ELSEVIER

Journal of Quantitative Spectroscopy & Radiative Transfer 88 (2004) 233–241

Journal of Quantitative Spectroscopy & Radiative Transfer

www.elsevier.com/locate/jqsrt

Effects of multiple scattering and atmospheric aerosol on the polarization of the twilight sky

Oleg S. Ugolnikov[a,*], Oleg V. Postylyakov[b,c], Igor A. Maslov[a]

[a] *Space Research Institute, Profsoyuznaya St., 84/32, Moscow 117997, Russia*
[b] *A.M. Obukhov Institute of Atmospheric Physics, Pyzhevsky per, 3, Moscow 109017, Russia*
[c] *Finnish Meteorological Institute, Vuorikatu 24, FIN-00101, Helsinki, Finland*

Received 3 November 2003; accepted 23 December 2003

Abstract

The paper presents a review of a number of wide-angle polarization CCD-measurements of the twilight sky in V and R color bands with effective wavelengths 550 and 700 nm. The basic factors affecting (usually decreasing) the polarization of the twilight sky are the atmospheric aerosol scattering and multiple scattering. These effects were distinguished from each other, and a method of multiple-scattering separation is discussed. The results are compared with the data of numerical simulation of radiative transfer in the atmosphere for different aerosol models. The whole twilight period is divided into different stages with different mechanisms forming the twilight-sky polarization properties.

Keywords: Polarization; Multiple scattering; Atmospheric aerosol; Radiative transfer

1. Introduction

The efficiency of the twilight observations for the atmosphere investigations has been attracting much attention for a long time. Starting as early as 1923, the twilight probing method has been the subject of detailed analyses [1]. The difference with the daytime period, when the sky background is formed by light scattering in the lower troposphere layers, is the accelerating elevation of the Earth's shadow over the observer and, thus, a rapid increase in the effective scattering altitude. This gives the possibility of the retrieval of the vertical profiles of the scattering and absorption coefficients, which can be useful for the investigations of aerosol and small admixtures in the atmosphere.

* Corresponding author. Fax: +7-095-333-5178.
E-mail address: ugol@tanatos.asc.rssi.ru (O.S. Ugolnikov)

0022-4073/$ - see front matter © 2004 Elsevier Ltd. All rights reserved.
doi:10.1016/j.jqsrt.2003.12.033