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Continuous monitoring of urban air quality with a pulsed DOAS technique

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[Introduction]
$NO_2$is emitted from anthropogenic sources and has a large influence on the production and extinction of the tropospheric ozone. Therefore, in the urban area, the observation of the NO_2 concentration is important to control air pollution. The purpose of this study is the observation of NO_2in Tokyo urban area by pulsed Differential Optical Absorption Spectroscopy (PDOAS). In PDOAS technique, we can easily remove background light to use pulsed light source and observe the average density of NO_2through long path length. We demonstrated this system in the trace gas observation campaign at Tokyo metropolitan area in summer 2009.

[Device outline]
The measurement system consists of a light source, a telescope, a small CCD spectrometer, and a lap top PC. In the campaign, two PDOAS systems were utilized simultaneously to retrieve NO_2 column densities along different directions. As the light sources, high-intensity flashing white obstruction lights available on the top of exhaust flues of incinerator plants were employed, in which one Xe lamp light source was located 6.3-km east and another was 7-km north from the observation site at the Hongo campus of Univ. of Tokyo. The both flash lights are focused by the telescopes and detected by the CCD spectrometers through optical fibers.

[Analytical technique]
The observed light spectra subtracted from the background lights are attenuated by the absorption of $NO_2$and the extinction of Rayliegh/Mie scattering in the range of 400-450 nm. In this wavelength range, there is no absorption from other trace gases except NO_2, so that we can easily retrieval NO_2concentration. The observed spectra have two components, one varies rapidly with wavelength and another varies slowly. The differential absorption spectra are obtained by removing slowly changing part (smooth line) which is fitted to the observed spectra. The differential absorption cross-section is defined by considering the absolute cross-section as the sum of the spectrum, which varies rapidly with wavelength, and a slowly varying component. Then, in the slowly varying component of the observed spectra, there is the effect of the extinction of Rayliegh/Mie scattering and the slowly varying absorption cross-section, so that the resulting structure of the observed spectra is only caused by the rapidly varying NO_2cross-section. Finally we obtain the NO_2concentration by peak-to-peak spectrum matching of the differential absorption spectra and the differential absorption cross-section.

[Results and discussion]
We observed the NO_2mixing ratio by two PDOAS systems in daytime from 27 July to 12 August, 2009. Temporal variations of retrieved NO_2column densities will be discussed in terms of spatially inhomogeneous distributions of NO_2. The NO_2column densities were also compared with single-point data of NOx measured by both chemiluminescence analyzer and laser-induced fluorescence instrument. For checking performances of PDOAS systems, two PDOAS systems were set using same light source to detect NO_2mixing ratio from same slant column. We will discuss the

differences of the NO_2detection limits estimated by the two time series of the NO_2mixing ratio observed by the two PDOAS systems with the different specifications, respectively.

Keywords: NO2, Urban air monitoring, Pulsed DOAS