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Incorporating Sub-grid Variability in Dust Emissions within a Regional Climate Model

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Sub-grid variability of wind speed and roughness length are incorporated into Regional Climate Model, version 3 (RegCM3) to better simulate dust emissions over Southwest Asia. The new scheme quantifies wind variability as dry convective eddies that occur in the planetary boundary layer forced by surface sensible heat fluxes. It is assumed that wind variability follows a Gaussian distribution. Incorporating sub-grid variability of wind increases dust emissions over the region by nearly 35%. In addition, the dust module is modified to incorporate the variability of surface roughness length. In this scheme, an empirical distribution of roughness length for each grid-cell is calculated based on the 4km Global Land Cover Characteristics (GLCC) dataset. Incorporating roughness length variability, alone, increases dust emissions by approximately 10% over the study region. Combining the variability of wind and roughness length increases dust emissions by nearly 50% over the region. As a result, new model simulations of aerosol optical depth (AOD) lie between Moderate Resolution Imaging Spectroradiometer (MODIS) and Multiangle Imaging Spectroradiometer (MISR) estimates over this region. Lastly, analysis of MODIS and MISR AOD data sets over the region is completed and verified against NASA's Aerosol Robotic Network (AERONET) data in the region.