VARIABILITY OF CLIMATICALLY IMPORTANT AEROSOL OPTICAL PROPERTIES OVER AN URBAN TROPICAL SITE AS RETRIEVED FROM SKYRADIOMETER OBSERVATIONS

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INTRODUCTION

Aerosol radiative forcing is a critical, though variable and uncertain, component of the global climate. Climate models use sparse information of aerosol optical properties. *In- situ* measurements, though important in many respects, seldom provide measurements of the undisturbed aerosol in the entire atmospheric column. The climatology of aerosol optical depth over some Indian stations using a multi-wavelength radiometer (Krishnamoorthy *et al.*, 1999) and the lidar-derived aerosol vertical profiles and sunphotometric/spectroradiometric derived aerosol optical thickness over Pune (Devara, 2000) are the currently available aerosol climatology over India. Modelling the aerosol effects on atmospheric radiation by solving the radiative transfer equation, requires the following aerosol optical properties: aerosol optical depth (loading); Phase function (angular dependence of light scattering); and single scattering albedo (ratio of scattering to extinction). Information on parameters such as single scattering albedo, refractive index, phase function are scarce or non-existent over Indian sub-continent. In this paper, presented are climate relevant aerosol optical characteristics, namely, spectral aerosol optical depth, phase function and single scattering albedo as retrieved from direct sun / diffuse sky measurements made with a skyradiometer.

SKYRADIOMETER

The skyradiometer (PREDE Model POM-01 L) consists of a sun-tracking system, a spectral scanning radiometer, rain detector, sun sensor and control unit. It has internal filters centered at wavelengths 315, 400, 500, 675, 870 and 1020 nm with half bandwidths of 3 nm for 315 nm and less than 10 nm for all other wavelengths with center wavelength accuracy of ± 2nm. The skyradiometer is capable of making highly accurate angular and spectral scans. The unique features of the instrument are: in-built calibration capability, and single detector design. It can measure direct and diffuse sky radiances at pre-defined scattering angles at regular time intervals.

RESULTS AND DISCUSSION

In the present study, direct solar and diffuse sky radiance observations collected during December 2000-April 2002 have been used. The spectral aerosol optical depth, single scattering albedo, phase function and volume size distribution are

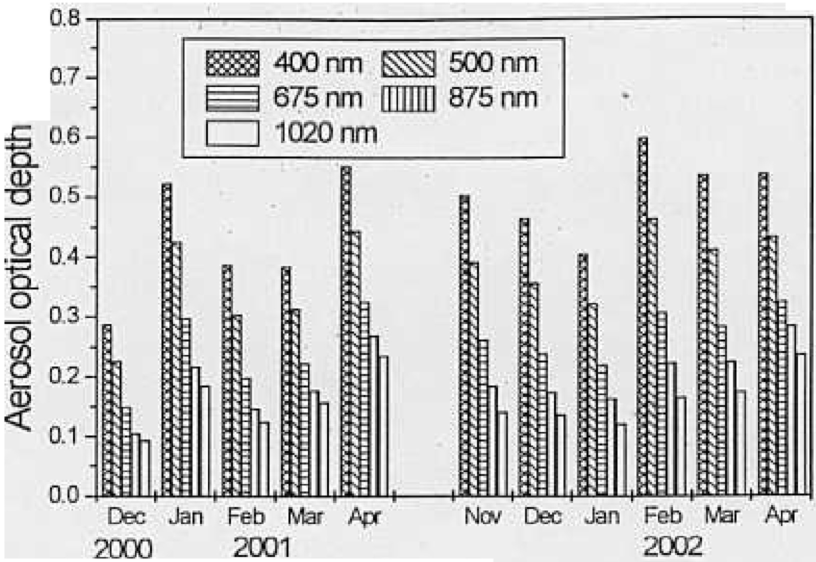

Fig. 1: Monthly mean spectral aerosol optical depths observed over Pune u PREDE Model POM-01 L skyradiometer

