

LIDAR MEASUREMENTS OF STRATOSPHERIC AEROSOL OVER BEIJING AND ANTARCTIC

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This paper will analyze variation properties of the stratospheric aerosol over Beijing and Antarctic, based on lidar measurements during 1991–1993 in Beijing ($39^{\circ} 54' N$, $116^{\circ} 27' E$) and March–November of 1993 at the Chinese Station ($69^{\circ} 22' S$, $76^{\circ} 23' E$) in Antarctic and sunphotometer–pyrheliometer measurements in Beijing from 1984 to 1993.

The lidar system used in Beijing from 1991 to 1992 and at the Chinese Station in 1993 consists of a Q-switched ruby laser with output energy of about 1.0J and a 40cm Cassegrain type telescope, and the lidar used in Beijing during 1993 has a 1.5m Cassegrain type telescope and a ruby laser with almost same output energy.

Since July 1991 the stratospheric aerosol is continuously monitored with the ruby lidar in Beijing. Fig.1 shows the year-averaged aerosol optical depth (dashed-curve) between 10km and 30km derived from the lidar-detected backscatter depth with assuming an aerosol extinction to backscatter ratio of 40. In Fig.1, the upper solid-curve represents the year-averaged total atmospheric columnar aerosol optical depth at $0.7\mu\text{m}$ measured by using the sunphotometer–pyrheliometer in Beijing during clear days, the figure out of the brackets is the value of the aerosol optical depth, and the figure in the brackets is corresponding year-averaged solar direct radiation in the wavelength range from $0.3\mu\text{m}$ to $4\mu\text{m}$ with the unit of w / m^2 . Fig.2 shows the lidar-measured aerosol backscatter depth in Beijing since June 1991. It can be found from Figs.1 and 2 that:

(1) The variation of the year-averaged stratospheric aerosol optical depth is quite same as the variation of the total columnar optical depth, from

1990 to 1992 the depths increase and after 1992 the depths decrease. After the Mt.-Pinatubo eruptions the stratospheric aerosol content has an increase of about one order of magnitude during October of 1991 in Beijing with the case that on October 16 the stratospheric aerosol optical depth is up to 0.18 and the largest backscatter ratio is 36 at the height of 22km, and the year-averaged stratospheric aerosol optical depth in 1992 is 0.08 larger than the normal value. The year-averaged total atmospheric columnar aerosol optical depth measured by sunphotometer and pyrliometer in 1992 is 0.14 larger than the one in 1990 before the Mt.-Pinatubo eruptions.

(2) The direct solar radiation has a decrease of about 20% from 1990 to 1992, which is basically coincident with lidar (or radiometer) observations..

(3) Since about 200 days after the Mt.-Pinatubo eruptions the stratospheric aerosol backscatter depth has a decreasing tendency.

Futhermore, lidar measurement results of the stratospheric aerosol in Beijing will be compared with the total atmospheric aerosol optical depths by using radiometer over Dunhuang (39 ° 46' N, 98 ° 29'E), Kashi (39 ° 28' N, 75 ° 59' E), Fuzhou (26 ° 5' N, 119 ° 17' E), Wulumuqi (43 ° 47' N, 87 ° 37' E) and Tengchong (25 ° 1' N, 98 ° 30' E) from 1990 to 1993 to analyze transport process of the Mt.-Pinatubo volcanic aerosol in China.

Since March 1993, our Institute started a three-year plan of lidar measurements of stratospheric aerosol over Antarctic. During 1993 altogether 62 groups of lidar-detected aerosol backscatter ratio profiles are obtained. Fig.3 shows some measurement results in April, June, August and October. As shown in Fig.3, there is often a aerosol layer with the maximum backscatter ratio of being up to 6 around the height of 12km over the Chinese Station in Antarctic, and another considerably strong aerosol layer around the height of 24km is sometimes observed. This paper will futher describe the aerosol profile and the integrated aerosol backscatter depth.

