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Numerical statistical study of reconstruction algorithms of the aerosol scattering matrix elements.

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The variations of the sky brightness are defined mainly by the volatility of the aerosol part of the atmosphere, which posesses strong scattering ability. Theoretical study of the radiation transfer problems is impossible without knowing it's optical parameters. In this work is considered the problem of reconstructing the aerosol scattering matrix by using observations of polarized radiation in the solar almucantar, i.e., in various directions that make the same angle θ_s with the zenith as the line of sight to the Sun [1, 2, 3].

The first component of the matrix is scattering phase function or indicatrix of the atmosphere, the second component is responsible for the polarization of radiation. Under the "single-scattering" approximation the observed values of the Stokes vector are proportional to the corresponding values of the matrix components.

Several iterative algorithms for estimation of the indicatrix are constructed in [1, 2, 3]. In this algorithms the values of the indicatrix are successively refining by mathematical modeling based on the information of the angle distribution of the radiation intensity on the underlying surface and under the assumption that the contribution of the single-scattered radiation is rather large. The polarization of radiation by air molecules is taken into account by using the well-known matrix of Rayleigh scattering. Reconstruction of the scattering matrix is carried out in several steps. On the first step we reconstruct the first component of the matrix assuming that the second component is null, after that we reconstruct the second component using the estimate of the first component. In this work the predictor-corrector modification of the method is suggested, i.e. on the third step we are looking for more precise estimate for the indicatrix using the estimate for the second component received on the second step..

In [4] is given theoretical substantiation of the convergence of the reconstruction methods for the indicatrix for specific parameters of the atmosphere. In order to numerically substantiate the convergence of these methods, an algorithm of Jacobi matrices calculation for the iteration operators of the methods was developed,

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and calculations were carried out for various parameters of the atmosphere. The objective of this work is to numerically substantiate the convergence of the methods of reconstructing the scattering matrix and suggested modification. Also a study of the influence of measurement errors on the reconstruction of the scattering matrix was carried out. Test calculations showed the stability of algorithms to errors in the initial data.

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