DIAL Measurement of NO_2 Concentration in a Stack Plume

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Differential absorption lidar (DIAL) has been recognized as a promising technique for range-resolved remote measurement of pollutant gas concentration.

A DIAL system for NO_2 measurements using a flashlamp-pumped dye laser has been developed at the National Institute for Environmental Studies (NIES). In this paper, we describe the outline of the system and measurement results of NO_2 concentration in a stack plume.

A schematic of the system is shown in Fig.1, and the system specifications are shown in Table 1. The system is computerized so that wavelength switching, laser firing and data acquisition are performed automatically. Acquired data are stored on magnetic tape, and processed to obtain NO_2 concentration profiles after measurement.

A stack plume from the Energy Center of NIES was measured from the roof of the main building about 120 m away. The NO_2 concentration profile obtained from 60 pulse-pair averages is shown in Fig.2. The range resolution is 120 m. The profile shows a peak in the vicinity of the stack, and the concentration at this peak is ~ 0.17 ppm with a probable error of ~ 0.05 ppm. This concentration is an average over 120 m including the stack plume. If NO_2 is assumed to exist only in the plume (~ 2 m in diameter), the NO_2 concentration in the plume is then estimated to be ~ 10 ppm, which is a reasonable value.

We are now investigating the possibility of constructing a two-wavelength lasing system.

Table 1.   System Specifications

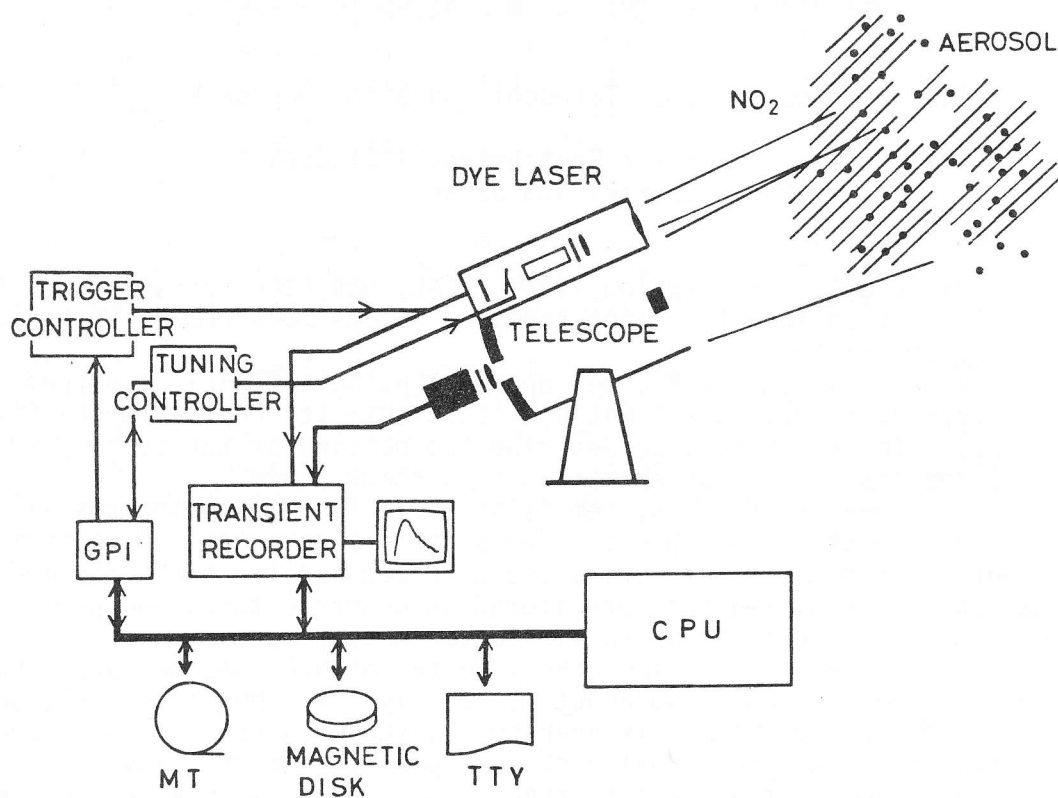|	
Laser type	Flashlamp-pumped dye laser
Wavelength tuning	Etalon
Wavelength	λ_{on} 4631 A
	λ_{off} 4658 A
Dye	C1H
Pulse energy	~ 100 mJ
Pulse duration	600 ns
Repetition	0.5 pps
Telescope	0.15 m ϕ Newtonian
Transient recorder	DM 901 (Iwatsu)
	10 ns minimum, 8 bits, 1024 segments
Minicomputer system	NOVA 02

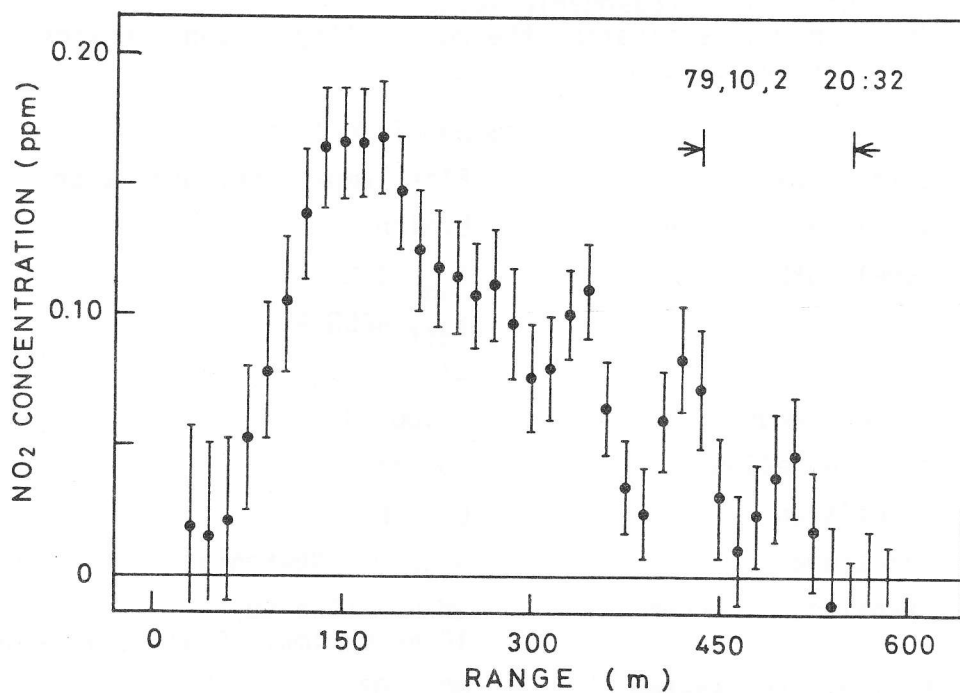Fig. 1   Schematic diagram of the System

Fig. 2   NO$_2$ concentration profile obtained from 60
pulse-pair averages