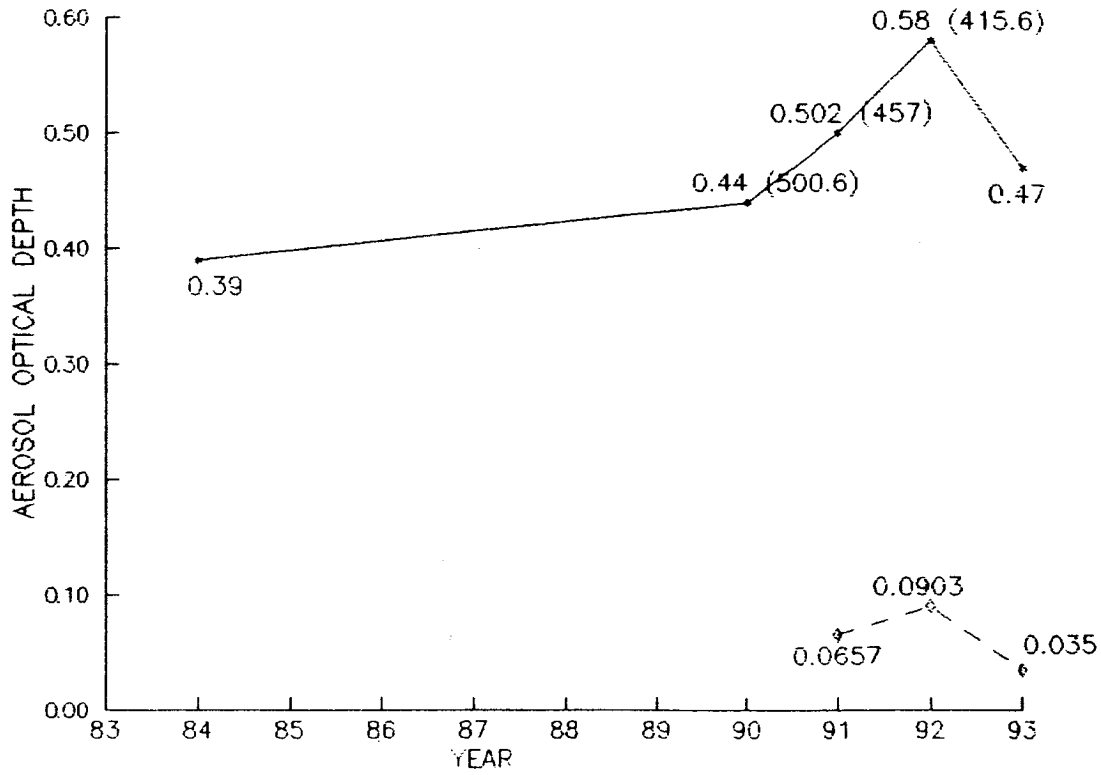


Fig.1 YEAR-AVERAGED AEROSOL OPTICAL DEPTH DURING 1984-1993

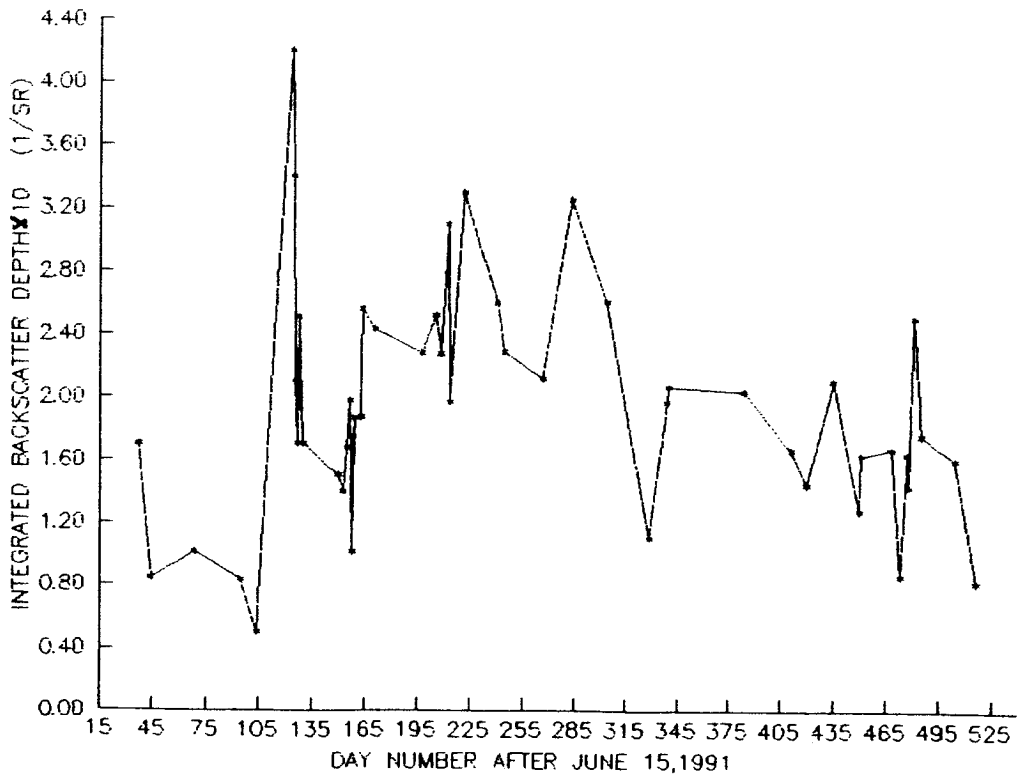


