Monte Carlo simulation of laser pulse propagation in clouds and water media

Daria E. Mironova [1], Sergei M. Prigarin [2]

The receiver of a monostatic wide-angle CCD lidar should record an expanding luminous ring in the case of sensing cloud layer of an optical thickness less than 4 in visible range of the spectrum [1, 2]. The brightness of the ring rapidly decreases with respect to time. The radial speed measured by the brightness ring area decreases for optical thicker cloud layers.

This paper being a continuation of the research presented in [3], deals with stochastic simulation of short laser pulses scattering in atmospheric clouds and water media. We analyze peculiarities of photons distribution in thin cloud layers. Simulation results show that the smaller luminous ring may appear for a short time in addition to the primary ring of light expanding in the cloud layer. The second ring appears because of local maxima of the cloud phase functions in the neighborhood of 180 and 140 degrees. Existence of such local maxima is typical for the most cloud phase functions. Moreover, under certain conditions the effects similar to expanding ring may be observed in water media.

References

[1] Love S. P., Davis A. B., Ho C., Rohde C. A. *Remote sensing of cloud thickness and liquid water content with Wide-Angle Imaging Lidar (WAIL)* // Atm. Res. 2001. N 59-60. P. 295-312

[2] Prigarin S. M., Aleshina T. V., *Monte Carlo simulation of ring-shaped returns for CCD LIDAR systems* // Russian J. Numer. Anal. Math. Modelling. 2015. V. 30. N 4. P. 251-257.

[3] Prigarin S. M., Mironova D. E. *Stochastic simulation of 3D distributions for laser pulses scattered in optical media*, Proc. SPIE 10035, 22nd International Symposium on Atmospheric and Ocean Optics: Atmospheric Physics, 100351M (November 29, 2016).

[1]Institute of Computational Mathematics and Mathematical Geophysics, SB RAS, prospect Akademika Lavrentjeva, 6, Novosibirsk, 630090, Russia. E-mail: `mirkin_93mail.ru`

[2]Institute of Computational Mathematics and Mathematical Geophysics, SB RAS, prospect Akademika Lavrentjeva, 6, Novosibirsk, 630090, Russia,
Novosibirsk State University, Pirogova Str., 2, Novosibirsk, 630090, Russia. E-mail: `sergeim.prigarin@gmail.com`