Aerosol Optical Thickness During ARM Enhanced Shortwave Experiment Intensive Observation Period

G.S. Golitsyn, P.P. Anikin, and M.A. Sviridenkov
Institute of Atmospheric Physics, Russian Academy of Sciences
Moscow, Russia

Aerosol optical thickness is one of the main optical parameters for characterizing the aerosol content in the atmosphere. During the Atmospheric Radiation Measurement Enhanced Shortwave Experiment (ARESE) intensive observation period (IOP) we measured aerosol optical thickness using two instruments: a photometer with five fields of view (FOV) from 1.9°to 8.3°and an effective wavelength of about 0.53 mcm (time duration - 15 sec) and an acoustic-optical spectrometer (spectral range 415 to 790 nm; measurement time for 128 spectral point - 5 sec, FOV -1°). Both instruments were mounted on a solar tracking system (the error in direction to the Sun does not exceed 2'). The estimated uncertainties in the aerosol optical thickness are about ±0.02. Measurements with MFOV occurred from September 22 to October 19, 1995; spectral measurements were carried out from the beginning of October. The measurements, averaged through the day-time temporal course of aerosol optical thickness τ for a wavelength of 0.53 mcm, are shown in Figure 1.

The background values of τ were about 0.01 - 0.02. An increase of optical thickness was caused usually by the wind erosion or by morning fogs. No noticeable variations in the diurnal course of t were found. The mean half-hour values of τ are shown in Figure 2.

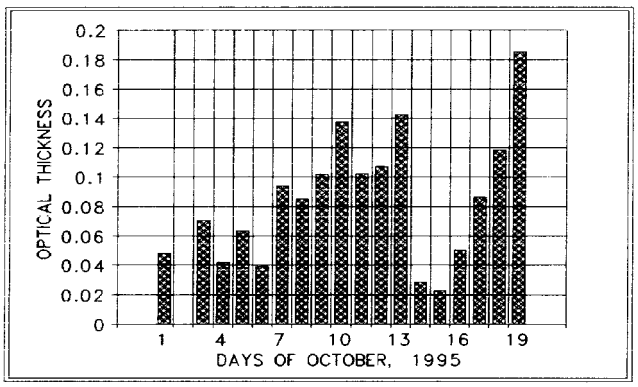

Figure 1. MFOV measurements averaged through the day-time temporal course of aerosol optical thickness τ for a wavelength of 0.53 mcm.

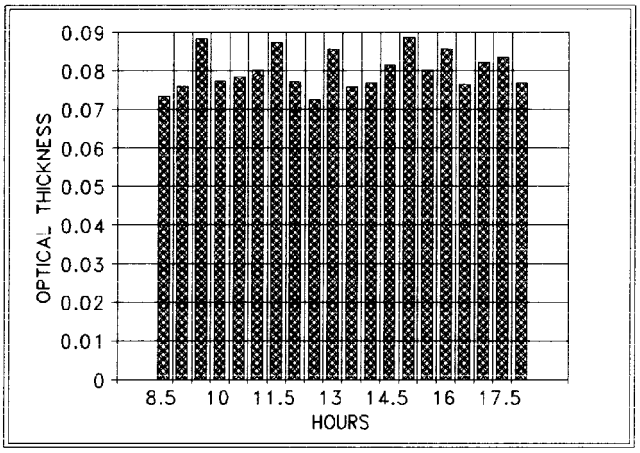

Figure 2. Mean half-hour values of τ.

The examples of typical spectral dependencies of aerosol optical thickness are shown in Figure 3.

An Angstrom exponent was found to be close to zero. This is evidence for a small amount of submicron particles in the period of experiment. Weak spectral dependence of the aerosol optical thickness impedes estimation of the

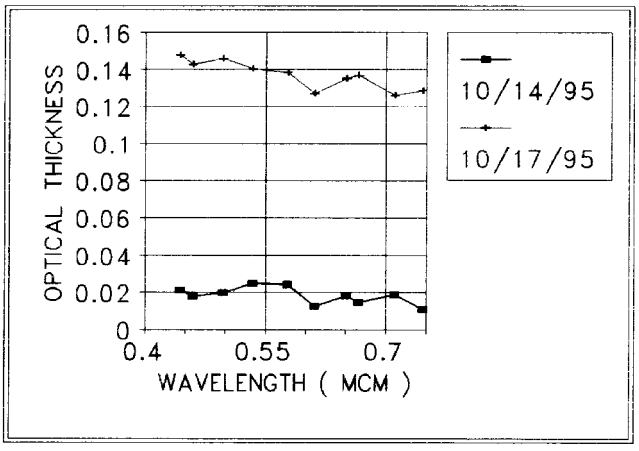

Figure 3. Examples of typical spectral dependencies of aerosol optical thickness.

microphysical characteristics of the aerosol from transparency measurements. The zero value of the Angstrom exponent formally corresponds to the inverse power law size distribution dN/dr (r - radius of particle) with the exponent equal to 3. Parallel with transparency measurements, solar aureole brightness was also recorded. The size spectra of coarse dispersed fraction retrieved from these data may also be approximated by inverse power in the radius interval from 0.6 to 11 mcm. We calculated optical thicknesses of the coarse dispersed aerosol and compared them with those measured. The correlation plot is given in Figure 4.

The correlation coefficient is equal to 0.95. Measured optical thickness is on the average two times greater than retrieved from aureole data. It may be supposed, taking into account these results, that particles of the submicron fraction of the aerosol have the same origin as coarse dispersed particles.

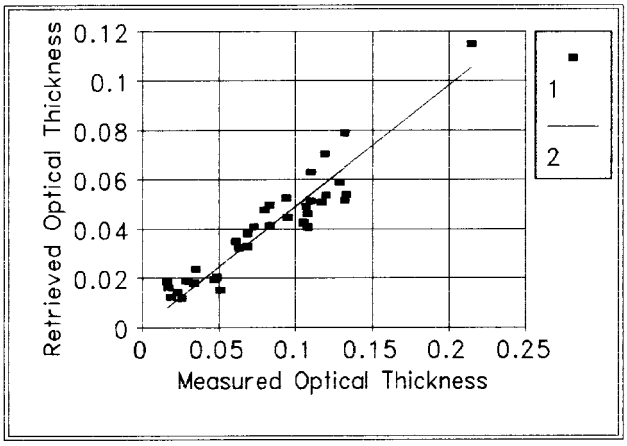

Figure 4. Correlation between measured and retrieved aerosol optical thickness. 2 - regression line.

Acknowledgment

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