Studies on Ground-Base Experiments for Verifications of a Spaceborne Lidar

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We think that there are many problems such as the effect of multiple-scattering to get the atmospheric parameters from the spaceborne lidar signal. We are planning to study ground-based lidar experiments and indoor model experiments for verifications of a future spaceborne lidar (Mie lidar and DIAL) as follows;

(1) Comparison between results of Monte Carlo simulations of multiple-scattering and ground-base experiments on various parameters such as filed of view, laser wavelength, laser linewidth, laser pulse length and depolarization to get new information of atmospheric parameters.

(2) Measurement of detector (APD) response to strong input (dynamic range and after effect) caused by such as cloud and ground scattering.

(3) Study on the influence of multiple-scattering on non-Mie lidar measurement (Water vapor DIAL, Raman lidar, doppler lidar, etc.).

(4) Study on a spaceborne horizontal beam lidar for measurement of stratospheric water vapor.

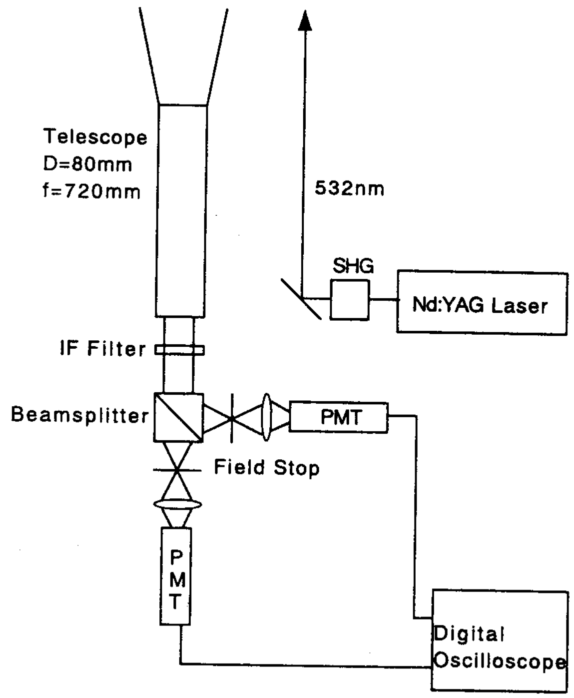


Fig. 1 Block diagram of the lidar system for ground-based multiple-scattering experiments (multiple field of view lidar system).

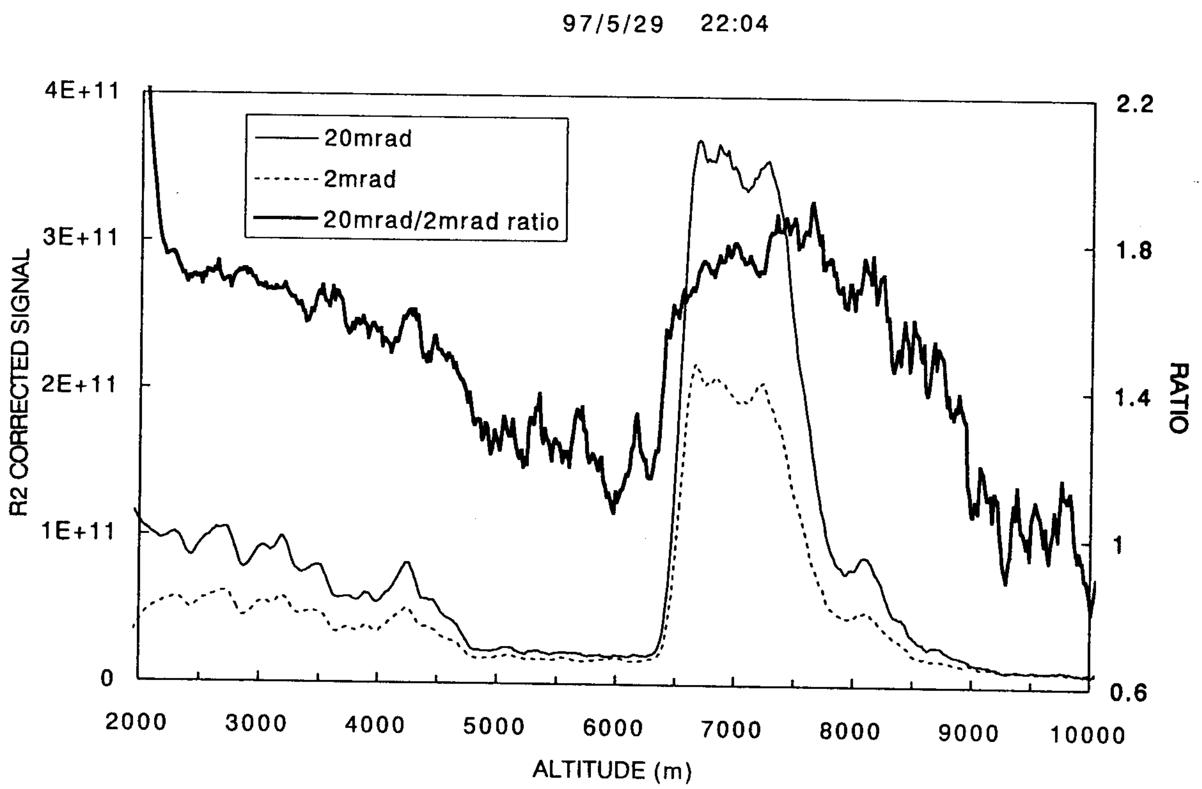
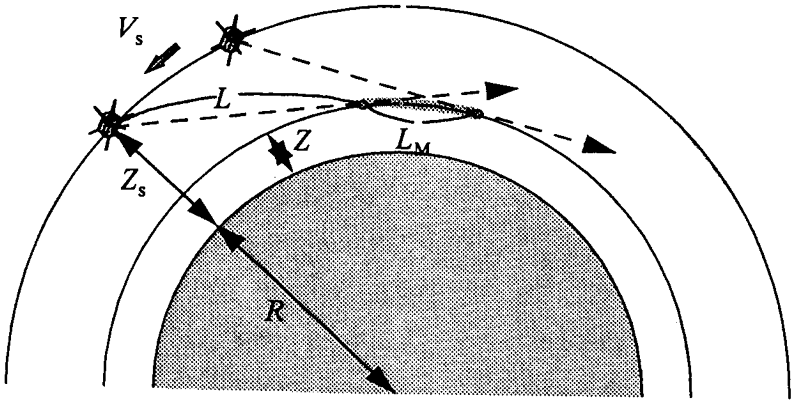