Fig.2 INTEGRATED AEROSOL BACKSCATTER DEPTH

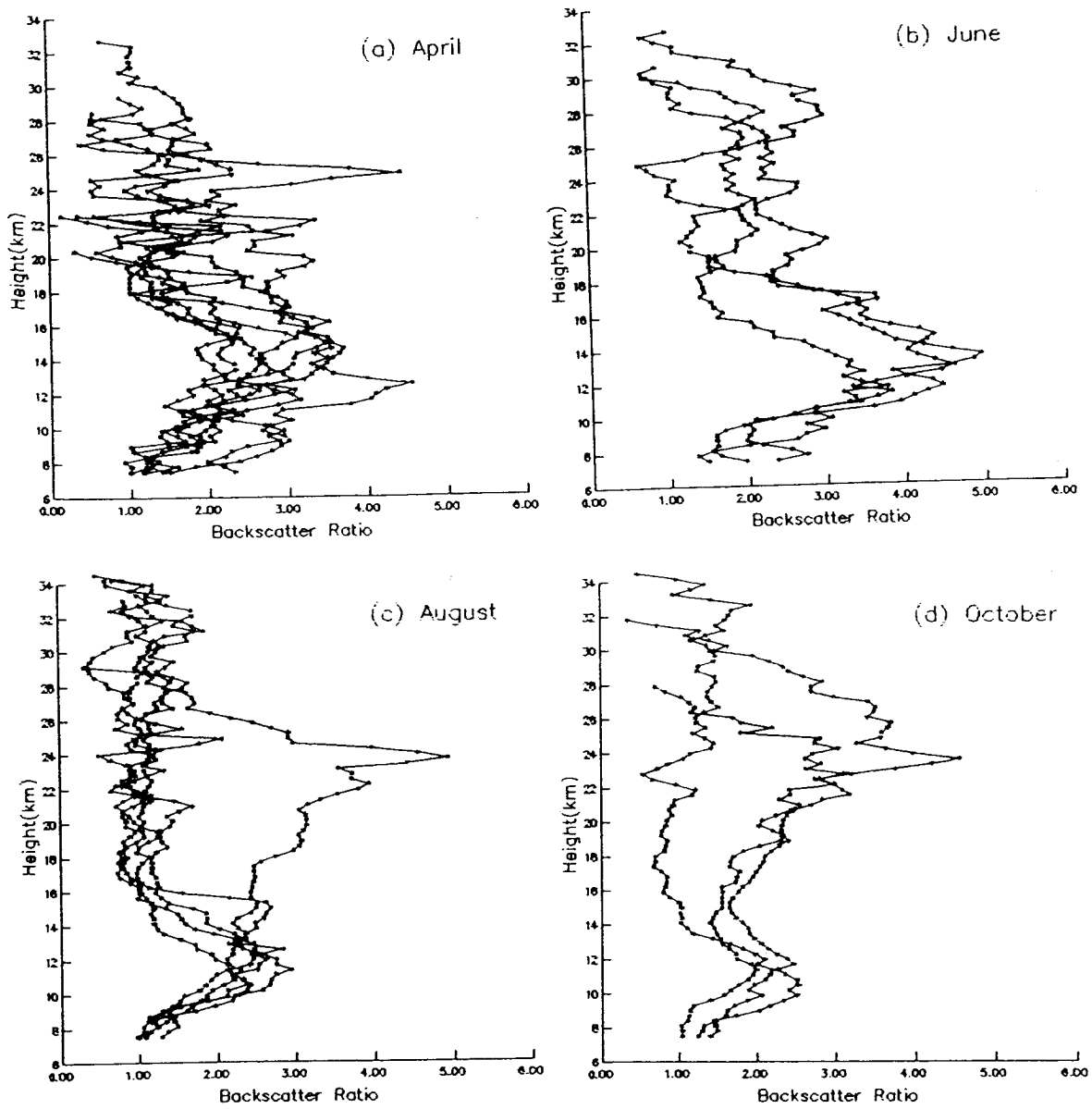


Fig.3 Backscatter Ratio over the Chinese Station in Antarctic in 1993