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Evaluation of dust model in Community Land Model (CLM) in simulating natural dust storms

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Dust contributes to the degradation of air quality and may affect the economy, public health and the environment. Accurate dust storm prediction helps state authorities and general people prepare beforehand to mitigate adverse impacts of dust storms. Dust emission modeling has become matured in the last few decades but its simulation and prediction in terms of sources, emission, transport, and deposition remains challenging. This study focuses on use of one of the existing dust models DEAD (Dust Entrainment and Deposition Model) within CLM (Community Land Model) in natural dust storms simulation and evaluates its effectiveness in capturing large-scale dust storms. We do so by comparing the simulated dust flux with AOT (aerosol optical thickness) obtained from AERONET (Aerosol Robotic Network) station and MODIS (Moderate Resolution Imaging Spectroradiometer) satellite. We also examine diurnal and seasonal patterns of dust storms in the MENA (Middle East and North Africa) region. Results show that the dominant controlling factor of dust storm in the MENA region is the wind speed and the simulation of the dust flux is limited by the coarse resolution of NCEP (National Center for Environmental Prediction) wind speed data used in driving the model. We observed that the CLM correctly simulates occurrence of large-scale dust storm in terms of extent and direction of the dust plume. Moreover, simulated AOT is consistent with observed AOT when the model is run in coupled CLM-CAM mode. However, dust flux results from offline CLM simulation don't show significant correlation with observations from AERONET and MODIS data in diurnal scale.

Keywords: CLM, AERONET, MODIS, Dust storm