Changes in aerosol parameters during dust and haze episodes in the Middle East and Southwestern Asia

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Abstract

Aerosols characteristics were analyzed during dust and haze episodes in the Middle East and Southwestern Asia in October, 2010 and March, 2012 using Moderate Resolution Imaging Spectroradiometer (MODIS) and Aerosol Robotic Network (AERONET) data. The dust and haze episodes deteriorated air quality over the Gulf regions, Iraq, Iran, India and Pakistan.

The aerosol optical depth (AOD) values in haze event were 2.03, 2.56, 2.67, 3.4, and 4.29 in Ambala, Sialkot, Faisalabad, Amritsar, and Ludhiana respectively. Maximum AOD values on 20th October in Gurdaspur, New Delhi, Batala, Bathinda, Kanpur, and Lahore were 1.89, 1.90, 2.89, 1.89, 1.6, and 2.5 respectively. Similarly, AOD values in during dust episode were found maximum on 18th March in Kuwait, Bahrain, Qatar, and Saudi Arabia and were 4.9, 4.4, 4.3, and 4.9, respectively. The AOD values were also found maximum on 19th March in Oman, Arabian Sea, and Iran and were 4.5, 5, and 5, respectively.

The aerosol volume size distributions (VSD), single scattering albedo (SSA), refractive index (RI), and asymmetry parameter (ASY) values during dusty days suggested that dust aerosols are dominant over the anthropogenic aerosol in the Lahore, Pakistan. On the other hand, VSD, SSA, RI, ASY values suggested that fine mode aerosols were predominant over coarse mode aerosols during the haze episode.

The short-wavelength aerosol radiative forcing (ARF) values at the surface and at the top of the atmosphere (TOA) during dusty and non-dusty days were in the range of -50 Wm-2 to -194 Wm-2 and -31 Wm-2 to -105 Wm-2, respectively. The shortwave ARF values during haze episode at TOA, surface and within the atmosphere were found to be in the range of −17.6 to −81.6 Wm-2 −64 to −193 Wm-2 and +47 to +119 Wm-2 , respectively, over Lahore. Likewise, over Kanpur, the ARF values were found to be in the range of 15.32 to −91.6 Wm-2, −38 to −134 Wm-2 , and +33 to +75.91 Wm-2 at TOA, surface and within the atmosphere, respectively. The large differences of TOA and surface forcing produce significant heating of the atmosphere at these sites.