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SEASONAL VARIATIONS IN AEROSOL CHARACTERISTICS OVER PATIALA, NORTHWEST REGION OF INDIA

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Abstract

INTRODUCTION Aerosols play a significant role in modifying the climate by absorption or scattering of solar irradiance (Charlson et.al. 1992). In Punjab urbanization, industrialization and changed agricultural practices has contributed significantly in increase of concentration of different types of aerosols. Indo-Gangetic plane suffers with severe fog, haze and smog that are due to increased anthropogenic activities (Singh et. al. 2004). Realizing the need for systematic studies of aerosol characterization over this region, a Multi-Wavelength Radiometer (MWR) was set up at Punjabi University Campus, Patiala in March 2006 under the ISRO's Geosphere Biosphere Programme (IGBP). The MWR takes observations at 10 wavelengths centered at 380, 400, 450, 500, 600, 650, 750, 850, 935 and 1025 nm, having FWHM from 6 to 10 nm.

The present paper highlights the seasonal variations in the aerosol characteristics over Patiala from April 2006 to March 2007. The data is supplemented by suspended particulate matter measurements carried out with a High volume Sampler (HVS; Envirotech Make).

OBSERVATIONS AND RESULTS Extinction measurements were taken regularly on clear, hazy and partially cloudy days during the study period. Spectral AOD values were estimated following the Langley Plot technique applied on spectral measurements (Shaw G.E. et. al. 1973). Monthly mean variations of spectral AOD has been grouped into four seasons viz. Equinoxes (March & April), Pre-Monsoon (May & June), Post-Monsoon (September & October) and Winter (November – February) and are shown in Figure-1 (a-d). Spectral AOD at all wavelengths is minimum (0.19 to 0.48) in Equinoxes and maximum (0.55 to 0.91) in Pre-Monsoon season. The AOD is comparatively more at shorter wavelengths than at longer wavelengths irrespective of the season indicating the dominance of finer particles over Patiala throughout the year. However during Pre-Monsoon season, AOD at longer wavelengths increases significantly in comparison to other seasons, indicating an increase in coarse particles also. This is attributed to transport of dust particles by southwesterly winds from Thar desert (Sikka D.R. 1997) that leads to hazy sky conditions. Higher values of AOD at shorter wavelengths during October & November result from the large scale burning of paddy residue in the fields. Low values of AOD at

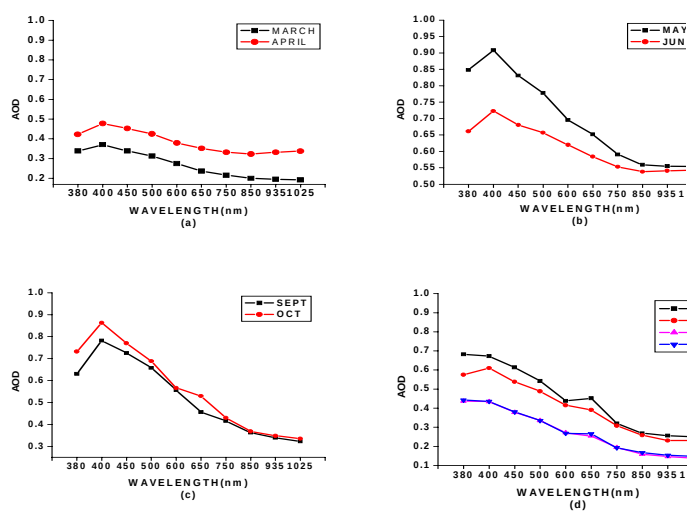

Figure-1. Monthly Mean Spectral AOD (a) Equinoxes (b) Pre-Monsoon (c) Post-Monsoon (d) Winte

longer wavelengths in the Post-Monsoon season are due to washout of most of the coarse particles during the monsoon seasons.