Fig. 2 Result of multiple field of view measurement.



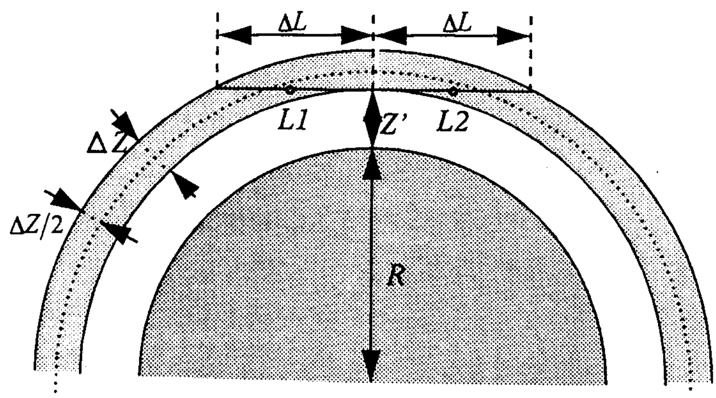
L : distance from satellite to a measured point
L_M : horizontal resolution
V_S : satellite velocity Z_S : satellite height
Z : measured height R : earth radius

Definition of L_M

$$L_M = \Delta L + \left(\frac{Z + R}{Z_S + R} \right) V_S \cdot \frac{M}{f} \quad , \quad \Delta L = c\tau/2$$

M : shot number f : repetition rate(Hz)

Fig. 3 Schematic diagram of spaceborne horizontal beam lidar.



ΔZ : height resolution

- $Z = Z' + \Delta Z / 2$
- $\Delta L \gg \Delta Z$

example : ΔL=160km → ΔZ=1.0km
ΔL=226km → ΔZ=2.0km

Fig. 4 Relation between horizontal resolution and height resolution.

Table 1. Parameters of the spaceborne horizontal beam DIAL

Parameters of the spaceborne horizontal beam DIAL

Pulse energy	0.1 J
Repetition rate	50 Hz
Spectral purity	0.999
Wavelength λ_{on}	932.57, 935.68 nm
Absorption cross section σ	4.19, 18.9 $\times 10^{-26} m^2$
Satellite altitude Z_s	500 km
Satellite velocity V_s	7.55 km/s
Ground velocity	7.0 km/s
Telescope aperture	1.0 m
Optical transmittance η	0.2
Detector efficiency Q	0.5
Excess noise factor F	2.5
Dark count	1000 count/sec

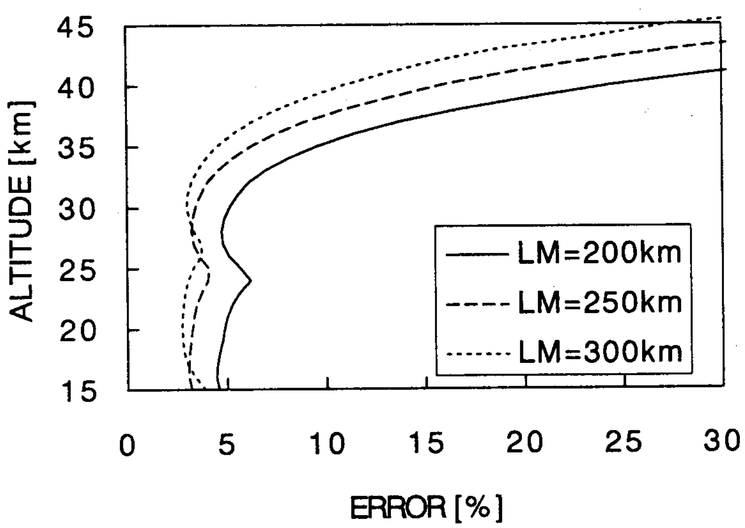


Fig. 5 Simulated result of random error profiles of water vapor density measurement.