summation of scattering and absorption coefficients. The results are then compared with those from a vertical lidar, operated by the National Institute of Environmental Studies (NIES) on the campus of Chiba University. We discuss the observed features of aerosol characteristics that vary both temporally and spatially.
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Author	JAMRUD AMINUDDIN, S.Si, M.Si, Ph.D.