Algorithm studies needed and development plan

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Objective is to develop algorithms for obtaining optical parameters of clouds and aerosols (extinction coefficient, etc.) from space lidar data as quantitatively as possible. The difference between the space lidar and ground based lidar is the geometry of the measurement. Space lidar looks a larger scattering volume downward. Problems specific to space lidars consequently arise. They are problems with giving a boundary condition in solving lidar equation, problems with multiple scattering, problems with inhomogeniety of scatterer within the foot print, etc. The study on algorithms includs the following subjects.

(a) Study of inversion algorithms for different targets

(b) Validation of algorithms with ground based lidar experiments and computer simulations

(c) Construction of models on optical characteristics of the targets based on ground based lidars and other data.

Regarding algorithm study for space lidar, NIES will start a new research program next fiscal year starting April 1998. This is a program with the Global Environment Research Fund of the Environment Agency of Japan. The themes on space lidar are as follows.

1. Study on application methods for space lidar data on clouds and aerosols

(a) Study on algorithm for deriving atmospheric parameters from space lidar data
(National Institute for Environmental Studies (NIES), Tokyo Metropolitan University)

(b) Statistical analysis of cloud structure and optical characteristics.
(NIES, Tohoku University, Tokyo Science University)

(c) Study on application of space lidar data to climate models
(University of Tokyo, NASDA/EORC, NIES, Tohoku University)

Study on multiple scattering in space lidar measurements of clouds and aerosols based on Monte Carlo method
(Peter Voelger, Eco-Frontier Fellow of Environment Agency of Japan)

We plan the following studies in each theme.

(a) Study on algorithm for deriving atmospheric parameters from space lidar data

- Study of inversion algorithm with computer simulations
- Validation of algorithms with ground based lidar observations
- Ground based lidar observation of optical characteristics of clouds and aerosols (including multiple scattering).

(b) Statistical analysis of cloud structure and optical characteristics.
-Statistical analysis of multi-layer cloud structure and optical characteristics using grouns based lidars, ceilometers, and NOAA satelite data

(c) Study on application of space lidar data to climate models
- Study on parametrization of cloud data ...
- Construction of simlation data of space lidar ...

In the study on validation of algorithm at NIES, we plan to use a high spectral resolution lidar (HSLR) using an iodine filter as a high resolution blocking filter. Figure 1 shows a block diagram of the lidar, and Fig. 2 and Fig.3 show backscattering and extinction coefficients determined with the HSRL without assmption on backscattering-to-extinction coefficient. In the study of statistical analysis of clouds, we use the Mie scattering lidar data which are measured continuously at NIES. An example of data is shown in Fig.4.

