# Trace gases observation campaign at Tokyo city area in summer 2007: the Observation of $NO_2$ by the pulsed DOAS technique

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[Introduction]

$NO_2$ is emitted from artificial 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. In this context, the purpose of this research is the observation of $NO_2$ in Tokyo urban area by pulsed Differential Optical Absorption Spectroscopy (p-DOAS). In p-DOAS technique, we can easily remove background light to use pulsed light source and observe the average density of $NO_2$ through long path length.

[Device outline]

The measurement system consists of a light source, a telescope, a small CCD spectrometer, and a lap top PC. The light source is a Xe lamp used as an aircraft warning light at a top of the chimney of Kita-ku sewage disposal facilities. This flash light is operated highly illuminant (more than 200,000 cd) in the daytime that is detectable from several km away. The observation site at 8th floor of the Eng. building 5 in the Univ. of Tokyo is 7 km apart from the flash light to the south. The flash light is focused by the telescope and detected by the CCD spectrometer through an optical fiber. The detected spectrum is in the wavelength range of 190-860 nm.

[Analytical technique]

The observed light spectra subtracted from the background lights is decayed by the absorption of $NO_2$ and the extinction of Rayliegh/Mie scattering in the range of 400-450 nm. In this range, there is no absorption of other trace gases except $NO_2$, so that we can easily retrieval $NO_2$ concentration. 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 $NO_2$ cross-section. Finally we obtain the $NO_2$ concentration by peak-to-peak spectrum matching of the differential absorption spectra and the differential absorption cross-section.

[Results and discussion]

We performed p-DOAS in daytime from 15th August to 1st September, 2007. A part of data sets cannot be retrieved because of the shortage of the observed light intensity. The acquisition time of 5 minutes was employed to estimate the $NO_2$ concentration. The average concentration of $NO_2$ from 8:30 to 17:00 in 23rd August is estimated to be 37 ppbv (the minimum 17 ppbv, the maximum 53 ppbv). Using the whole data of this date, we discuss about the comparison between p-DOAS and the other techniques such as Chemical Luminescence (CL) and Laser Induced Fluorescence (LIF). The concentrations obtained by p-DOAS tend to be lower than those obtained by CL and LIF. One of the reasons of this trend would be on the typical climate in summer season of Tokyo area. Another reason would be caused by the differences between the long pass observation by p-DOAS and the site observation by LIF/CL.