Vertical Distribution of Aerosol Radiative Forcing and Heating Rate over Different Locations in South Asian Region

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Atmospheric aerosols from both natural and anthropogenic sources affect the Earth atmosphere radiation budget directly by scattering and absorbing the incoming solar radiation, and indirectly by modifying the cloud radiative properties. South Asian region, in general, and India, in particular, due to rapidly growing industrialization and expanding urbanization in recent years has become a major regional aerosol hot spot. The present study is conducted over five different locations of south Asia located in India and Pakistan, namely, Ahmedabad (23.03^{o}N, 72.55^{o}E, 55m amsl), Gurushikhar (24.65^{o}N, 72.78^{o}E, 1680m amsl), Karachi (24.87^{o}N, 67.03^{o}E, 49m amsl), Kanpur (26.51^{o}N, 80.23^{o}E, 123m amsl), and Gandhi College (25.87^{o}N, 84.13^{o}E, 60m amsl).

In the present study we have analyzed the seasonal variation in the shortwave and longwave aerosol radiative forcing estimated using measured aerosol optical properties over these locations. Measurement of aerosol optical depths (AODs) at five different wavelength bands centered at 0.4, 0.5, 0.65, 0.875, and 1.02 μm were conducted over Ahmedabad and Gurushikhar using a hand held *sun photometer* during 2006-2008. Aerosol scattering (using *Nephelometer*) and absorption (using *Aethalometer*) coefficients are measured over Ahmedabad to calculate the single scattering albedo (SSA). AOD, SSA, and asymmetry parameter (g) are also obtained over Kanpur, Karachi and Gandhi College for the same time period from AERONET (Aerosol Robotic Network) in the wavelength range of 0.38-1.02 μm.

The principal input parameters required for calculating aerosol radiative forcing are AOD, SSA and g. Optical Properties of Aerosols and Clouds (OPAC) [1] model has been used to estimate these input parameters for entire shortwave (0.25-4.0 μm) and longwave (4.0-40.0 μm) range making use of all the measured aerosol properties. Estimations of aerosol radiative forcing are performed using radiative transfer model, making use of aerosol characteristics obtained from OPAC in both shortwave and longwave range. The vertical extinction profiles of aerosols are obtained from the space-borne CALIOP LIDAR onboard the CALIPSO [2] over all the study locations which are used to estimate the vertical distribution of aerosol forcing and heating rate. Detailed results on seasonal variation of aerosol radiative forcing and the vertical distribution of forcing and heating rates will be presented and discussed.

References:

[1] M. Hess et al., *Bull Amer. Meteor. Soc.*, **79** (1998).
[2] D. M. Winker et al., Proc. SPIE Int. Soc. Opt. Eng., **doi:10.1117/12.466539** (2003).