USE OF POLARIZATION LIDAR FOR INVESTIGATION OF METEOROLOGICAL FORMATIONS

Yu.S.Balin, G.O.Zadde, V.E.Zuev, G.M.Krekov,
G.G.Matvienko, A.I.Popkov, I.V.Samokhvalov,
G.A.Titov, V.S.Shamanaev
Institute of Atmospheric Optics of the Siberian
Branch of the U.S.S.R. Academy of Sciences,
Tomsk, U.S.S.R.

ABSTRACT

This paper presents the results of theoretical and experimental investigations of depolarization characteristics of different meteorological formations. Experimental investigations are carried out with a monostatic lidar. The ruby laser radiation is polarized in a vertical plane. The radiation reflected is accepted by a lens system of 150 mm in diameter and a viewing angle of 12' and further it is divided by Wollaston prism into the components polarized orthogonally. In this case the principal plane of the prism is exposed parallel with the laser polarization plane.

Investigations show the degree of radiation polarization, reflected from water clouds, to be changed within 1÷0.7 (seldom up to 0.6) depending on their density. In most cases a signal reflected from the cloud leading edge is polarized completely. The time shift is observed between polarized and crosspolarized components of a signal, reflected from a cloud, depending on the density of a meteorological object. While penetrating into the cloud depth a degree of polarization decreases up to 0.8-0.7, and the character of this decrease is different for various types of clouds.

For crystal clouds the shift between the components of the reflected signal is not observed and the magnitude of polarization degree amounts to 0.1÷0.3 in comparison with water clouds. The polarization degree of radiation reflected by fog is not less than 0.6, and that in the rains of average intensity (about 5mm/h) is always about 1.

The authors have suggested an algorithm of numerical solution of nonstationary transfer equation in the vector form to forecast the influence of multiple scattering effects on polarization characteristics of

the lidar light signal. The method of statistical simulation (Monte-Carlo technique) forms the basis of the algorithm.

Numerical estimates obtained for a model of stratocumulus at $\lambda = 0.6943\mu$ under boundary conditions close to the conditions of natural experiment being discussed proved to be in a good agreement with the results of observation.

Specifically, Fig. 1 shows the profiles of polarization (P) versus depth (L) of the following drop formations: fog (curve 1) with horizontal meteorological visibility of 4 km two stratocumulus at a height of 1100 m with the attenuation factors $\delta = 0.01m^{-1}$ (curve 2) and $\delta = 0.05m^{-1}$ (curve 3). Curve 3 shows the results of numerical estimates and the value of their statistical error.

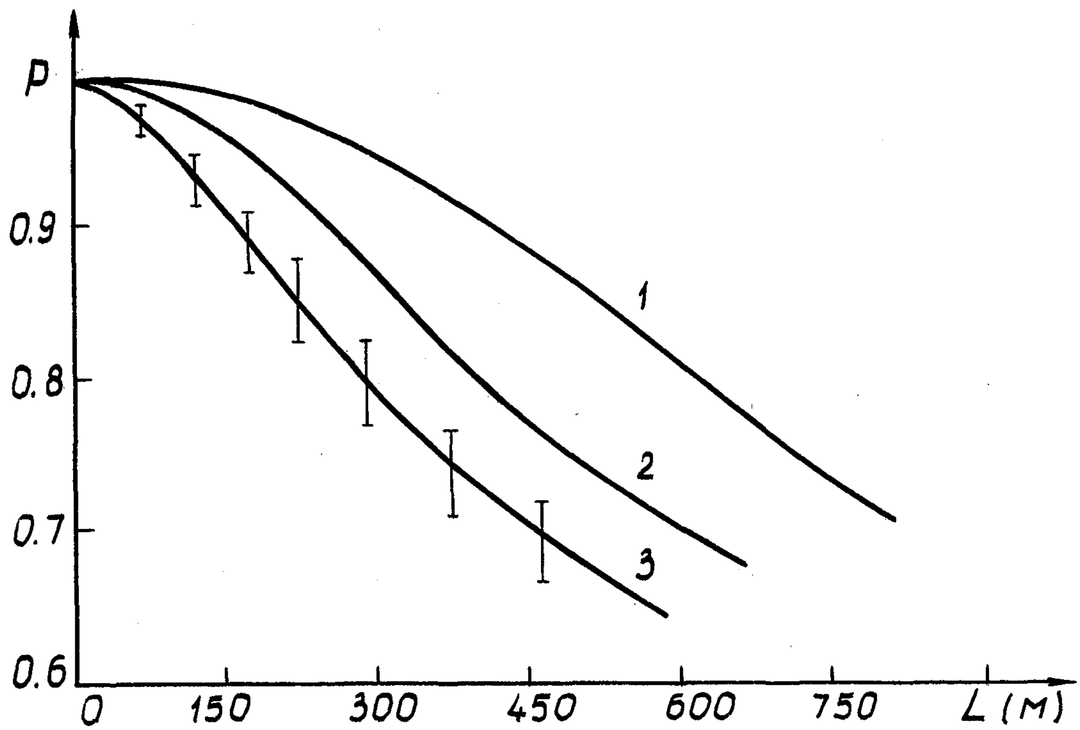

Fig. 1