Verification of dust forecast over the Indian region with satellite and ground based observations

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Abstract: This article presents the verification results of the dust forecast by a numerical model over India and neighbouring regions. National Centre for Medium Range Weather Forecasting Unified Model (NCUM) is a global numerical weather prediction (NWP) model with a prognostic dust scheme. Evaluation of the performance of dust forecast by NCUM is carried out in this study. Model forecast of dust optical depth (DOD) at 550 nm is validated against ground-based and satellite observations since optical depth measurements in mid-visible wavelength are easily available. Daily 5-day forecast based on 00 UTC initial condition during dust dominated pre-monsoon season (April–May) of 2014 is used in this study. Location specific and geographical distribution of dust forecast is validated against Cloud-Aerosol Lidar and Infrared Pathfinder Satellite Observation (CALIPSO) satellite retrieved DOD observation at 532 nm, Moderate Resolution Imaging Spectroradiometer (MODIS) aerosol optical depth (AOD), Ozone Monitoring Instrument (OMI), aerosol index, and Aerosol Robotic Network (AERONET) station data of total and coarse mode AOD. The verification results indicate that NCUM dust forecast generally gives good representation of large scale geographical distribution of dust over the western region of India. DOD forecasts show good correlation with co-located CALIPSO DOD over the western part (0.71) compared to central (0.58) and eastern (0.61) part of India in April while it show similar trend in May with slightly improved correlation (0.68) over the eastern part of India. Results also show that DOD forecasts are better correlated to AERONET coarse mode AOD observations over Jaipur in April and over Kanpur in May. Vertical distribution of dust concentrations in the forecast show reasonably good agreement with attenuated backscatter and depolarization ratio from CALIPSO observations. The model is also able to simulate spatiotemporal distribution of dust during a major dust event as observed by CALIPSO, MODIS, and OMI.