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STATISTICAL ANALYSIS FOR STRATOSPHERIC AEROSOL SENSING DATA AFTER Mt. PINATUBO ERUPTION

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Experimental investigation of the stratospheric aerosol dynamic after the Mt. Pinatubo eruption has been carried out at the lidar station housed in the Institute of Physics the Belarus Academy of Sciences (Minsk, 53.85^{o} N, 27.5^{o} E). The statistical analysis for vertical profiles of the total-to-Rayleigh backscatter ratio $R(h)$ has been performed to establish a generality in the behavior of the stratospheric aerosol layer (SAL). The data processing resulted in that the correlation matrix and its eigenvectors have been found, besides, the profiles have been classified and its dynamic has been brought to light in terms of the profile classes.

The used technique of the data statistical processing is analogous to that of Ref.1. We reported in Ref.1 our studying the stratospheric situation when macroparameters of the SAL are stable enough likewise in the background case. Therefore, the obtained results of Ref.1 stay also valid in the main features applying to other unperturbed stratospheric situations.

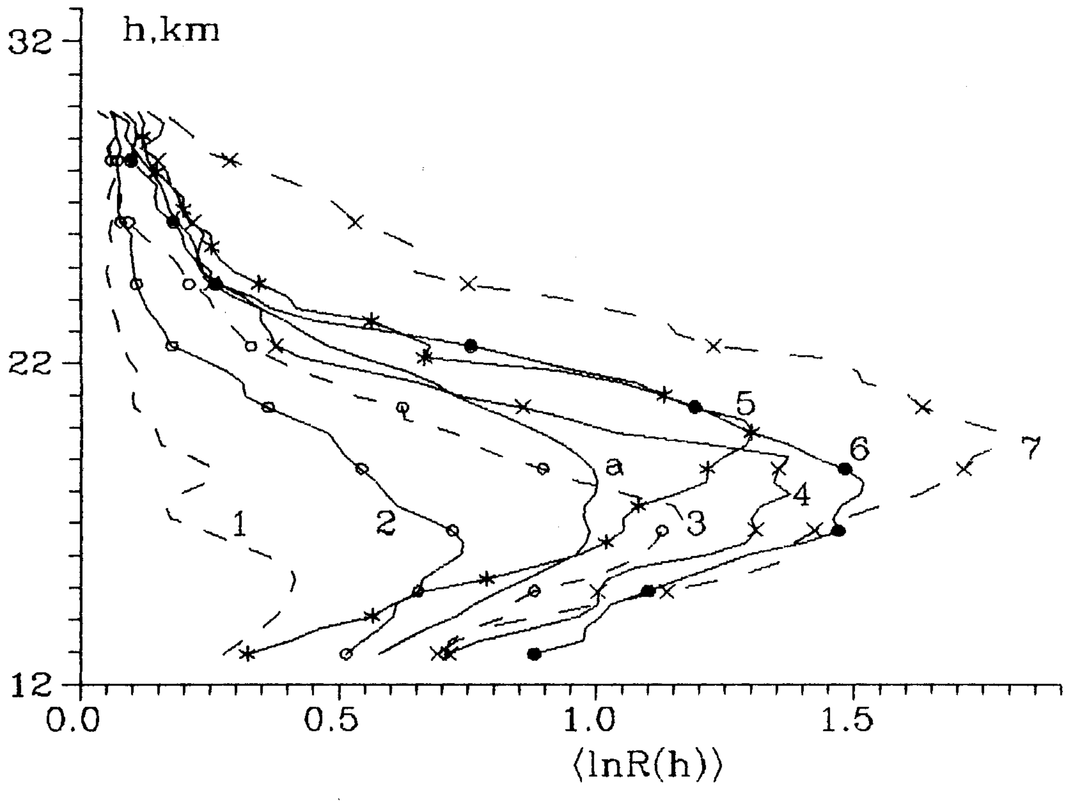

Fig.1. Profiles $<\ln[R(h)]>$ (a) and $<\ln[R(h)]>_p$ (p=1,...,7).

The present work, on the contrary, deals with the unstable stratosphere. The results are relevant to the period from July, 1991 till May, 1993. The 82 profile examples $R(h)$ from experiments were taken to be analyzed. We have calculated the mean profile $<\ln[R(h)]>$, the covariant matrix W for the vectors $\ln[R_k(h_j)]$ (k is the profile number, h_j height), the eigenvalues and eigenvectors $\xi_i(h_j)$ of the operator W.

It appears that the sum of the first three eigenvalues amounts to 73% of the total sum, i.e. for 73% of variations of the vector $\ln[R_k(h_j)]$, the equation holds (cf. Ref.2)

$$\ln[R_k(h_j)] \cong <\ln[R(h_j)]> + \sum_{i=1}^{3} c_{ki}\xi_i(h_j).$$

Emphasize, the three values c_{ki} (k=1,2,3) provides the main information about the profile features.

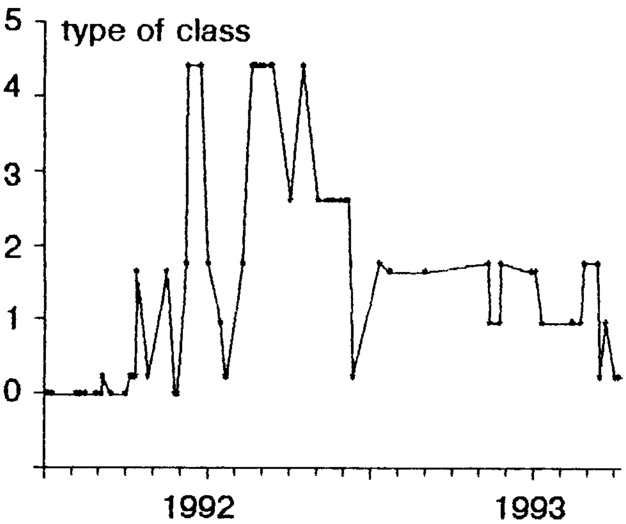

Fig.2. The time-distribution of the profiles $\ln[R_k(h_j)]$ in classes.

The coefficients c_{ki} were further used to classify the experimental data through the code ISODATA (see Ref.3). It was found that the measured massive of data for $\ln[R_k(h_j)]$ allows to be separated into seven classes. The Fig.1 depicts the resultant overall mean profile $<\ln[R(h)]>$ and the mean profiles $<\ln[R(h)]>_p$ (p=1,...,7) for the classes. From the Fig.1, it is seen, the classes are distinguished by the aerosol vertical distribution and total amount.

The Fig.2 illustrates the time-distribution of the profiles $\ln[R_k(h_j)]$ in classes. The type of class, to which 24-hourly profile belongs, is plotted against periods of time. It is convenient with the graphic of the Fig.2 to distinguish between periods of time when the SAL was in the states of formation, evolution and degradation.

As a conclusion we note, the performed analysis resulted in the nice compact representation for the variety of the experimental total-to-Rayleigh backscatter ratio profiles. Due to this representation, tendencies in time dependence of the profiles have become easy-to-interpret. The developed classification can be also used to compare scattering profiles measured at different lidar stations.

References

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