Temporal Variations of Black Carbon and Aerosol Optical Parameters Over Patiala

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Atmospheric aerosols play important role in the earth's radiative balance and influence the global climate as they affect radiative forcing directly by scattering and absorbing the sunlight[1]. Knowledge of aerosols physical and optical properties is important in determining their ability to modify the radiation budget. Considerable uncertainty exists in the estimates of aerosol radiative forcing due to large variability in their spatial and temporal properties and their characterization. Patiala (lat; 30^0 20'N, LONG. 76^0 24'E) is situated in the northwest part of Indo-Gangetic plains where significant temporal variations in AOD, aerosol mass concentration and their optical properties are expected due to diverse nature of aerosol sources and their removal processes. Black carbon is one of the important components of aerosols that vary considerably over the year at Patiala that affects the radiative forcing significantly. Under ISRO-GBP "ARFI" project, measurements of aerosol optical depth (AOD) using Multi Wavelength Radiometer (MWR), mass concentration by High Volume Sampler (HVS), mass concentration of black carbon by Aethalometer has been carried out over Patiala[2]. The optical properties of aerosols such as optical depth (τ_λ), scattering and absorption coefficients and single scattering albedo (SSA) are wavelength dependent and needed to be specified over the whole spectrum for estimating the atmospheric radiative forcing. Spectral AOD values are estimated following the Langley Plot technique applied on spectral measurements of solar flux by MWR. Spectral variations of Single Scattering Albedo (SSA) are obtained by using OPAC software package of Hess et.al.[3] as applied to the observed spectral optical depths. The paper presents the results of AOD measurements carried over Patiala during 2008-09. Based on the climatological pattern over Patiala, four distinct seasons are considered for aerosol characterization, viz. pre-monsoon (April-June), monsoon (July-September), post-monsoon (October-November) and winter (December-March).

Day time average of black carbon mass concentration is maximum (>15.0 $\mu gm/m^3$) in post-monsoon season and is minimum (<5.0 $\mu gm/m^3$) in pre-monsoon and monsoon seasons. Spectral AOD at shorter wavelengths is maximum (1.2-1.4) in post-monsoon season while it is minimum (0.2-0.4) in winter season. However, at longer wavelengths AOD has maximum value in pre-monsoon season in both the years. Higher AOD during post-monsoon at shorter wavelengths is attributed to abundance of submicron soot particles emitted by large scale biomass burning of paddy residue in the fields and higher AOD at longer wavelengths during pre-monsoon is due to dust transported from Thar desert by south westerly winds[4]. Angstrom turbidity parameter is minimum (0.13) in winter and maximum (0.4-0.5) in pre-monsoon due to dust and in post-monsoon season due to biomass burning. Mass concentration of RSPM is maximum (150-250 μ gm/m^3) in post-monsoon season while NRSPM is maximum in pre-monsoon season during period of study.

Aerosol optical properties over Patiala has been estimated by employing the OPAC software package considering the composite aerosols as a external mixture of five components viz. water soluble, insoluble, soot, nuclei mode minerals and accumulation mode minerals having different mixing ratios depending upon the season. SSA (at all wavelengths) has been found to be lower (<0.78) during pre-monsoon season and maximum (0.85-0.91) during winter season. The SSA of aerosols is found to be strongly wavelength dependent. It decreases with wavelength during post-monsoon and winter seasons when absorbing aerosols are dominant over Patiala whereas during pre-monsoon season, it increases with wavelength which is attributed to the dominance of dust. Detailed optical parameters of the aerosols will be discussed during presentation.

Key words: Black Carbon; Aerosol optical depth; Single Scattering Albedo (SSA)

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