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OBSERVATION OF ATMOSPHERIC OZONE BY DIAL WITH RAMAN LASERS PUMPED BY A KrF LASER

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Since we first began using the XeCl excimer laser (308 nm) in DIAL for stratospheric ozone detection,[1] the XeCl ozone lidar became a useful tool for the monitoring of the stratospheric ozone concentration.[2,3]

Shorter wavelength lasers are needed for the observation of ozone in the troposphere where the ozone concentration is about one order of magnitude smaller than in the stratosphere. In 1983, we observed tropospheric ozone with the conbination of the second Stokes line (290.4 nm) of stimulated Raman scattering from methane pumped by a KrF laser and the XeCl laser line.[4]

In this paper, we will report the measurement of the ozone distribution from ground to 30 km, using three Stokes lines of Raman lasers pumped by a KrF laser. The characteristics of our lidar system are shown in Table 1. Fig.1 shows the ozone profile observed by the second Stokes lines of methane (290.4 nm) and hydrogen (313 nm).[4] This system is simpler than that of the previous paper, because it is based on a single KrF excimer laser. We are now preparing the KrF laser with fast repetition rate (~80 Hz). A set of data will be taken in several minutes with this high-power laser.

At wavelengths shorter than 295 nm, the background solar radiation is effectively suppressed by atmospheric ozone. Such a solar-blind effect can be expected when we use two wavelengths 277 and 290.4 nm for DIAL ozone detection. Fig.2 shows a preliminary measuremnent of the day time ozone distribution in the troposphere using these wavelengths generated by a KrF laser with a Raman shifter. Analysis using the lidar equation predicts the maximum detectable range is 7 km. In the present experiment, the dominant range limiting factor is the low transmission of the solar-blind filter.

References

1. Uchino, O. et al., Appl. Phys. Lett., Vol. 33, 807 (1978).
2. Werner, J. et al., Appl. Phys., Vol. B32, 113 (1983).
3. Pelon, J. and G. Megie, 12th ILRC (1984).
4. Uchino, O. et al., Opt. Lett., Vol. 8, 347 (1983).

Transmitter			
Laser	KrF-pumped $H_2(S_1)$	KrF-pumped $CH_4(S_2)$	KrF-pumped $H_2(S_2)$
Wavelength (nm)	277.0	290.4	313.0

Receiver	
Telescope	50 cm dia.
Field of view	1 mrad
Filter bandwidth (transmission)	2 nm (10 %)
Photo counter	
vertical resolution	1 sec
channel number	1000

Table 1. Characteristics of Lidar system

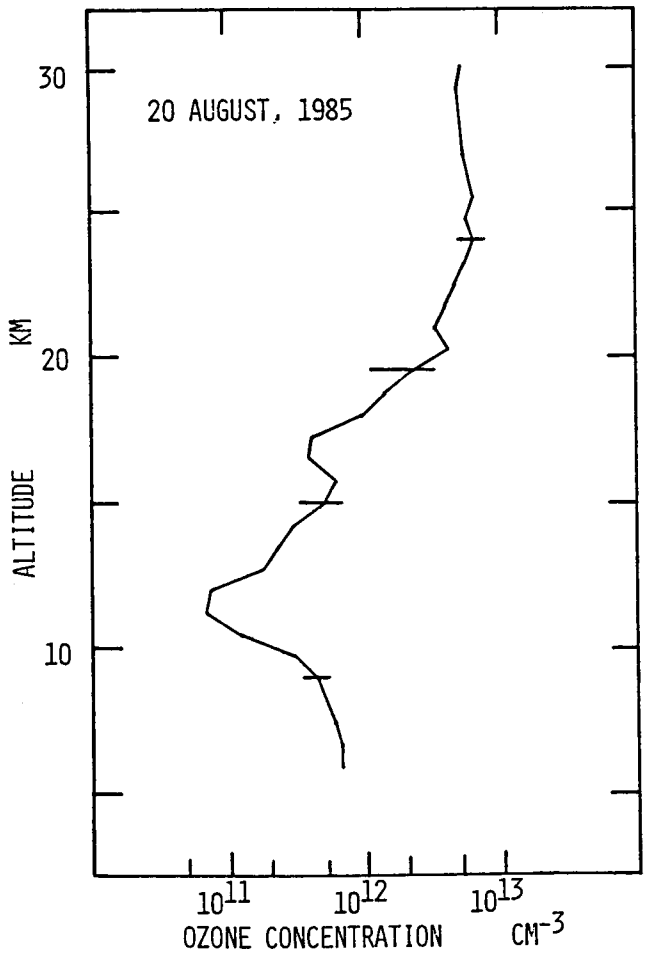

Fig.1 Ozone profile by 290.4 and 313 nm.

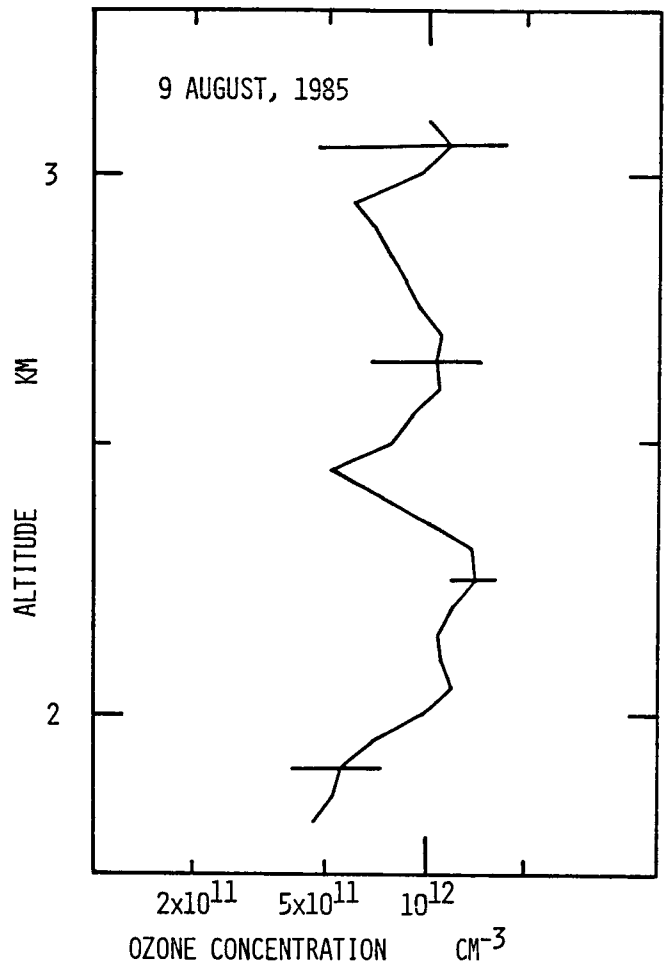

Fig. 2 Ozone profile by 277 and 290.4 nm in the daytime.