Scanning lidar noise filtering and signal processing using multi-section slope values

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Scanning lidar is a remote sensing device that uses a laser as a light source to calculate distance information with a horizontal measurement distance of 5 km and a distance resolution of 30 m. When a laser, which is a light source, is irradiated into the atmosphere, and the irradiated laser light is scattered by air molecules and particles distributed in the atmosphere, the back-scattered light is collected with a telescope to measure a signal. The distribution of fine dust by distance can be calculated through the analysis of the collected optical signals.

In order to use the optical signal collected by the telescope, it is necessary to preprocess noise data such as solar background noise and smooth the entire data. This paper applies the method of adopting multi-section slope values as a noise processing method required in the data processing process.

The data processing algorithm is divided into six steps. First, the raw data is summed by six. This is to reduce the error of signal strength and make the overall signal graph smooth. Second, remove noise. As an operation to exclude values of sunlight and background concentration, values with an SNR(signal-to-noise ratio) value of 3 or less are removed. Third, a value according to the distance is corrected (range corrected) by multiplying an existing signal value by a distance squared value. This is necessary because the strength of the signal decreases as the distance increases. Fourth, a moving average is applied. This is for smoothing effect like 6 sums. Fifth, the dissipation coefficient is calculated. It is calculated using the equations from the Klett (1981) paper. In this case, the reference value has a influence on the reliability of the data. If a section in which noise processing is not perfect or a section in which a singular value occurs is selected as a reference point, the final calculated concentration value has a larger error value than the normal range. Therefore, in this paper, all reference values and sigma m (the slope in a specific value section back and forth from the reference point) are obtained at intervals of 500 m within the range of 1.5 km to 5.5 km, and an algorithm that adopts the optimal value is applied. Sixth, PM_{10} is obtained by dividing the dissipation coefficient value by the dissipation efficiency value.