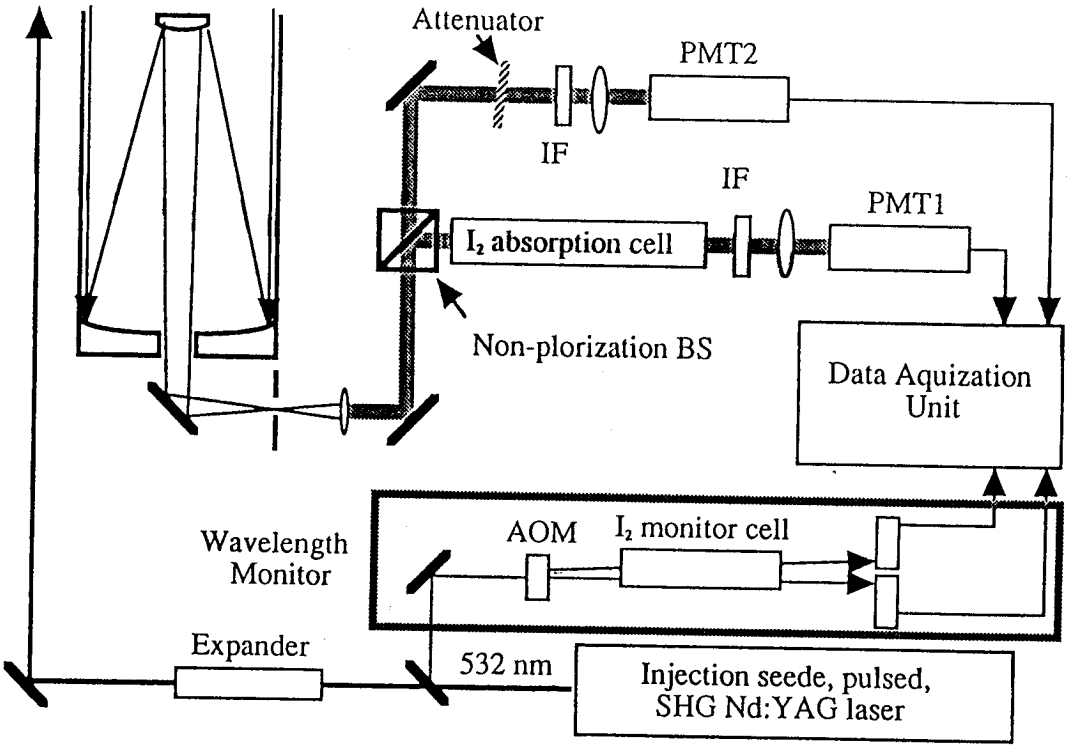

Diagram of a high spectral reolution lidar using an iodine absorption filter

Fig. 1 Block diagram of the high spectral resolution lidar (HSRL) at NIES.

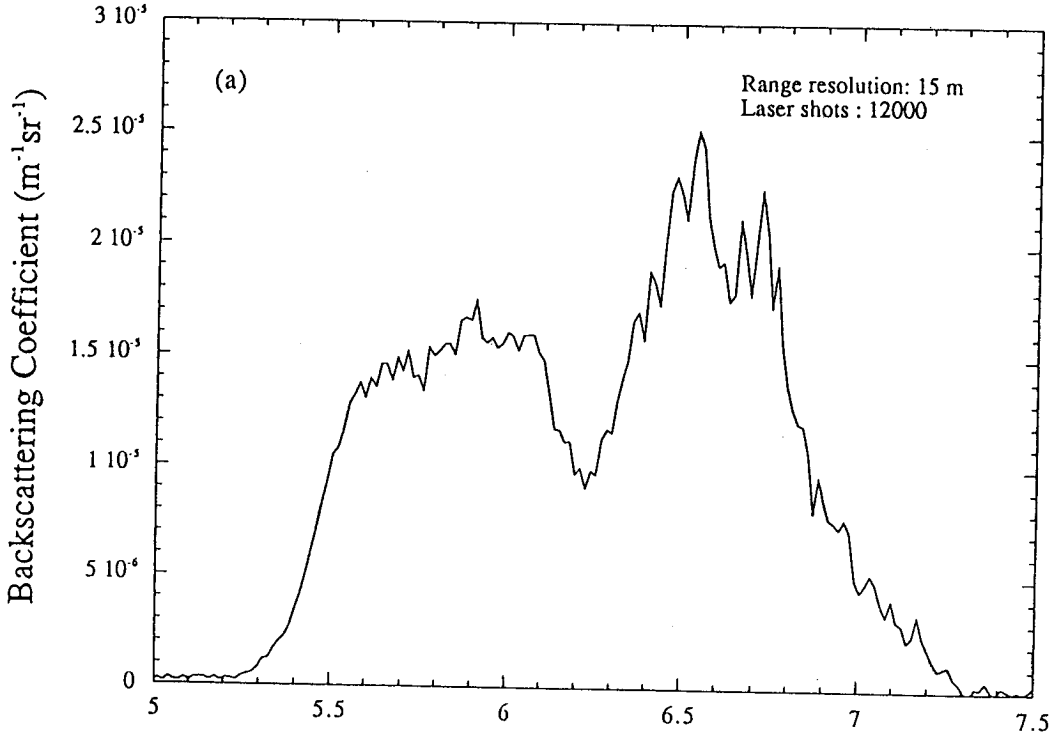

Fig. 2 Backscattering coefficient measured with the HSRL.

