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# Retrieval of aerosol microstructure and radiative properties for moderate turbidity under conditions of West Siberia

T. B. Zhuravleva (1), T.V. Bedareva (1), and M.A. Sviridenkov (2)

(1) V.E. Zuev Institute of Atmospheric Optics, SB RAS, Tomsk, Russian Federation (ztb@iao.ru), (2) A.M. Obukhov Institute of Atmospheric Physics RAS, Moscow, Russian Federation

Reliable information on columnar optical and microphysical aerosol properties is urgent for an adequate assessment of the aerosol radiative and climatic effects. One of the basic methods for a passive remote sensing of the aerosol in the total atmospheric column is Sun and cloudless sky photometry. In particular, the spectral measurements of the direct and diffuse solar radiation with the automatic Sun-sky scanning radiometers and the algorithms developed to solve the inverse problems [1] make it possible to retrieve the microphysical and optical characteristics of the atmospheric aerosol on the basis of measurements in many regions of Earth by a unified technique. However, the strategy [1] is specific in that the data of the Level 2.0, presented on the AERONET website (http://aeronet.gsfc.nasa.gov), contain retrieved values of such important aerosol characteristics as single scattering albedo (SSA) and refractive index only for situations when aerosol optical depth (AOD) $\tau$ for the wavelength of 440 nm exceeds 0.4. This is why the data are scarce for the regions with weak anthropogenic loading (for instance, the mean value of $\tau$(500 nm) for the boreal zone of Siberia is 0.15 in summer). The lack of the data on aerosol microphysical and radiative parameters stimulates the development of different approaches to aerosol retrievals from the data of Sun/sky measurements.

This paper presents the results of the aerosol parameter retrieval at low and moderate atmospheric turbidities with newly developed software package. Our approach is based on iterative solution of the radiative transfer equation by the Monte Carlo method and on subsequent solution of the linear inverse problem for the single scattering characteristics. To increase the rate of convergence of the iterative procedure, the initial aerosol phase functions are calculated for the "synthetic" size distribution constructed using separate inversion of spectral AOD (fine fraction) and aureole radiance (coarse fraction). The algorithm was tested in closed numerical experiments with different aerosol models at different AODs and compared with standard AERONET retrievals [1].

To retrieve the aerosol optical and microstructural properties, we selected the data of measurements in the summer periods of 2003-2009 at the Tomsk AERONET station (56.5°N, 85.1°; $\tau$(440 nm)<0.4, $\tau$(1020 nm) >0.05). It was found that mean asymmetry factor of the aerosol phase function decreases from 0.72 at 340 nm to 0.6 at 1020 nm. Such values and spectral behavior do not coincide with widely used models of continental aerosol (WCP, OPAC). The mean SSA in visible region is about 0.9-0.92, slightly decreasing with wavelength. Volume distributions are usually bimodal; and the concentrations of fractions are of the same order. The mean values of the real and imaginary parts of the refractive index under background conditions are 1.5 and 0.011 respectively.

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