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Variation of Pinatubo Volcanic Aerosols Observed by Lidar in Fukuoka, Japan

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Introduction

Violent Eruptions of the Philippine Volcano Pinatubo in mid June 1991 injected a large amount of volcanic gases into the stratosphere and caused a serious perturbation on the stratospheric aerosols for a long period (more than 3 years) . The vertical distribution of the volcanic aerosols has been observed by Nd : YAG lidar in Fukuoka (33N, 135E) since June 7 , three weeks after the major eruptions . The characteristics of the lidar system at Fukuoka University are shown in Table1 .

All the profiles of backscattered signals have been normalized well above the aerosol layers by matching them with the Raileigh backscattering profiles which are calculated from the rawin sonde data obtained by Fukuoka Meteorological Observatory . Fernald's method has been applied in the analysis to take into account the effects of attenuation of the laser beam and return signals by atmospheric particulates .

Observations

Fig.1 shows 400 day variation of scattering ratio (R) . There are some important aspects to be noticed . First , an intense scattering layer ($R \geqq 2$) appeared around the altitudes of 22 km about 80 days after the day of the eruption of Mt. Pinatubo , and the layer has persisted for a long period (more than 3 years) decreasing its peakvalue . Second , the width of the layers has broadened gradually since the autumn in 1991 . Third , there are substructures with short period in the long term variation of the layer . Extremely intense scattering layers appeared every about one month. The layer was enhanced when southerly component of local winds at the altitudes of around 20 ~ 25 km were enhanced.

Fig.2 shows 900 day variation of integrated backscattering coefficient (I.B.C.). In the long term variation there are two maxima. The appearance of the maxima corresponds to the enhancement of westerly winds in winter seasons, and is considered to be seasonal variations. In the long term variation of I.B.C., there are substructures of short periods. These substructures also correlate with the southerly component of the local winds similar to the case of scattering ratio.

Latitudinal diffusion of aerosols was activated by the effects of the westerlies in winter with intermittent injections of dense aerosol in the lower latitude which occurred at intervals of about one month. The injections correlated with southerly component of local winds at the altitudes of around 20 ~ 25 km. In consequence of the active latitudinal diffusion, column density of stratospheric aerosols over Fukuoka increased and thickness of the layer was broadened.

Results of the analysis about the vertical transportation of the aerosols by diffusion and sedimentation will be shown in the presentation.

(1) Transmitting System		
laser	:	Nd : YAG laser
wave length	:	532 nm (second harmonic wave)
power	:	100 mJ / pulse
pulse width	:	7 nm
repetition rate	:	10 Hz
collimator	:	10 cm telescope
(2) Detecting System		
telescope	:	30 cm (Cassegrain type)
filter	:	532 nm narrow band pass interference filter (half width : 1.7 nm)
photo multiplier	:	E M I 9558QB
photon counter	:	multi channel analizer (MCA) divide a signal into 1024 channels and count the number of photons within each channel (1 channel = 1micro sec.)