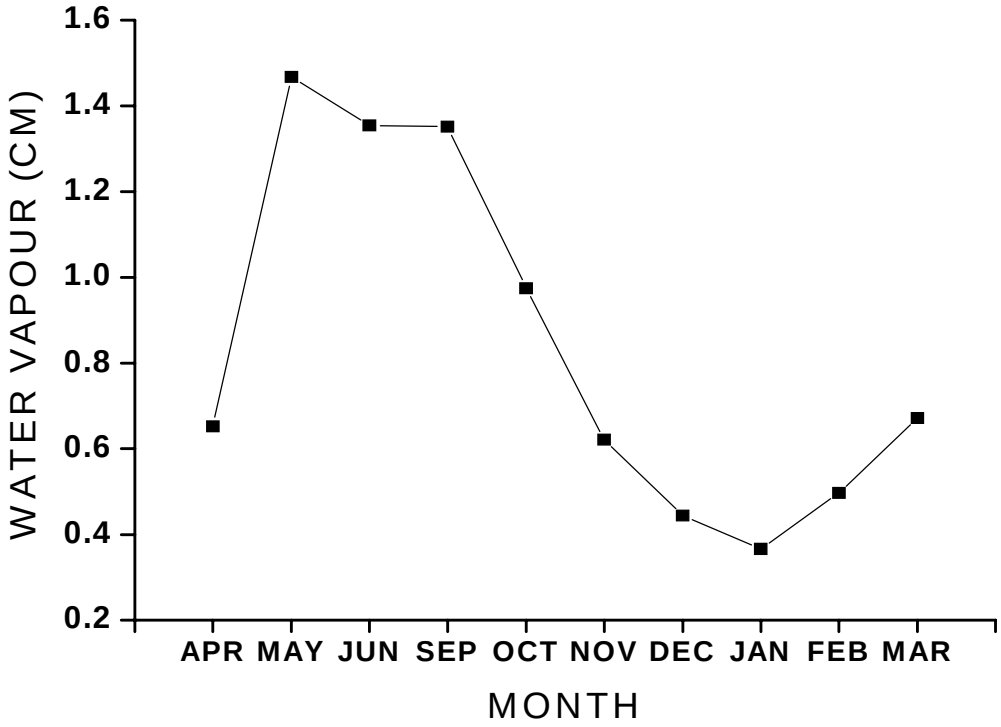

Figure 2. Monthly Mean Columnar Water

Monthly variations of columnar water vapor content during the study period show maximum value of about 1.47 cm from May to September and thereafter decrease systematically with minimum value of 0.37 in January (Figure 2). High values of water vapor content during May and June may be due to paddy sowing season and occasional rain/thundershowers due to western disturbances..

ANGSTROM PARAMETERS Spectral measurement of AOD is important to obtain information about the relative size distribution of aerosols (Satheesh et. al. 2001). A simple way of expressing the wavelength dependence of AOD is through Angstrom relation (Angstrom 1964) expressed as $\tau_p = \beta\lambda^{-\alpha}$ where β is turbidity coefficient and α is wavelength exponent. The β and α are evaluated by linear square fitting of τ_p - λ on a log-log scale. The temporal variations in β and α are shown in figure

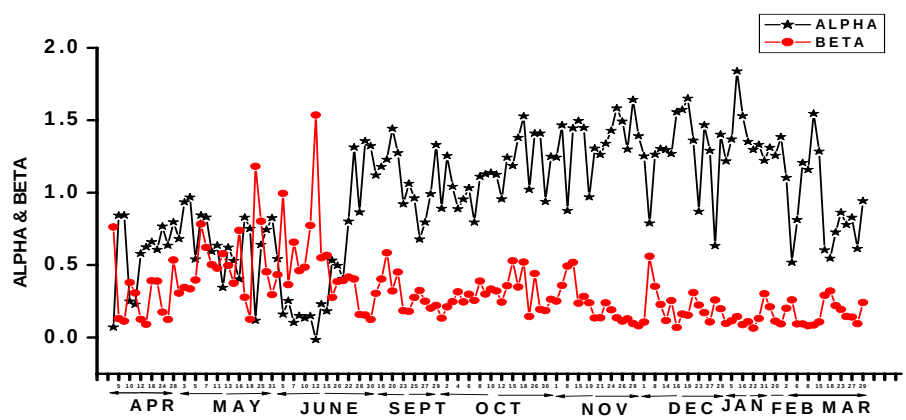

Figure 3: Temporal variations of Angstrom Coefficients

3. Values of □ are in the higher range (0.52 to 1.84) from September to March and are in the lower range (~0.0 to 1.36) from April to June. Reverse is true for □ and high values of □ (0.12 to 1.53) in May & June are due to dust transported from Rajasthan side as mentioned in the previous section. Highest value of □ (1.54) and min value of □ (~0.0) on June 12 is due to the dust storm that engulfed the northwest region of India.

SUSPENDED PARTICULATE MATTER (SPM) Temporal variation of RSPM (≤ 10 □m) and NRSPM are shown in figure 4. Mass concentration of RSPM varies from 8.39 □gmm^3 to 615.64 □mg/m^3, with a mean value of 105.9 µgm/m^3 while NRSPM mass varies between 0.35 □gm/m^3 and 742.91 □gm/m^3 with a mean value 105.17 µgm/m^3. Because of the continued presence of haze and dust, there is an overall low concentration of RSPM as compared to NRSPM during the month of May. NRSPM mass concentration jumps to 742.91 □gm/m^3 on a severe dust storm day of June 12.

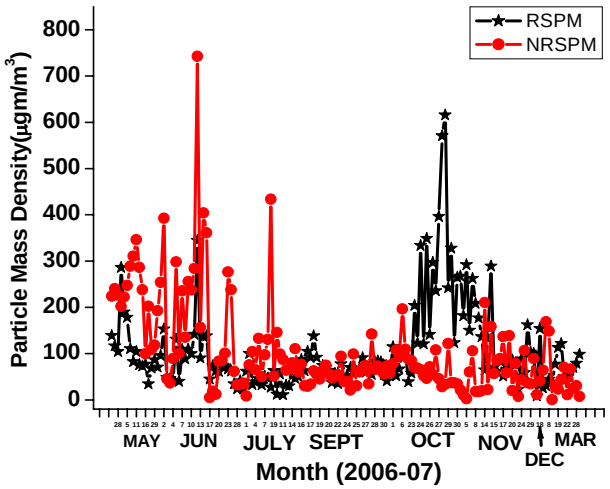

Fig. 4: Temporal Variation of Particulate Matter

CONCLUSION Mean monthly spectral AOD shows significant seasonal variations. Spectral AOD at all wavelengths is maximum in Pre-Monsoon and minimum in Equinoxes. Higher AOD at longer wavelengths during Pre-Monsoon is attributed to transport of dust from desert. Angstrom coefficients also exhibit significant monthly variations. NRSPM mass concentration is higher in May & June while. RSPM is maximum in October and November.

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