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WAVELENGTH DEPENDENCE of AEROSOL OPTICAL PARAMETERS MEASURED by a TUNABLE LIDAR

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INTRODUCTION

Wavelength dependence of aerosol backscattering coefficients is important for the analysis of the DIAL measurement and the determination of the atmospheric properties. Usually several discrete wavelengths, such as the fundamental, second harmonic and third harmonic frequencies of a Nd:YAG laser, are used for measurements of wavelength dependence. In this study, a tunable solid state laser is used, which provides a continuously tunable wavelength source. This laser is originally designed for the DIAL measurement from the ultraviolet to the mid-infrared[1], which is based on a YAG laser pumped Ti:sapphire (Al_2O_3) laser, its harmonics, and sum- and- difference frequency mixing with another Nd:YAG laser. We report the validity of an assumption of the power law between the extinction coefficient and the backscattering coefficient, and a wavelength dependence of the extinction coefficient.

EXPERIMENTAL

The fundamental frequency and the second harmonic frequency of the Ti: sapphire laser is used in the measurement. The second harmonic frequency of the Nd:YAG laser (600 mJ/pulse, 5-7 ns pulse width) is used to pump a Ti:sapphire laser (695 - 905 nm, 130 mJ/pulse at 790 nm), which is operated at the repetition frequency of 10 Hz. The second harmonic frequency spans 370 - 440 nm (25 mJ/pulse at 390 nm). The wavelength regions from 380 to 440 nm, and 730 to 880 nm have been used for the measurement. The measurement was done at the main campus of Chiba University. The laser light is emitted at the elevation angle of 10 degrees. The backscattered signal is received by a 30 cm telescope, detected a Hamamatsu R928 photomultiplier, and is digitized by a 10 bit transient recorder. The measurement, which is analyzed, was done in 3:30 - 4:50 and 5:40 - 7:00 pm, November 5 .

RESULTS OF MEASUREMENT

In the analysis we assumed a power relation between the backscattering coefficient $\beta_\lambda(R)$ and the extinction coefficient $\alpha_\lambda(R)$: $\beta_\lambda(R) = k_1 \alpha_\lambda(R)^{k2}$, and the Klett equation is used to obtain the extinction coefficient. Then, the wavelength dependence of the extinction coefficient is obtained on the assumption of the Angstrom relation: $\alpha_{\lambda 1}(R)/\alpha_{\lambda 2}(R) = (\lambda_1/\lambda_2)^{-\xi}$. For the analysis of each wavelength region, we obtained some combinations of (k_2 and ξ);

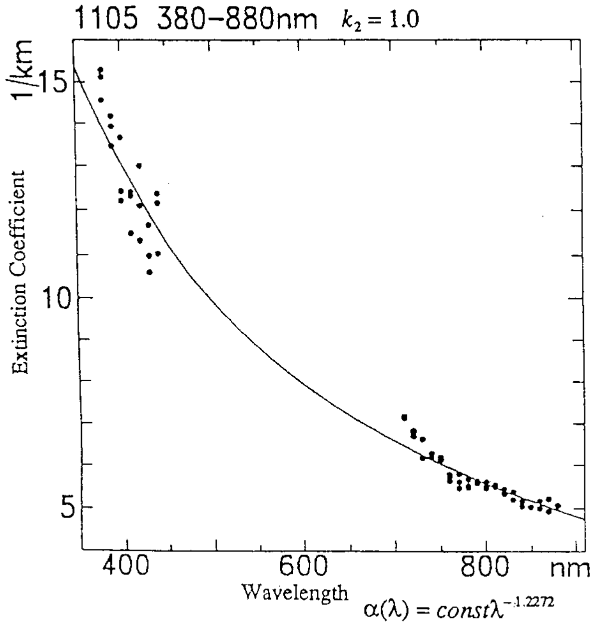

Fig.1 Wavelength dependence of the atmospheric extinction coefficient.

for 390 - 850nm: $(k_2, \xi) = (0.7, 0.86)$, $(1.0, 0.72)$, and $(1.3, 0.54)$,
and for 710 - 880 nm: $(k_2, \xi) = (0.7, 1.82)$, $(1.0, 1.61)$, and $(1.3, 1.28)$.
When we combine the two region, a combination of $(k_2, \xi) = (1.0, 1.23)$ appears most probable.

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[1] R. Toriumi, H. Tai, N. Takeuchi:DIAL Measurements of Nitrogen Dioxide Based on Solid-State Lasers, 25PC1 in this abstract.