Radiative forcing due to dust events for an Indo-Gangetic Plain station, Kanpur

Sachchidanand Singh (1), Anup K Prasad (2), S S Chauhan (2), S Singh (2), Ramesh P Singh (2), Manoj K Srivastava (1) and Risal Singh (1)

(1)Radio and Atmospheric Sciences Division, National Physical Laboratory, New Delhi - 110012, India.

(2)Department of Civil Engineering, Indian Institute of Technology, Kanpur – 208 016, India.

(ssingh@mail.nplindia.ernet.in / Phone Number: +91-11-25742610 Extension: 2243)

The Indo-Gangetic Plain encounters several dust storms during the pre-monsoon period. These dust events have significant impact on the regional scale radiation budget. In the present study, we have estimated the change in radiation forcing during the major dust events that occurred during the year 2005 over the background conditions for the Kanpur station. The data for this study is obtained from the CIMEL sun sky radiometer deployed on the IIT Kanpur campus as a part of AERONET (AErosol RObotic NETwork) network. The aerosol forcing calculations at Top-of-the-Atmosphere (TOA) and at surface were carried out using the Santa Barbara Discrete Ordinate Radiative Transfer (SBDART) codes. The input parameters for this model, such as the spectral variations of aerosol optical depth (AOD), single scattering albedo, asymmetry factor etc., have been obtained from level 1.5 processed AERONET data. The obtained data is also compared with TERRA/MODIS level 3 retrievals. The result shows that the AOD during dust storm events were generally more than 1.0. The Angstrom exponent 'α' ranged between (-)0.007 and (+)0.3. Gradual rise have been observed in AOD from April till July, correlated with frequency and intensity of dust storms during the season (April-May-June). The size distribution generally shows bimodal distribution, where the coarse mode increased enormously during the dust events. The single scattering albedo (SSA) is also found to increase for dust event days. During the days, when AOD is high due to dust outbreak, the aerosol forcing varies between -29.5 to –87.5 W/m^2 (Average –57.5 W/m^2) and –2.9 to –26 W/m^2 (-13.5 W/m^2) at the surface and TOA, respectively. For non-dusty days, however, the corresponding values varies between –19.5 to –52.4 W/m^2 (average –34.5 W/m^2) and +2 to –10 W/m^2 (-2.5 W/m^2) only. This clearly indicates that due to enhancement in dust aerosol the average surface forcing is increased by about -22 W/m^2 and the TOA forcing is increased by about -11 W/m^2. The correlation between AOD at 500nm and the forcing at surface and TOA for the above-mentioned duration clearly shows a negative correlation and the slope of the regression line gives the aerosols forcing efficiency of about -46 W/m^2 and -17 W/m^2 at surface and TOA, respectively.