1 YAGレーザーレーダーによる成層圏エアロゾル層の観測
(I). 最近の観測結果とその理論的検討

Observation of Stratospheric Aerosols with Nd:YAG Laser Rader.
Part I: The Results of Recent Observations and a Theoritical Study

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There have been two large volcanic eruptions since we began Nd:YAG Lidar observation of stratospheric aerosols, or since Oct.'79. A vast amount of dust has been injected into the stratosphere by each of these eruptions. One eruption is that of well-known Mt.St.Helens (46.2°N,122.2°W) whose major eruption occured on 18 May,1980. The scale of the eruption is estimated at the greatest one in this century. The drastic increase and the change of stratospheric aerosols were observed by many groups in the world. The other is that of Sierra Negra (0.8°N,91.2°W), which erupted on 13 Nov.,1979. The scale of the eruption was not so large, and the dust amount which penetrated into the stratosphere was smaller than that of Mt.St.Helens. The increase of stratospheric aerosols in Dec.'79 which was observed by SAGE and Rosen and Hofmann[1)] is now infered that it originated from the eruption of Sierra Negra. Our lidar system has detected both increases of stratospheric aerosols caused by these two volcanic eruptions, and the change of backscatter from stratospheric aerosols.

In both cases, when the first detection of the increase of stratospheric aerosols, the peak value of the scattering ratio R at 1.064 μm (Nd:YAG fundamental) was 2.0, and the width of the increased layer was less than 750 m. (Fig.1) Since (R-1) is proportional to λ^{α} (λ is wavelength,and α is about 3.),[2)] (R-1) or R for Nd:YAG Lidar at 1.064 μm is larger than that of other conventional lidars, which are generaly used for the observation of stratosperic aerosols, and whose wavelengths are shorter than 1.064 μm (for instance ruby Lidar, λ =0.694 μm).

Therefore, YAG lidar has been expected more useful for observation of stratospheric aerosols[2], especially when aerosols incleased as such a thin layer. We were able to observe this increased layer accurately at 1.064 μm, as was expected.

The accuracy of the observation with Nd:YAG 2nd harmonic (0.532 μm) is not so good as that of Nd:YAG fundamental.When stratospheric aerosols are not increased, the scattering ratio at 0.532 μm is as small as about the limit of the detection. But, when the amount of aerosol is increased, we can observe the aerosol layer with good accuracy.

The information about the size distribution of stratospheric aerosols can be obtained by the comparison of the backscattering coefficient of two wavelengths (1.064 μm, 0.532 μm). We observed the increase of β_S/β_F at the layer after the increase of stratospheric aerosols, where β_S and β_F are backscattering coefficient at 0.532 μm and 1.064 μm. (Fig.2) The increase in Fig.2 will correspond to the result of the observation in ref.1. After the increase of stratospheric aerosols caused by Mt.St.Helens, β_S/β_F has been gradually increased from about 1.5 to about 4.0. We are tring to reproduce this change by a numerical model which takes account of some physical and chemical processes.

References :

1) Rosen,J.M. and D.J.Hofmann, A Stratospheric Aerosol Increase, Geophys.Res. Let.,7, 669-672, 1980.

2) Shibata,T.,M.Fujiwara and M.Hirono, Observation of Stratospheric Aerosols by Nd:YAG Lidar with a New Type of Near-Infrared-Sensitive Photomultiplier Tube, Jpn.J.Appl.Phys.,19, 2205-2209, 1980.

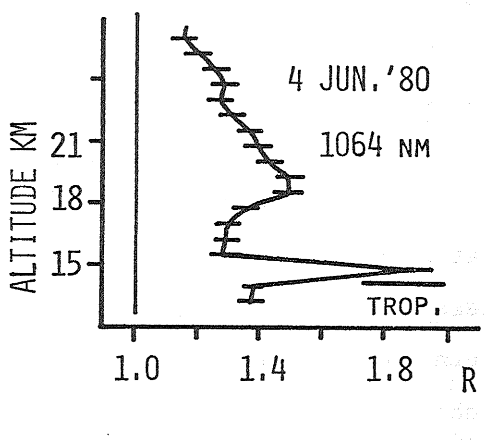

Fig.1

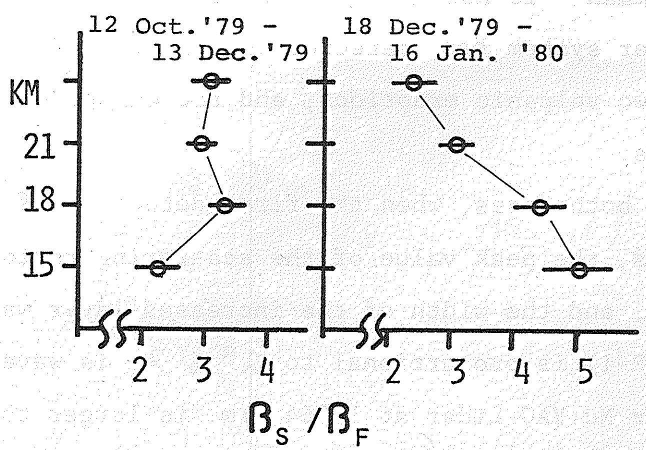

Fig.2