Table1 specification of the lidar system

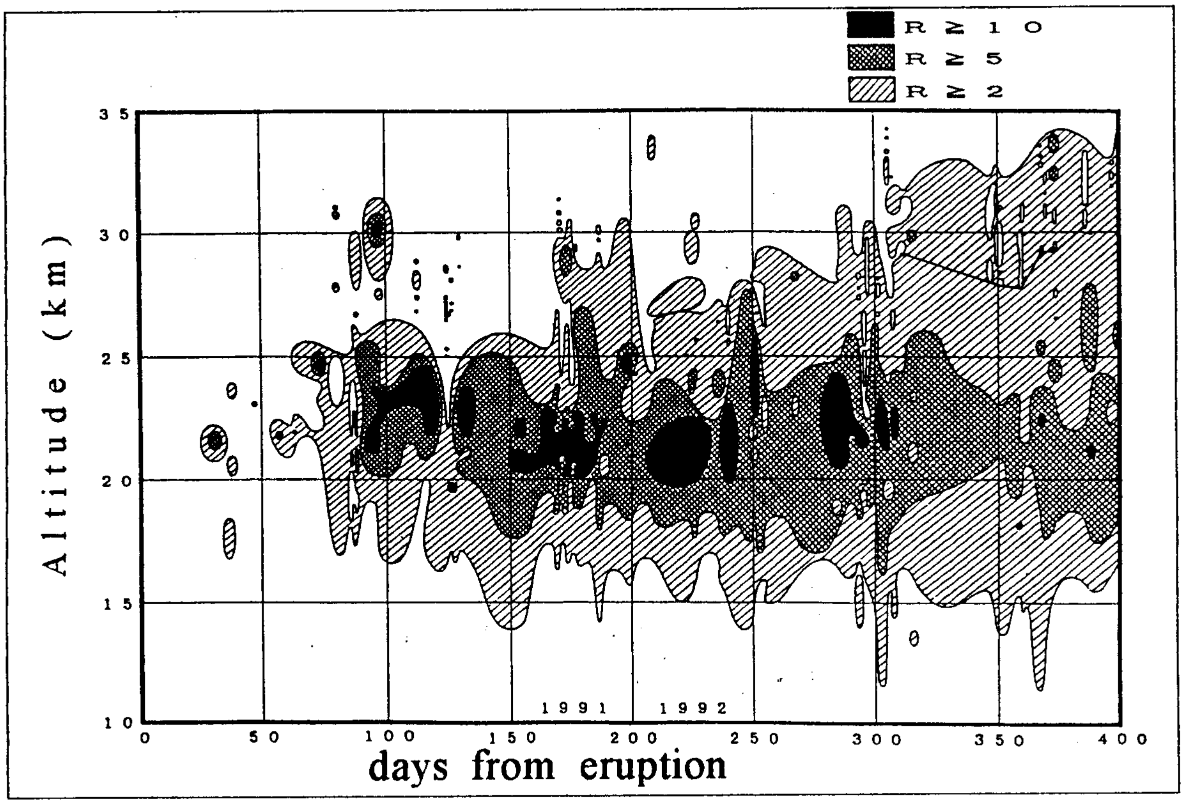

Fig. 1 400 day variation of scattering ratio (R)

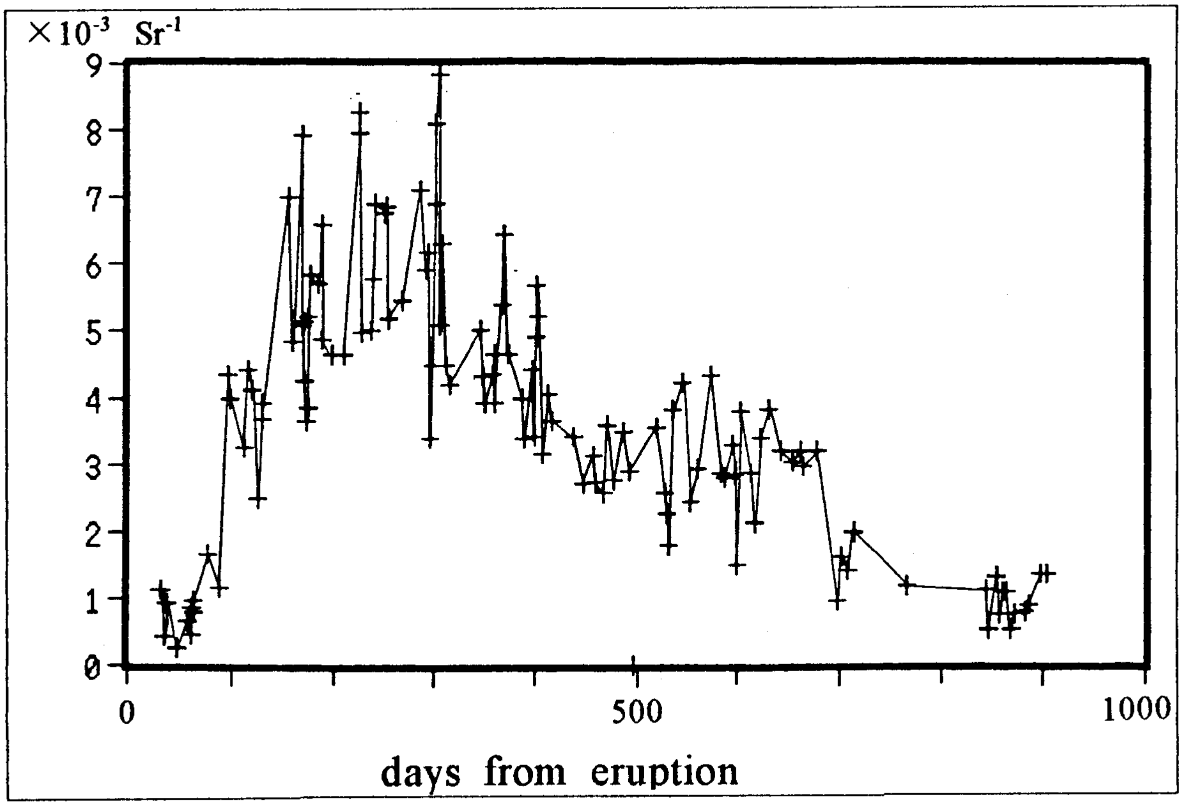

Fig. 2 900 day variation of integrated backscattering coefficient (IBC)