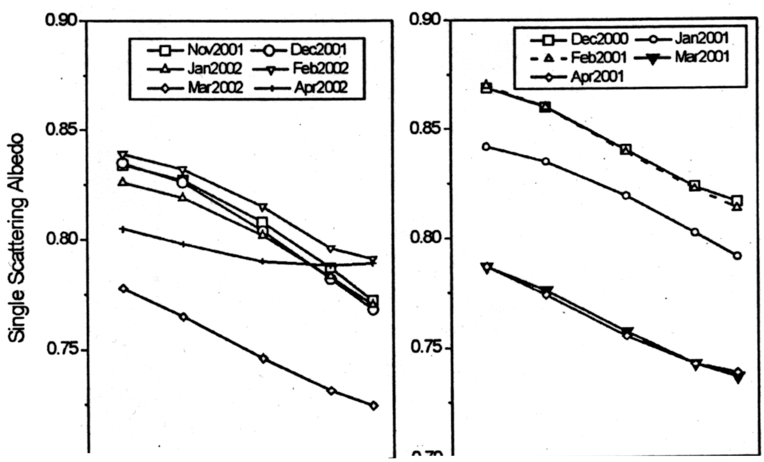

Fig. 2: Monthly mean spectral single scattering albedo values retrieved from a skyradiometer over Pune

retrieved from the data sets using a radiative transfer model (Nakajima *et al.*, 1996) with relevant values of surface albedo, real and imaginary components of aerosol refractive index. The aerosol optical depth (AOD) and single scattering albedo (SSA)

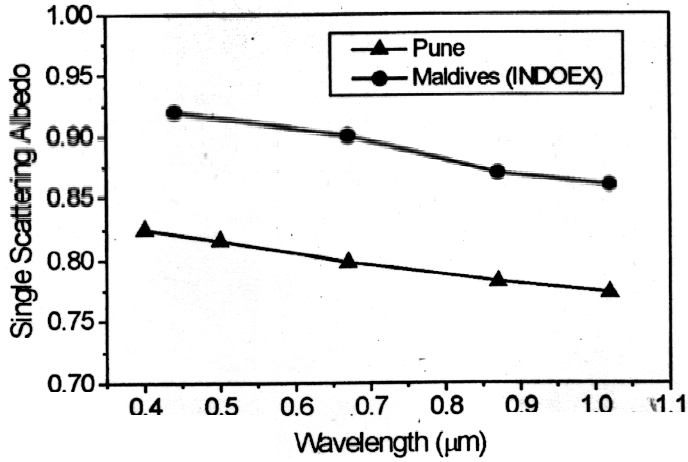

Fig. 3: Average single scattering albedo observed over Pune and its comparison with those values observed over Maldives during INDOEX

were retrieved at every 15 minute interval on clear sky days. These instantaneous values of about 35-40 observations are used to compute daily means. Monthly means of AOD and SSA were obtained using daily means. Data could not be obtained during May-October due to mostly of cloudy sky conditions. In Figure 1, shown are the monthly mean AODs at 400, 500, 675, 870 and 1020 nm wavelengths over the period covering December 2000 – April 2002 including two annual cycles. Month-to-month variation in AOD shows significant variation indicating increase from winter to pre-monsoon. Within winter season, AODs peak in the month in which the frequency of occurrence of ground-based inversions is maximum. Figure 2 illustrates monthly mean spectral variations in retrieved single scattering albedo. The spectral dependence of single scattering albedo shows that the values decrease with increase in wavelength. This agrees well with the urban/Industrial aerosol model of Dubovik *et al.* (2002). Figure 3 shows the comparison of mean single scattering albedo values observed over Pune with those observed over Maldives during INDOEX (Dubovik *et al.*, 2002). The magnitudes of SSA retrieved from the sun/sky radiance data over Pune are low suggesting that the aerosols over the observational site is of complex mixture with significant portion being the absorbing type. Seasonal variation in SSA are higher in winter and relatively lower in pre-monsoon indicating the dominance of absorbing aerosols during pre-monsoon. Such an extensive database would enable us to develop a tropical urban aerosol model in the near future.

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