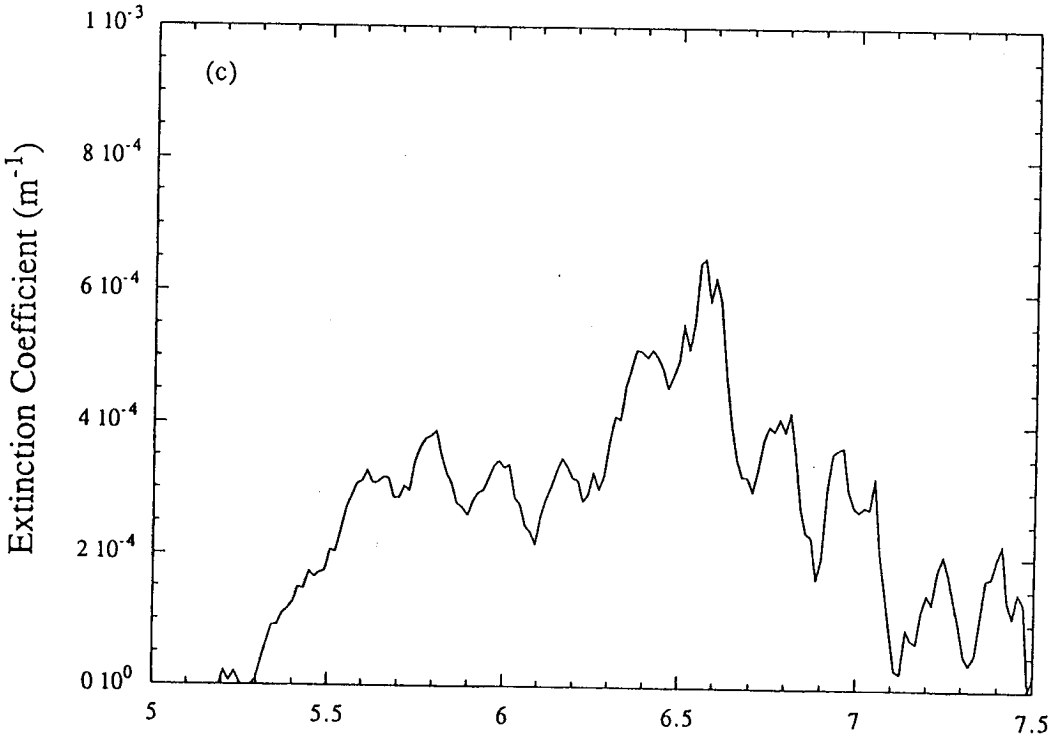

Fig. 3 Extinction coefficients measured with the HSRL.

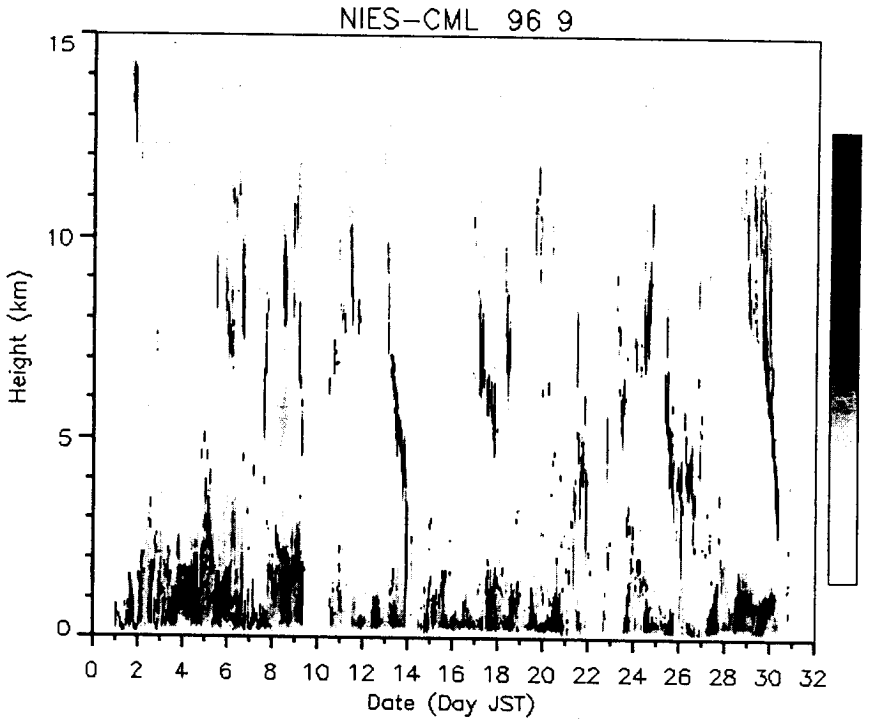

Fig. 4 Temporal variation of vertical profile of aerosols over Tsukuba measured with a compact Mie scattering lidar at NIES. (Range corrected THI).