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STUDIES THE STRATOSPHERIC AEROSOL LAYER BY SPECTRAL-POLARIZATION LIDAR

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Lidar sounding the stratospheric aerosol layer (SAL) has been carried out at the lidar station in the Institute of Physics (Minsk, 53.85^o N, 27.5^o E) since 1985. The lidar station (Ref.1) contains a receiving Cassegrain telescope having 500 mm diameter, a two-wavelength radiator, a four-channel optical analyzer, a computer and a system for data processing. The optical analyzer allows two-wavelength sounding and simultaneous determining the depolarization ratio of a backscatter signal. The receiving system contains 4 photo-multipliers (PM-136, and special PM for infrared region) and an electro-mechanical shutter to safeguard photo-elements against the backscatter radiation of the near zone. The radiator of the lidar station is a YAG-laser working at two wavelengths $\lambda_1 = 0.532$ and $\lambda_2 = 1.064$ µm.

We have processed experimental data and calculated the total-to-Rayleigh backscatter ratio $R(h) = [\beta_a(h) + \beta_m(h)]/\beta_m(h)$ (where $\beta_a(h)$ and $\beta_m(h)$ are aerosol and molecular backscatter coefficients respectively) by means of the technique developed in Ref.2. In calculating the profile *R(h)* the reference point was taken at the height about 30 km. A backscatter signal at the wavelength 1.064 µm coming from near this height was perturbed by noise noticeably. In the cases of cirrus presence during the stratosphere sounding, the ratio of the backscatter values at two wavelengths in the cirrus cloud was additionally taken to reduce error values for *R(h)*. With the same purpose, in the analysis of experimental data obtained by long measurement series, the specific function was considered, defined by

$$\alpha(h) = \frac{\beta_a(h,\lambda_1)\beta_a(h',\lambda_2)}{\beta_a(h,\lambda_2)\beta_a(h',\lambda_1)}.$$

The function $\alpha(h)$ is the ratio of aerosol backscatter values at two wavelengths, normalized at the value of this ratio taken at the certain height h' within the tropopause layer. Changing of aerosol micro-structural parameters with the height leads to variations in the function $\alpha(h)$.

The technique for determining profiles of the aerosol backscatter depolarization has been developed in Ref.3. Analysis of experimental data after Mt.Pinatubo eruption taken at the lidar station of the Institute of Physics brought out the following features of the optical parameters height profiles.

The degree of the backscatter aerosol depolarization 0.02 - 0.03 was measured within the SAL. Such values were close to the experimental errors. The small depolarization bears evidence to aerosol be formed by a liquid. Large depolarization values were measured in the tropopause, what is probably because of cirrus traces. Depolarization was found to be also larger in the upper layers of the stratosphere.

After Mt.Pinatubo had erupted, two typical profiles $\alpha(h)$ were brought out. The first profile (Fig.1) was typical for the period from November, 1991 till January, 1992. It was characterized by weak height dependence of $\alpha(h)$ (line 2) in that region of the SAL where *R(h)* was a maximum (line 1). At the same time, increased values $\alpha(h)$ were measured at heights above the SAL. For the following time-period (Fig.2), another profile was typical which showed rising $\alpha(h)$ with the height growth.

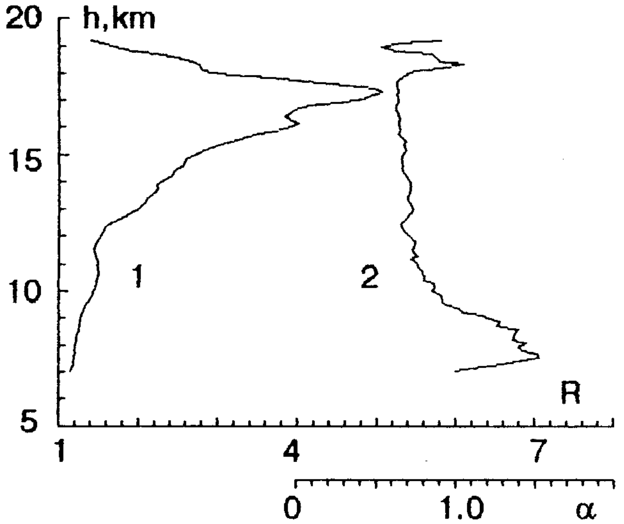

Fig.1. The profiles *R(h)* (1) and $\alpha(h)$ (2) observed on January 13, 1992.

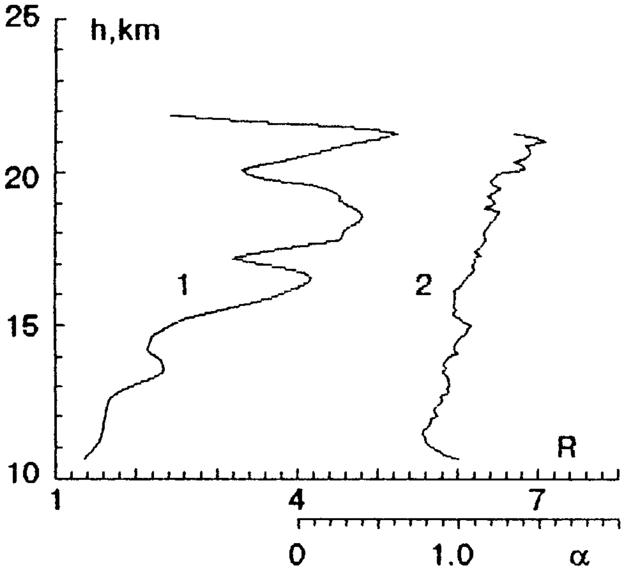

Fig.2. The profiles *R(h)* (1) and $\alpha(h)$ (2) observed on May 2, 1992.

It was found for some layers to be occasionally characterized by enhanced degree of depolarization accompanying by relatively small aerosol backscatter ratio values $\gamma(h) = \beta_a(h, \lambda_1)/\beta_a(h, \lambda_2)$ (the example is shown in Fig.3). This can be due to large particles having irregular form.

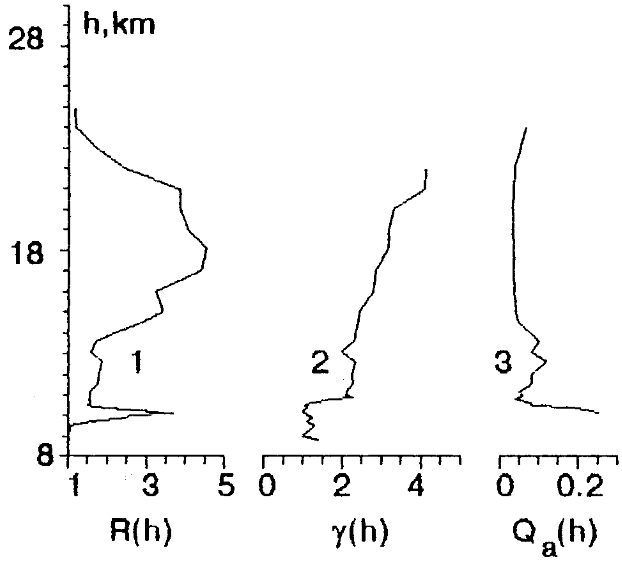

Fig.3. The optical parameters profiles observed on April 1, 1992: 1 - *R(h)*; 2 - $Q_a(h)$; 3 - $\gamma(h)$.

References

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