SPACE INHOMOGENEITIES OF THE BACKSCATTERING COEFFICIENT AS OBSERVED FROM LIDAR SOUNDING DATA

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ABSTRACT

The variability of the thermodynamic state of the atmosphere in time and space gives rise to the concentration and structure field of the atmospheric aerosol being inhomogeneous. It is obviously shown by the statistical material stored at the searchlight sounding of the atmosphere. The optical state of the atmosphere is subjected to random changes practically at any altitude. Weak correlation of the scattering coefficient variations in different spectral regions points out the change not only of the concentration but also of the nature and sizes of the aerosol particles.

The existence of aerosol complexes and their transfer by the atmospheric motions accounts for instability of the atmosphere properties. This phenomenon can be used for the measurement of the wind velocity vector, in this case it is necessary to know the aerosol inhomogeneity parameters. However, the structure of those remains uninvestigated up to date.

The aim of the paper was to investigate the character of the space variations of the backscattering coefficient from the lidar signals. The investigation procedure consisted of the observation and registration of the fluctuations of the reflected signal envelope. The lidar with the following parameters was used: pulse energy - 0.1 j; duration - 30 ns; mirror area - 0.02 m^2.

The fluctuations of the registered signal are due to the atmosphere inhomogeneity and background noises. An effective mean to separate out the signal from the noise background is a mutual correlating analysis. At the same time the interval between sounding pulses must not exceed the temporal radius of the correlation of backscattering coefficient fluctuations. For each concrete case this interval can readily be chosen from the experiment.

The investigations were carried out for typical states of the atmosphere (haze, mist, precipitation). The results show the presence of aerosol inhomogeneities practically under all conditions in the atmosphere. However, their scale and degree (it can conveniently be characterized by the variation coefficients) are essentially different. It is noticed that the atmosphere turbidity growth gives rise to the decrease of the inhomogeneity scale and the increase of the variation coefficient.

Thus in hazes the mean size of inhomogeneities is of the order of some hundred meters. The variation coefficient changes within 0.03 ÷ 0.15. For precipitation and mist the typical scale of inhomogeneities was of tens of meters, the variation coefficient reaches the values of 0.3.